Cost of Trading, Effective Liquidity Measures, and Components of the Bid-Ask Spread in the Emerging Stock Market of Ukraine

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ABSTRACT OF THESIS

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The thesis studies aspects of the cost of equity trading in the emerging stock market of Ukraine. The market is quite new (opened in 1997 but started to operate actively only in 2004) and little research on this market has been done so far. The market appears to offer lucrative investment opportunities that attract attention of both Ukrainian and foreign investors but the cost of trading Ukrainian stocks is quite high and can considerably decrease the returns to investors. The empirical part of the thesis is based on the transactions data from the main trade floor in Ukraine, PFTS, for 59 Ukrainian stocks during 2004-2006.

The cost of equity trading in Ukraine is found to be quite high compared to many other stock markets, both developed and emerging. An in-depth study has shown that the medium-sized trades are the cheapest to execute, followed by large and then small trades. The reason for the pattern is seen in the price improvement suggested by brokers to the larger, more valued customers in order to keep the business with them and is in line with the findings in other literature for dealership markets (Reiss and Werner (1996), Hansch et. al (1999), and Huang and Stoll (1996)). The average cost of institutional sale trades exceeds the average cost of institutional buy trades at any market condition (falling, neutral, or rising), which is a puzzling result given that sales are often found in the literature to be more expensive in falling market, while purchases are more expensive in rising market.

The efficacy of a number of measures of liquidity is studied. In line with findings for other emerging markets, it is shown that the proportion of zero daily returns (Lesmond (1999)) and the proportion of no-trading days are the most reliable liquidity measures for the Ukrainian stock market. Turnover, a measure widely applied in literature for developed stock markets, has a very small power for measuring liquidity in Ukraine.

The spread components are estimated by applying three spread decomposition models most frequently referred to in literature: Stoll (1989), Glosten and Harris (1988), and Huang and Stoll (1997). The estimation results show a low importance of the asymmetric information component, which is surprising given that insider trading is considered a serious risk in Ukraine.

To present the importance of incorporating the transactions costs into portfolio return analysis, a momentum trading strategy is examined. It is shown that momentum portfolio returns decrease considerably when the cost of trading is taken into account.

I dedicate this study to God, owing to whose mighty power over the circumstances the work over the study was started and thanks to whose provision of strength and patience it was finished.

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Declaration

I declare that this thesis was composed by me and that it is all my own work. The thesis or its parts have not been submitted for any other degree or professional qualification.

Anna Serdyuk

October 2010

Chapter 1

Introduction

Moderate returns and high co-movement in the stock prices in the developed stock markets have urged investors to look for new opportunities for reduction of portfolio risk and enhancing of portfolio return. In the end of 1980s – beginning of 1990s new destinations for investment became available with the opening of many emerging markets to the foreign capital inflows. Net portfolio equity inflows to emerging markets grew year by year from USD 11.4 bln. in 1999 to USD 24.1 bln. in 2003, USD 68.8 in 2005, and USD 145.1 in 2007 (International Bank for Reconstruction and Development and World Bank, 2008). Literature has documented substantial diversification benefits from investing in emerging equity markets (DeSantis (1994), Divecha et al. (1992), Harvey (1995), Bekaert and Urias (1996), and other), though transaction costs were rarely taken into account in the studies. The costs of equity trading in emerging markets are considerably higher than in the developed markets (Jain (2003)) and they can considerably decrease high gross returns on emerging markets portfolios documented in literature (Domowitz, Glen, and Madhavan (2000)).

Among the established equity markets with a long history, as, for example, Shanghai Stock Exchange founded in 1891 and Buenos Aires Stock Exchange founded in 1854, there is a group of very young emerging stock markets located in Central and Eastern Europe and the Former Soviet Union (CEE/FSU) that started their operation only in the beginning of 1990s. Portfolio investment to CEE/FSU region represent a relatively small, albeit growing share of the portfolio inflows to developing countries. Net portfolio equity inflows to CEE/FSU region were USD 0.4 bln. in 1995 (or 2.8% of the total net portfolio equity inflows to developing countries), and have grown to USD 11.1 bln in 2006 (or 10.6% of the total net portfolio equity inflows to developing countries) (World Development Indicators, 2008).

The Ukrainian stock market is one of the CEE/FSU stock markets. It emerged in 1990s after the breakdown of the USSR and beginning of privatisation of the previously state-owned economy. The market stayed fairly underdeveloped for about a decade and almost collapsed during the 1998 financial crisis. However, in 2004 it revived and have started developing actively. By 2007 market capitalization of the Ukrainian stock market reached USD 111.8 bln. and the market became one of the largest in Eastern Europe (for comparison, market capitalization in Poland in 2007 was USD 207.3, in Czech Republic – USD 73.4 bln., in Hungary – USD 47.7 bln., in Romania – USD 44.9 bln.).

The Ukrainian stock market is remarkable because there is a substantial number of companies that are fairly large by international standards, a feature that differs Ukraine from many Central and Eastern European countries. Many of the companies have strong positions in the international markets of metallurgy, chemical fertilizers, machine building, agriculture, and food industry.

Ukrainian stock market has a considerable potential for growth due to the active growth of Ukrainian economy (annual GDP growth rate averaged 7% between 2000 and 2007) driven by well educated labour force of Ukraine, large domestic market (the population of Ukraine is about 50 mln. people), and access to a variety of resources including some of Europe's best agricultural land, significant coal and metal reserves, and a strategic location connecting European, Russian, and Asian markets.

The Ukrainian stock market is characterized by high returns, which are attainable neither in the Western European and the U.S. stock markets nor in the more developed Eastern European emerging markets. In 2007 Ukraine was second best performing stock market in the world (after China) with the growth of index PFTS, the main stock index of Ukraine, by 135.4%. Taking a longer-term perspective, in the end of 2009, Ukraine was ranked as the stock market winner of the decade in terms of the gains on the stock index with the index PFTS gain of 900%. The top-ten list also included stock indices of Peru, Russia, Romania, China, Bangladesh, Slovakia, Kuwait, Estonia, and the Czech Republic (Financial Times, 18/12/2009).

Nevertheless, high returns in the Ukrainian stock market are undermined by a number of risks common for many emerging markets such as low liquidity, high volatility, low transparency, low ownership structure disclosure, weak corporate governance, and weak protection of the property rights of minority shareholders. Low liquidity and information asymmetry in the Ukrainian stock market result in high transaction costs, which considerably decrease high equity returns in the market. Jain (2003) estimated the bid-ask spreads for a large cross-section of stock markets around the world and have found that the quoted bid-ask spread in the Ukrainian stock market in 2000 was 15%, which was one of the largest estimates among 51 developed and emerging markets considered in the study.

Usually a decision to buy or sell a particular asset is based on the expectations about future performance of this asset. Buying a stock with high expected gross returns might result in considerably worse performance than expected if trading costs for this stock are high. Literature has documented that higher illiquidity was found to be associated with higher expected returns (Bekaert, Harvey and Lundblad (2006)), while the decline in transaction costs may have contributed to a fall of about 1% in the equity premium, which was documented for 100 years of data for the U.S. (Jones (2002)).

Ukrainian stock market has considerably grown in the past several years, though such important area of research for a stock market as the cost of transacting has attracted almost no attention in Ukraine. The only study in the area, to our best knowledge, is Ryzhkov (2007) that investigates the components of the bid-ask spread for Ukrainian stocks.

A study of the cost of trading and liquidity is important not only for investors and portfolio managers, but also for stock exchanges, stock brokers, and stock market regulators. The cost of trading and liquidity are important determinants of the quality of a stock market. Brokers evaluate their performance based on the transaction costs of the trades executed by them. Regulators often try to promote policies that lower transaction costs and increase stock market liquidity.

Liquidity and the cost of trading are a part of the market microstructure direction of financial research. Market microstructure is the branch of financial economics that investigates trading and the organization of markets (Harris, 2003). This field of study has substantially grown in size and importance in the last three decades being driven by substantial increase in trading volume, changes in the regulatory environment, and new technological innovations that affect securities trading all over the world (Madhavan, 2000). The recent literature is distinguished by high activity in the area of theory and extensive empirical examination of theoretical predictions.

The market microstructure literature has studied numerous aspects of the cost of trading and liquidity for developed markets. It was shown that illiquid and assets with high transaction costs trade at low prices relative to their expected cash flows (Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), Datar, Naik and Radcliffe (1998), and Chordia, Subrahmanyam, and Anshuman (2001)). Liquidity was found to predict future returns and liquidity shocks were documented to be positively correlated with return shocks (Jones (2002) and Amihud (2002)). To allow researchers more flexibility in the design of their studies, a menu of liquidity measures was developed in the literature and the efficacy of the measures for measuring stock liquidity was studied (Lesmond et al. (1999), Amihud

(2002), Pastor and Stambaugh (2003), Hasbrouck (2004), Bekaert et al. (2006), Holden (2007), and Goyenko et al. (2009)).

Various approaches to measuring the cost of trading were suggested in literature. They include quoted bid-ask spread, effective bid-ask spread (Roll (1984), Stoll (2000), Naik and Yadav (2003), Glosten and Harris (1988), Huang and Stoll (1997), and Madhavan, Richardson, Roomans (1997)), price impact (Beebower and Priest (1980), Keim & Madhavan (1996), and Smith et al. (2001)), delay costs and opportunity costs (Treynor (1981) and Perold (1988)). Theoretical literature has predicted and empirical literature has documented that the cost of trading depends on the trade size (Lee (1993), Harris and Hasbrouck (1996), Bernhardt and Hughson (2002), Reiss and Werner (1996), Huang and Stoll (1996), and Hansch et. al (1999)). An interesting finding in the microstructure literature is the asymmetry in the cost of trading for institutional buy and sell orders. It was found that institutional purchases are more expensive when the market is rising, while institutional sales are more expensive when the market is falling (Holthausen et al. (1987), Chan and Lakonishok (1993), Keim and Madhavan (1998), Saar (2001), Chiyachantana et al. (2004), and Bikker et al. (2007)).

Theoretical and empirical findings related to the influence of information on the cost of trading have motivated researchers to find the ways of decomposing the bid-ask spread into its components (which include order processing cost, inventory holding cost, and information asymmetry cost). Various spread decomposition models were suggested and empirically tested in literature (Choi, Salandro, and Shastri (1988), Stoll (1989), George, Kaul, and Nimalendran (1991), Glosten and Harris (1988), Huang and Stoll (1997), and Madhavan, Richardson, Roomans (1997)).

While there is extensive and constantly growing literature on market microstructure for developed markets, there is surprisingly little microstructure research on emerging markets, perhaps because accurate and detailed data are difficult to obtain. Some of the available studies are described below. Lesmond (2005) analyze the efficacy of various liquidity measures for measuring liquidity in emerging markets, while Bekaert et al. (2006) study the influence of liquidity on expected returns in emerging markets. Jain (2003) in his study of the influence of institutional design on liquidity of the world stock markets documents that the estimates of the quoted and effective bid-ask spreads for emerging markets are higher than those for developed markets. Domowitz, Glen, and Madhavan (2001) present estimates of the cost of trading (price impact) for 17 emerging markets and show that the high cost of trading in emerging markets significantly reduces the benefits of international diversification and dramatically changes the composition of global efficient portfolios. Hanusek and Podpiera (2003) study the components of the bid-ask spread in the Prague Stock Exchange and find that the value of the asymmetric information cost component is surprisingly low given the evidence of a high level of informed trading in the Prague stock exchange.

Ukrainian stock exchange PFTS records detailed data, which includes quoted-bid ask spreads, both closing and intra-day, trade prices, quantities, and time of trade execution and therefore allows estimating various microstructure models. Based on the data the study aims at examining the aspects of the cost of equity trading and the effective ways of measuring liquidity in the Ukrainian stock market. By this the study aims at filling the gap in the cost of trading and liquidity literature for the Ukrainian stock market.

The thesis contributes to knowledge in the following ways:

1. The thesis presents a detailed overview of the Ukrainian stock market. The market is very young and is little known to international investor; available research on the Ukrainian stock market is scarce. The overview includes information on the history of the stock market development, describes the main characteristics of the largest Ukrainian stock exchange PFTS, and presents the main weaknesses of the

market that have an influence on the cost of trading, in particular, the level of free float, the Ukrainian corporate governance legislation and enforcement, and transparency of public companies. Also, the level of ownership concentration in the Ukrainian public companies is shown and the main institutional investors into Ukrainian equity are presented. Further, the process of trade execution and settlement in PFTS is described. The overview is supplemented by the insights of the Ukrainian investment professionals on the market operation gained through interviews carried out by the author.

2. The thesis performs an in-depth study of the cost of trading, which has not been done for the Ukrainian stock market before. The cost of trading is estimated for Ukrainian stocks in terms of both quoted and effective bid-ask spreads. To show the dependence of the cost of trading on the trade size, the cost of trading is estimated separately for small, medium-sized, and large trades. The study shows the influence of the market condition (rising, falling, or neutral) on the cost of trading for buy and sell trades. Finally, in order to help investors and portfolio managers to design trading strategies that lower transaction costs, the importance of various determinants of the bid-ask spread is analysed (Chapter 4).

3. The efficacy of liquidity measures for measuring liquidity in the Ukrainian stock market is studied. As an essential characteristic of a stock market and a significant input in many other areas of financial research, liquidity needs to be correctly and efficiently measured. The study investigates the efficacy of such liquidity measures as quoted bid-ask spread, turnover, Amihud's measure (Amihud, 2002), the proportion of zero daily returns (Lesmond et al., 1999), the proportion of no-trading days, and the volatility of return for measuring liquidity of the Ukrainian stock market. Further, liquidity of the Ukrainian stock market is compared to the liquidity of other emerging markets based on different measures of liquidity (Chapter 5).

4. The components of the bid-ask spread are estimated. Theory suggests that there are three main components of the bid-ask spread: order processing cost, inventory holding cost, and information asymmetry cost. Taking into account low informational transparency of Ukrainian companies, weak corporate governance, and weak legal system of property rights protection of minority shareholders, it is expected that the cost of trading in Ukraine is large due to high asymmetric information component of the bid-ask spread. The components of the bid-ask spread are estimated for the Ukrainian stocks by applying Stoll (1989), Huang and Stoll (1997), and Glosten and Harris (1988)) models of the bid-ask spread decomposition. Three different models are applied in order to see whether the estimates provided by alternative models are plausible and consistent with each other.

5. A study of the influence of the cost of trading on portfolio returns is performed based on investigating the performance of a momentum strategy with and without accounting for the cost of trading. The ability of the strategy to outperform the market is studied.

Chapter 2

Overview of the Ukrainian Stock Market

2.1. Introduction

The Ukrainian stock market has emerged very recently, in 1990s after the breakdown of the USSR and beginning of the privatisation of the previously state-planned economy. The market has been developing quickly and by 2007 became one of the largest stock markets in Eastern Europe by market capitalization.

Ukrainian stocks have been giving high returns, which are attainable neither in the West European and the U.S. stock markets nor in the more developed Eastern European emerging markets. In 2007 Ukraine was second best performing stock market in the world (after China) with the growth of index PFTS, the main stock index of Ukraine composed mostly of large industrial companies, by 135.4%. After a fall during world economic recession of 2008, index PFTS was sixth best performing index in the world in 2009 with the index growth by 44.3%. Taking a longer-term perspective, in the end of 2009, Ukraine was ranked as the stock market winner of the decade in terms of the gains on the stock index with its index PFTS gain of 900%. The top-ten list also included stock indices of Peru, Russia, Romania, China, Bangladesh, Slovakia, Kuwait, Estonia, and the Czech Republic (Financial Times, 18/12/2009).

Nevertheless, high returns in the Ukrainian stock market are undermined not only by the risks of low liquidity and high volatility, which are the risks common for emerging markets, but also by a number of country-specific risks. Many Ukrainian public companies have low transparency, low level of the ownership structure disclosure, and weak corporate governance. Also the system of protection of the rights of minority shareholders in Ukraine is weak.

Even though market capitalization of Ukrainian stock market is quite large (USD 111.8 bln., or 78% of GDP), trading activity in the market is quite low. Many large industrial companies, which are interesting to investors, have very small free floats (about 4%) as large stakes in them belong either to big private financial-industrial groups or to the state. Many private companies that are potentially interesting to investors but are not listed on the stock exchange yet, do not rush to go public. On the one hand, they are careful about being transparent due to, among other reasons, a weak system of property rights protection in Ukraine. On the other hand, bank capital is still easily available in Ukraine, while liquidity of the stock market is low.

Stock exchange PFTS (First Stock Trading System) is the main trading platform in Ukraine. It has a dealership market structure with multiple brokers posting their quotes in an electronic trading system PFTS NEXT. The trading system is viewed as highly transparent and effective in regards to technology. Though, annual equity value traded on PFTS is quite low, only about USD 2 bln.

This chapter aims at acquainting the reader with the Ukrainian stock market and providing a background for empirical research in the further chapters of the thesis.

The study is based mainly on information from the following sources: State Commission for Securities and Stock Market (the Ukrainian stock market regulator), PFTS stock exchange, reports and studies conducted by international organizations such as World Bank, European Bank of Reconstruction and Development, USAID, and Standard & Poors'. The study is complemented by the insights of investment practitioners from the major investment companies in Ukraine on some aspects of the Ukrainian stock market operation. The insights were gained through interviews conducted by the author.

The chapter is organised as follows: Section 2 presents a short history of development of the Ukrainian stock market, presents the market in the context of other Eastern European markets, and presents some statistical figures that describe the stock market and the stock exchange PFTS. Section 3 describes stock market legislation, corporate governance, and information disclosure in Ukraine. Section 4 describes the process of trading on PFTS, while Section 5 suggests professionals' insights on the operation of the Ukrainian stock market. Section 6 concludes.

2.2. History of the Ukrainian Stock Market Development

Formation of the Ukrainian Stock Market

A historical perspective is necessary to understand the reasons of low activity in the Ukrainian stock market, its specific features, and a lack of interest from the general public in investment of their savings through investment funds.

Since the beginning of 20th century, when the communist government came into power in Ukraine and until 1991, when Ukraine proclaimed its independence, Ukraine was a part of the Soviet Union, a country where state was the sole owner of all enterprises and where stock market did not exist.
While the stock markets were actively developing in many countries of the world, the state-planned economy predominated in the Soviet Union. The companies received financing from the state budget; a few generations of people invested their savings either in the Savings bank (which was state-owned too) or in the government bonds.

In 1990s the mass privatisation and deregulation of the economy became the starting point of the stock market development in Ukraine and other post-soviet Eastern European countries. This differs the group of countries from the other emerging markets (i.e. Asia and Latin America), where economy was initially private and the active stock market development started with the rapid growth of the export oriented industries.

Privatization in Ukraine has been performed in two stages: mass certificate privatization (1992-1998), and privatization for money (from 1999 till present).

Mass privatization in Ukraine was a rapid sale of a large number of enterprises to a "mass" number of investors - employees and the public. Large percentage of companies' shares (25% to 100% of each company) were sold in exchange for privatization certificates. Privatization certificates were distributed free-of-charge to all citizens of Ukraine. In Ukraine, mass privatization involved the universe of the country's approximately 10,000 medium and large industrial enterprises (PricewaterhouseCoopers/USAID, 1998).

A mass privatization approach was chosen in order to provide the fastest transfer of ownership from public to private hands (Roland, 2000). The program aimed for rapid and equitable distribution to the public and the development of capital markets, while revenue generation was of a lower priority (IMF, 2002).

Among all the enterprises, the government picked out a list of strategic ones (Verhovna Rada, 2000). Enterprises in this group are monopolists (or hold at least 35% of their product market). The enterprises are subject to privatization, but the state retains either a blocking minority (>25%) or a controlling share (>50%) in these enterprises.

During 1992-1998, 10,480 medium and large enterprises were privatized (IMF, 2002). By the end of the period the state ownership in the Ukrainian economy decreased to 62%.

Subsequently, in 1999, the certificate privatization finished, the unused certificates were annulated, and since then the privatization has been continued in a form of cash sales (or "privatization for money").

In the process of privatization two types of joint-stock companies were created: closed joint stock companies and open joint stock companies. Closed joint-stock companies (CJSC) are owned by a specified circle of owners and the existing stock holders have a primary right for buying the stocks that are sold by other stock holders. Companies of this kind cannot be traded on a stock exchange. Stocks of open joint stock companies (OJSC) can be sold freely. These companies can be listed on a stock exchange.
As of July 2008, there were about 31 thousand of joint stock companies in Ukraine. The majority of them (about 21 thousand) were functioning in the form of a closed joint stock company. About 10 thousand of joint stock companies were open joint stock companies (World Bank, 2008). Listed companies comprise a small proportion of the total number of joint stock companies.

Privatization in Ukraine provided securitization of the economy and created a basis for the stock market development. One of the Ukrainian stock exchanges, PFTS, was opened in 1995. Initially it operated as an electronic information system and over time became the biggest securities trading platform in Ukraine.

Development of the Ukrainian stock market during 2000-2010

The development of the Ukrainian stock market (USM) during the last decade can be divided into four main stages. First, the period of 2000-2004, when the market had very low trading volumes and had been developing very slowly. Second, the period of 2005-2007 - the time of market revival and subsequent active growth and development, which started after the Orange revolution of December 2004 and the arrival of new, more democratic government. Third, the period of January 2008 -

March 2009, the time of the greatest fall in the history of USM, resulted from the global financial crisis. Finally, from March 2009 till present (2010) the USM have been going through recovery and have seen further growth (See Graph 2.1.).

During the first three periods PFTS was the main trading floor in Ukraine and accounted for about three quarters of the organized equity trading in Ukraine. PFTS had a dealership market structure and was characterized by large order sizes since most of the market participants were institutional investors. PFTS had an electronic trading system, though it was a common practice to pre-negotiate trades over the phone. An important characteristic of the 2009-2010 period was the start of operation of a new exchange, the Ukrainian Exchange (UX), which introduced to the market the long-awaited order-driven trading technology. The order-driven trading increased the speed of the order execution and the information transparency of the market. As a result, large volume of trading in liquid stocks has moved from PFTS to UX.

Figure 2.1. Index PFTS in 2001-2010.

The period of 2000-2004

From 1990s, the time of origination of the Ukrainian stock market, and until 2004 the stock market of Ukraine had been developing very slowly.

Firstly, supply of stocks was very limited. The stock market was hardly seen as a place to raise capital but rather as a means of ownership redistribution. The level of corporate governance, information transparency, and property rights protection was very low, which hindered Ukrainian companies from going public. At the same time, the availability of bank loans was high. Privatization of large and interesting for investors state-owned enterprises often resulted in shares going to the hands of the financial-industrial groups who aimed at acquiring large stakes in a company and exercising long-term control over the company. As a result, very little portion of a company stocks after privatization was left to float (about 4%), which greatly limited liquidity of the Ukrainian stock market. For example, Western NIS enterprise Fund and Sigma Bleyzer, two foreign funds among those very few foreign funds investing in Ukraine, had to work directly with the Ukrainian block holders instead of buying stocks through the organized stock market[1].

Secondly, demand for Ukrainian stocks from domestic institutional investors was low. After many collapses of the investment funds in Russia and Ukraine in 1990s, no mutual or private pension funds existed in Ukraine till the new Law "On Collective Investment Institutions" (2001) came into effect. In 2003 an investment company Kinto opened the first in Ukraine closed-end fund based on the new law. The first open-ended fund in Ukraine was opened by the same company in 2004. The funds were very successful and put a foundation for the development of mutual funds industry in Ukraine. The closed-end fund after three years of its operation brought 699.4% return, while the open-ended fund has brought more than 100%

[1] Natalia Zaderey. "Development of the Ukrainian stock market in 2004 fully depends on the Ukrainian top corporations". 27.01.2004, Business Information Network, http://bin.ua

return after first year of its operation. New funds appeared in the market, though the industry has been developing very slowly and domestic investment funds have not become important players in the Ukrainian stock market. The growth of mutual fund investment was hindered by low trust to and understanding of the mutual fund investing among the Ukrainian public as well as high profitability of bank deposits at the time.

Thirdly, foreign investors were retained from investing into Ukrainian stock market due to the lack of transparency in the property rights protection and distribution. There were many examples of unfair privatization, when companies interesting to investors were sold to the parties close to the government at a price, which was considerably lower than their fair value. One of the examples was privatization of Kryvorizhstal in 2004, one of the largest businesses in Ukraine and a globally-important steel producer. There were both foreign and domestic investors interested in buying the plant but the State Property Fund of Ukraine (a government body that manages state ownership) created such privatization conditions that excluded foreign investors from bidding for the plant. It required that the acquirer of the plant had to have worked in the Ukrainian market for at least three years and produced at least 1 mln. tones of Ukrainian coke annually. As a result, the plant was sold to the Interpipe Group, a group closely related to the Ukrainian President, for USD 803.7 mln., while Russian company Severstal offered USD 1.2 bln. and a U.S. consortium LNM Group & US Steel – USD 1.5 bln. with an intention to invest further USD 1.2 bln. into the plant's renovation.

Those investors who dared to invest into Ukrainian stocks focused mainly on the blue chip companies, many of which were still seen as underpriced.

The period of 2005-2007

After the years of very slow development of the Ukrainian stock market caused largely by non-transparent property distribution rules in Ukraine backed by the Ukrainian authorities, 2005 became the turning point for the Ukrainian stock market. The presidential elections of December 2004 and the corrupt computation of votes in favour of the candidate favoured by the previous President of Ukraine, resulted in the "Orange Revolution", when millions of Ukrainians went out on the streets with protests. Success of the Orange Revolution and arrival of new, more democratic government raised interest in Ukraine among the international community.
Further steps of the new government assured international investors in the decrease of risks of investment in Ukraine and resulted in the inflow of foreign portfolio capital. This heated up the prices of Ukrainian assets, increased the volumes of trading, and gave a spur for the further development of the stock market. Among the steps was cancellation of the corrupt 2004 Kryvorizhstal sale and a further transparent and fair sale of the plant in 2005; the acquisitions of Ukrainian banks by foreign investors, and the first successful IPOs at the London Stock Exchange's Alternative Investment Market (AIM) by three Ukrainian companies.

2005 have also seen first IPOs in PFTS. A Ukrainian retail network Retail Group sold 10% of its shares and attracted USD 27.5 mln.[2] A sequence of IPOs on PFTS continued with Rodovid Bank, a publishing house KP Publications, a large machine-building plant Motor-Sich, and one of the leading producers of dairy products in Ukraine Ukrproduct. Though Ukrainian IPOs often were considered by international investors as not proper IPOs due to the lower requirements related to information disclosure.

[2] Anna Yeremenko, 26.12.05, Kommersant Ukraine.

2005 have seen three-fold growth in the volume of trading, from USD 206.8 mln. to USD 643.9 mln. and an increase of PFTS index by 138%. Arrival of foreign investors and an increased number of stocks in the Ukrainian stock market are seen as the main drivers of the growth. According to the PFTS 2005 Annual Report, "Like in the case with government bonds, increase in the volumes of trades with stocks occurred foremost due to the increased demand of foreign investors for Ukrainian assets." According to some estimates foreign investors accounted for about 70% of trading volume in PFTS stocks[3]. Ukrainian mutual funds as institutional investors played a minor role in the Ukrainian stock market. They had low popularity among Ukrainian public due to low trust to mutual funds as a result of many cases of their collapse in 1990s, and a possibility to earn quite high interest on secure bank deposits.

Higher activity in the stock market starting 2005 has led to the blue chip companies coming to their fair value and therefore becoming less popular among investors than they used to be over 2000-2004. Investors started to actively search for the undervalued assets and switching to the second and third tier stocks, many of which were still able to provide excessive profitability. According to the PFTS 2005 Annual Report, "With their [foreign investors'] involvement during 2005, stocks of second tier experienced increased demand, while blue chips experienced stable demand".

The growth of trading volume and market capitalization of PFTS continued through 2006 and 2007 being supported by positive domestic economic trends such as active GDP growth (real GDP growth rates were 2.6%, 7.1%, and 7.7% in 2005, 2006, and 2007 respectively[4]), stable exchange rate, new tax code favourable for small business, and general deregulation of the economy. Among the global factors, high availability of capital in the world capital markets encouraged international

[3] Sergey Lyamets et al. Overview of the Ukrainian stock market in 2006. 15/01/2007, Business Information Network, http://bin.ua
[4] CIA World Factbook, 2010.

investors to look for new profitable opportunities, one of which was investing in Ukraine.

Increase in trading activity increased liquidity of the Ukrainian stock market and resulted in the decrease of the bid-ask spreads for moderately liquid stocks from 20% in 2004 to 10% in 2006.

2007 was the best year in PFTS since its origination in 1997. Development of the market together with active growth of Ukrainian and world GDP and high availability of capital on the world capital markets resulted in even larger inflows of foreign portfolio capital than in previous years and increased the volume of trading in PFTS by 69% compared to 2006. Index PFTS (index of blue-chip companies) has grown by 144% from 496 in the beginning of 2007 to its historical high of 1,209 on 15 January 2008. In 2007 Ukrainian stock market was the best performer in Europe and second in the world.

Despite the positive changes, many problems in the Ukrainian investment environment kept risks of equity investment in Ukraine quite high.
Some of the most important problems were weak system of property rights protection and weak corporate governance. Joint stock companies were regulated by a quite outdated Law "On Business Associations" adopted in 1991, a time when market changes only started in Ukraine. The weaknesses of the law gave room for manipulations and resulted in quite a few cases of dilution of the minority shareholders' share. A big scandal occurred in 2006 when one of the blue-chip companies, Zaporizhstal, announced additional share issue which diluted minority shareholders' ownership. The company, 80% of ownership in which belonged to three large financial-industrial groups, in June 2006 approved an increase of stock capital by USD 89 mln. through adding to the main company its five affiliates. The affiliates were mainly trading companies that sold Zaporizhstal's produce and their value was considerably lower than the declared one. After the announcement the

company's stock price dropped by 60% from $1.20 to $0.47. The minority shareholders were given an option to trade in their stocks at the market price prevailing at the time of sale, which resulted in the minority shareholders' loss of USD 75 mln. and a decrease of their share from 8% to 3%[5]. The Law "On Business Associations" did not provide for compensation to minority shareholders during additional share issues and stated that the buyout price had to be no lower then the nominal share price. Therefore formally, the majority owners of Zaporizhstal acted in compliance with the law. Some of the minority shareholders of Zaporizhstal were large Ukrainian investment funds such as Dragon Capital, Concord Capital, Renaissance Capital, Sincom, and Kinto. They appealed to the court against the Zaporizhstal additional share issue but their appeal did not have any success. After the precedent, PFTS stopped trading Zaporizhstal's shares and the company was excluded from the index PFTS, where it previously took weight of 15%.

Other examples of dilution of minority shareholders took place in 2006-2008 and included such companies as Alchevsk Iron & Steel, Kievmedpreparat, Nikolayev Aluminuous Plant, and Prominvestbank. Such cases emphasized an appealing necessity of adoption of a new company law in Ukraine, which was finally done in 2008 when the Law "On Joint Stock Companies" replaced the Law "On Business Associations".

The risks and limitations in the Ukrainian stock market made many Ukrainian blue-chip and high growth companies go for IPOs at the foreign trading floors instead of PFTS, which restricted the growth in trading volumes in PFTS. Ukrainian stock market had limited capital resources. If a company was interested in attracting a few hundred million dollars, it faced with inability of the domestic investment market to satisfy such demand. Also, offerings and placements in the Ukrainian stock market were not viewed as secure enough. In 2000s Ukrainian companies faced with problems of corporate raiding when interested parties acquired a shareholding with an aim of putting pressure on existing owners and management and taking over

[5] Vyachaslav Mironenko, 26 June 2006, Investgazeta, #25.

control over the company with hostile aims such as getting rid of a competitor or own empire building rather than increasing company's efficiency. In addition to this, there was no confidence in that the information disclosed to the stock exchange during an IPO would not become available to third parties harming the business through that.

High dependence of the Ukrainian stock market on the capital of foreign investors presented another risk, a risk of high fluctuations in the prices of Ukrainian stocks in response to the changes of situation in the world financial markets. For example, when on 10 May 2006 the U.S. federal funds rate was raised to its highest level since 2001, 5.0%, there was a considerable outflow of funds from the Ukrainian stock market, which changed the rising trend of the Index PFTS to falling and resulted in a drop of Index PFTS by 19.5% during the next month.

The period of 2008

While the profitability of the Ukrainian stock market was one of the best in the world in 2007, in 2008 the market experienced some of the largest losses. From 15 January 2008, the market's peak, till 6 March 2009, the market's trough, index PFTS lost 83.5% and came back to the value it had at the time of the Orange Revolution. Market capitalization decreased by almost five times, from USD 110 bln. to USD 22.5 bln.

The fall of the Ukrainian stock market was mainly a result of the large foreign capital outflows from Ukraine after the beginning of the world liquidity crisis. With the worsening of the situation in the global financial markets, international funds started to actively withdraw capital from Ukraine following the global trend of redirecting investments into more secure assets. Large outflow of foreign capital had a catastrophic effect on the highly depended on foreign capital stock market of Ukraine.

Despite the considerable decrease in liquidity in PFTS in 2008, the volume of trading grew during the year by 24% as a result of active sales of Ukrainian stocks by investors.

The situation in the Ukrainian stock market worsened with a steep downward trend in the Ukrainian economy. External markets of debt capital virtually closed and Ukrainian companies and financial institutions faced difficulties with borrowing cheap financial resources. Later this developed into a considerable drop of liquidity of the Ukrainian financial sector. In addition to this, drop in the world commodity prices, especially steel prices, created a considerable negative impact on the Ukrainian economy. Steel is one of the main exports in Ukraine and steel producing companies and iron ore extracting companies are among the companies with the highest capitalization on PFTS. Drop of the world steel prices resulted in the large drop of Ukrainian industrial output in 2008 (30%) and further negative impact on the value of the assets in the Ukrainian stock market.

To increase transparency of trading, in May 2008 PFTS introduced some important changes to the reporting of trades. Before, some of the trades executed by PFTS brokers with PFTS-listed stocks were not reported to PFTS. Trades which were performed directly between a PFTS broker (a member of PFTS) and an outside investor (non-member of PFTS) (also called "the third party trades") were not obligatory to be reported to the exchange. Brokers could have voluntarily reported these trades to PFTS at a specially allotted time (before the opening of the trading session (before 11 a.m.) during the next two trading days after the trade execution). As a result, a portion of the third party trades was out of sight of the stock market observers/participants. On 26 May 2008, PFTS obliged the brokers to report the details of all their third party trades. The reporting had to be done through the trading terminal of PFTS no later than the next working day after the trade execution and the data on the third party trades started being published on PFTS web-site in a special section called "Reporting". As a result, information about all trades performed by PFTS brokers with PFTS listed securities became available to the market.

The period of 2009-2010

2009-2010 brought gradual recovery to the stock market. From the beginning of March 2009 till the end of August 2010, index PFTS grew by 303% and reached 792.8.

2009 opened a new page in the development of the Ukrainian stock market. In March 2009 a new stock exchange started its operation, the Ukrainian Exchange (UX). Ukrainian Exchange was started by a group of large Ukrainian brokers, which traded in PFTS, and the Russian Trading System (RTS). UX introduced to the market the long-awaited order-driven trading technology, which increased the speed, efficiency, and information transparency of trading and opened access to trading to general public. As a result, a large portion of PFTS volume in liquid stocks moved to UX. In August 2009, just five months after the opening of the UX, the volume of equity trading on UX exceeded that on PFTS. In June 2010, UX accounted for 70,507 equity trades of the total volume of $183 mln., which was more than four times higher than the equity trading volume on PFTS ($44 mln.). Apart from the order driven market UX also operated dealership market where low liquidity stocks were traded.

The Internet trading opportunity allowed increasing the number of investors considerably. While in April 2009 there were 10 individual investors trading in UX, in October of the same year their number increased to more than 1,500[6]. The increased number of individual investors did not create a considerable impact on the total volume of trading but was an important step towards attracting more

[6] "Stock Market: The New Blood". 2009, Investgazeta #41.

attention to investing in the stock market equity among Ukrainian public, which can be an important step on the way of raising the stock market liquidity.

The weakened position of PFTS resulted in the takeover of the exchange by a large Russian stock exchange, the Moscow Interbank Currency Exchange (MICE) in autumn 2009. Bids for PFTS (though unsuccessful) were also done in previous years. In response to the innovation introduced by RTS in UX, MICE started an order-driven trading technology on PFTS. Despite the changes in PFTS, UX kept the leading positions in the market.

We expect that the presence of two large competing stock exchanges in the Ukrainian stock market should accelerate the speed of development of the market in the years to come.

2.3. Overview of the Ukrainian Stock Market

Ukrainian Stock Market in the Context of European Emerging Stock Markets

Standard & Poors' classifies the Ukrainian securities market as a frontier market. Frontier markets are a subgroup of emerging markets and are investable but have lower market capitalization or liquidity than the more developed emerging markets. More than 20 countries are classified as frontier in Europe, Africa, Asia and Latin America. The European Frontier markets group includes Bulgaria, Croatia, Estonia, Latvia, Lithuania, Romania, Slovak Republic, Slovenia, and Ukraine.

The market capitalization of Ukrainian stock market is the largest among European frontier markets (USD 111.8 bln.) and larger than of some emerging markets, e.g. Hungary and Czech Republic (Table 2.1). The advantage of the Ukrainian stock market is that a substantial number of traded companies are fairly large by international standards, a feature that many Eastern European countries lack.

Market capitalization as percentage of GDP is 78.3 and is higher than in other frontier markets and many other emerging markets, e.g. Hungary, Poland, and Czech Republic.

Table 2.1. World Stock Markets in 2007.

	Market Capitalization (USD, million)	Market Capitalization (% of GDP)	Value of shares traded, USD million	Turnover (Value of shares traded as % of market capitalization)	Number of listed domestic companies
Developed markets					
United States	19,425,855	147.6	35,510,463	182.8	5,133
United Kingdom	3,794,310	159.6	4,697,356	123.8	2,913
Emerging markets					
Russia	1,503,011	107.1	960,424	63.9	328
Poland	207,322	44.0	91,429	44.1	328
Czech Republic	73,420	34.0	44,272	60.3	131
Hungary	47,651	37.1	48,890	102.6	41
Frontier Markets					
Ukraine*	111,756	78.3	1,996	1.8	335
Romania	44,925	27.0	8,626	19.2	2,098
Bulgaria	21,793	32.8	7,431	34.1	369
Slovak Republic	6,971	10.1	35	0.5	153

Source: World Bank World Development Indicators 2008, PFTS stock exchange.
*The numbers for Ukraine refer to the PFTS stock exchange. (PFTS stock exchange accounts for 74% of the organized equity trading in Ukraine).

In 2007 the number of listed stocks was 335, which is less than in Romania (2,098) and Bulgaria (369) but more than in Poland (328) and Czech Republic (131).

A specific feature of the Ukrainian stock market is low free float of listed companies and low trading activity. As a result, trading volume in Ukraine is relatively modest as compared to other countries in the Emerging Markets and Frontier Markets groups. For example, in 2007 value of shares traded in Ukraine was USD 1,996 mln., or 1.8%, of the market capitalization. The corresponding number for Bulgaria was 34.1%, for Poland, 44.1%.

Ukraine is a part of such global indexes as MSCI Frontier Markets and S&P Frontier BMI (former S&P/IFC Global for Frontier Group). Separate country index MSCI Ukraine is regularly produced by Morgan Stanley, while S&P Ukraine is regularly produced by Standard & Poor's. Index PFTS is the main domestic stock market index. It includes only blue-chip companies and has been computed daily since 1997.

Ukraine is open to foreign investors. Restrictions on foreign investments exist only in the publishing and broadcasting sectors, and foreigners are not allowed to participate in the manufacturing of weapons.

Organized Equity Markets of Ukraine and PFTS Stock Exchange

Ukrainian equity market has been actively growing in the past decade. There are 8 registered stock exchanges in Ukraine.

Among 8 registered stock exchanges, PFTS Stock Exchange is the largest and accounts for over 90% of trading in the organized securities market and 74.1% in the organized equity market in Ukraine. The remaining seven exchanges have low activity and perform limited operations acting mainly as facilitators in the State Property Fund privatization process (USAID, 2006 [1]).

Market capitalization of PFTS has been actively growing and increased from USD 4.8 bln. (10% of GDP) in 2003 to USD 111.8 bln. (78% of GDP) in 2007 (Table 2.2).

The market is dominated by large companies. Top-ten companies by market capitalization take 44.7% of total market capitalization of PFTS, while top-ten companies by value traded account for 42.5% of total value traded of PFTS. The number of listed companies varied between 191 and 335 between 2003 and 2007.

Table 2.2. PFTS stock exchange market indicators.

	2003	2004	2005	2006	2007
Stock market capitalization, USD million	4,803	11,780	29,100	44,119	111,756
Stock market capitalization as % of GDP	10.0%	20.0%	35.0%	40.3%	78.3%
Capitalization of top-10 companies by market capitalization (% of total)	68.0%	85.3%	55.9%	50.2%	44.7%
Value traded, USD million	93.8	206.8	643.9	1,168.3	1,996.0
Value traded of top-10 companies by value traded (% of total)	-	80.0%	45.8%	40.1%	42.5%
Number of listed companies	267	191	262	296	335

Source: State Commission for Securities and Stock Market, PFTS Stock Exchange

Ukrainian stock market is dominated by industrial enterprises but is fairly diversified by industry. Metallurgy and metal mining companies take 40% of the total market capitalization of PFTS, which is not surprising as iron and steel are the main exports of Ukraine. Power engineering and supply companies take 14% of PFTS market capitalization, banking - 12%, mechanical engineering - 8%, oil and gas - 6%, telecommunications - 4%, and pipes - 3%.

Even though there are many industrial companies with large market capitalization in PFTS, free floats of many of the companies are extremely low. There is no official data on free floats of public companies but according to an estimate of one of the World Bank studies, average free float for listed companies in Ukraine was around 4 percent in 2005 (World Bank, 2006). The same estimate of 4% was suggested in a USAID study of the Ukrainian stock market, with a comment that the majority of newly issued shares of the companies are often distributed among existing shareholders (USAID, 2006 [1]). Estimates of free floats of listed companies are suggested by a privately-run Fund Market Project (www.fundmarket.ua), whose aim is to gather all publicly available information about Ukrainian public companies and publish in on their own web-site. The estimates are averages of the free float estimates of major Ukrainian investment companies. The 2009 estimates for the largest companies are presented in Tables 2.3 and 2.5. For the top-ten capitalized companies the estimates vary between 0.5% and 9.6% and are in line with the estimate of average free float in Ukraine of 4% suggested by the World Bank and USAID studies mentioned above. Though for the first tier companies the estimates are somewhat higher, from 4.2% to 33.8%.

Some details on the top-ten companies by market capitalization are presented in Table 2.3. Market capitalization of the companies varies between USD 2,174 mln. to USD 12,114 mln., which takes from 1.9% to 10.8% of total market capitalization. Trading activity of the companies is not high though. Annual value traded of the companies varies from USD 4.8 mln. to USD 145.8 mln. Such a low value is not surprising if consider the free float of the companies, which is extremely small, from 0.5% to 9.6% of company market capitalization.

All the securities listed on PFTS are divided into three listing levels ("tiers") based on their liquidity and a number of other characteristics. A detailed list of requirements is presented in Table 2.4. Third tier stocks are admitted to the PFTS stock market based on the agreement with the authorized body of the stock exchange.

A stock is delisted if it was not traded during 60 consecutive calendar days.

First tier companies are not necessarily the largest companies but the most liquid ones. Some of the large Ukrainian companies are not among the most liquid due to their low free floats.

Table 2.3. Top-10 companies by market capitalization, 2007.

		PFTS Code	Industry	Mcap, USD, mln.	Mcap as % of total Mcap	Value traded, USD mln.	Value traded as % of total PFTS value traded	Number of trades	Free Float
1	Arcelor Mittal Kryvyi Rih	KSTL	metallurgy	12,114	10.8%	41.40	2.1%	210	1.4%
2	Azovstal metallurgy	AZST	metallurgy	6,579	5.9%	62.87	3.1%	2,895	4.4%
3	North Ore Mining and Processing Plant	SGOK	metal mining	5,817	5.2%	4.84	0.2%	39	0.5%
4	Ilyich Iron and Steel Works	MMKI	metallurgy	4,686	4.2%	14.40	0.7%	885	9.6%
5	Raiffeisen Bank Aval	BAVL	finance	4,555	4.1%	61.72	3.1%	831	4.0%
6	Ukrnafta	UNAF	petrochemical	4,271	3.8%	92.19	4.6%	2,281	8.0%
7	Ukrtelekom	UTEL	telecom	3,984	3.6%	29.75	1.5%	1,502	7.1%
8	South Ore Mining and Processing Plant	PGZK	metal mining	2,982	2.7%	66.00	3.3%	888	7.7%
9	Ukrsotsbank	USCB	finance	2,821	2.5%	145.80	7.3%	1,288	4.2%
10	INTERPIPE Nyzhnodniprovsky Tube Rolling Plant	NITR	pipes	2,174	1.9%	28.69	1.4%	1,065	6.1%
	Total			**49,982**	**44.7%**	**547.67**	**27.4%**	**11,884**	

Source: PFTS Stock Exchange; *information about free floats is from Fund Market (http://fundmarket.ua) as of 2009.

In the end of 2007 the first tier contained 10 stocks and accounted for about 18% of the market capitalization, while second and third tiers contained 29 and 296 stocks respectively and accounted for 30% and 52% of the market capitalization respectively.

Table 2.4. PFTS stock listing requirements for 1st and 2nd Tiers.

	1st Tier	2nd Tier
Minimum value of the issuer's net assets, USD million	19.0	9.5
Minimum last financial year revenue, USD million	19.0	9.5
Minimum term of business activity of the issuer	3 years	1 year
Absence of losses	2 out of 3 last years	Last year
Minimum number of shareholders	500	100
Minimum capitalization, USD million	19.0	9.5
Minimum number of trades for each of the last 6 months	10	10
Minimum average monthly value traded for the last 6 months, USD million	0.19	0.05
Maximum spread size, %	15	50

Source: PFTS Stock exchange, 2008.

Some details on the first tier companies are presented in Table 2.5. First tier list includes only three of the top-ten capitalized companies. Another seven do not meet the requirements for the first tier listing. The list of the first tier companies is dominated by regional power engineering and distribution companies. Total value traded of the first tier companies is higher (USD 723 mln.) than total value traded of the top-ten companies by market capitalization (USD 548 mln.), which tells about higher liquidity of the first tier companies. This is not surprising taking into account that free floats of these companies are mach larger, from 4.2% to 33.8%.

Table 2.5. First Tier Companies, 2007.

	Company	PFTS Code	Industry	Mcap, USD, mln.	Mcap as % of total Mcap	Value traded, USD mln.	Value traded as % of total PFTS value traded	Number of trades	Free Float
1	Ukrnafta	UNAF	Petrochemical	4,271	3.8%	92.19	4.6%	2,281	8.0%
2	Ukrtelekom	UTEL	Telecom	3,984	3.6%	29.75	1.5%	1,502	7.1%
3	Ukrsotsbank	USCB	Finance	2,821	2.5%	145.80	7.3%	1,288	4.2%
4	Centerenergo	CEEN	Power Engineering	1,990	1.8%	83.26	4.2%	1,959	21.7%
5	Dniproenergo	DNEN	Power Engineering	1,979	1.8%	78.22	3.9%	985	8.7%
6	Zakhidenergo	ZAEN	Power Engineering	1,492	1.3%	99.52	5.0%	2,487	29.9%
7	Kyivenergo	KIEN	Power Engineering	918	0.8%	48.45	2.4%	519	9.3%
8	Donbasenergo	DOEN	Power Engineering	872	0.8%	20.18	1.0%	816	14.2%
9	Motor Sich	MSICH	Mechanical Engineering	709	0.6%	109.82	5.5%	1,545	33.8%
10	Stirol	STIR	Chemical	663	0.6%	16.03	0.8%	763	9.6%
	Total			**19,698**	**17.6%**	**723.22**	**36.2%**	**14,145**	

Source: PFTS Stock Exchange; *information about free floats is from Fund Market (http://fundmarket.ua) as of 2009.

Institutions in the Ukrainian Stock Market

Institutional equity holdings dominate in the Ukrainian market. The main investors into Ukrainian equity (equity of both open and closed joint stock companies[7]) are domestic companies, they account for 82.5% of the total equity holdings (Table 2.6). Domestic individuals account for 10.7% of the total equity holdings. Foreign investors play a minor role in the Ukrainian equity market. Their equity holdings account for only 6.7% of the total equity holdings.

[7] For details on distinction between open and closed joint stock companies, see Section 2.2, Subsection "History of the Ukrainian Stock Market Development".

Table 2.6. Structure of equity investors in Ukraine, 2007.

The table present details on the ownership distribution by the type of investor in both open and closed joint stock companies of Ukraine.

Stock holdings of companies, USD bln.	32.4	89.1%
Stock held by domestic companies, USD bln.	*30.0*	*82.5%*
Stock held by foreign companies, USD bln.	*2.4*	*6.6%*
Stock holdings of individuals, USD bln.	4.0	10.9%
Stock held by domestic individuals, USD bln.	*3.9*	*10.7%*
Stock held by foreign individuals, USD bln.	*0.05*	*0.1%*
Total	**36.4**	**100.0%**

Source: State Commission for Securities and Stock Market.

Large blocks of equity in the largest industrial enterprises of Ukraine are mainly held by Ukrainian business groups. Business groups are conglomerates in a form of financial industrial group or a group of vertically integrated companies. Among the largest business groups are System Capital Management (chemicals, telecommunications, energy, metallurgy, machine building, brewery, media, and other), ISD (metallurgy, machine building, telecommunications, agriculture, media, and other), Privat group (finance, oil&gas, metallurgy, food industry, media, and other), Interpipe (pipes, energy, finance, media, and other), and Finance and Credit Group (finance, machine building, energy, and other). The groups are largely controlled by Ukrainian oligarchs.

Table 2.7 presents the ownership structure of the top-20 Ukrainian companies by market capitalization in 2007. The companies take 60.7% of the total market capitalization of PFTS. The largest portion of equity in the companies belongs to the business groups, 69.3%. It is followed by state ownership, 12.4%. 4.1% of equity in the companies belongs to offshore companies. Offshore companies are often Cypriot companies started by Ukrainian nationals with an aim to avoid transparency or decrease tax burden. The rest 14.2% of ownership in the companies is either not disclosed or belongs to minority shareholders.

Table 2.7. The structure of the disclosed ownership of the top-20 Ukrainian companies by market capitalization.

Data on the ownership structure is taken from www.fundmarket.ua as of beginning of 2010. www.fundmarket.ua is a privately managed web-portal that presents all publicly available data for Ukrainian public companies. Since discussion in the chapter focuses mostly on 2007, the companies in the list below are chosen based on their market capitalization in 2007.

	Company name	PFTS Code	MCap, USD, mln.	State	Business Group	Offshore company	Disclosed Ownership, % of Total
1	ArcelorMittal Kryvyi Rih	KSTL	12,114	0.4%	94.4%		94.8%
2	Azovstal	AZST	6,579		97.3%		97.3%
3	North Ore Mining and Processing Plant	SGOK	5,817		99.5%		99.5%
4	Ilyich Iron and Steel Works	MMKI	4,686		90.4%		90.4%
5	Raiffeisen Bank Aval	BAVL	4,555		95.6%		95.6%
6	Ukrnafta	UNAF	4,271	50.0%	42.0%		92.0%
7	Ukrtelecom	UTEL	3,984	92.8%			92.8%
8	South Ore Mining and Processing Plant	PGZK	2,982		44.0%	52.7%	96.7%
9	Ukrsotsbank	USCB	2,821		94.2%		94.2%
10	INTERPIPE Nyzhnodniprovsky Tube Rolling Plant	NITR	2,174		91.5%		91.5%
11	Nadra Bank	NADR	2,130		92.2%		92.2%
12	Central Ore Mining and Processing Plant	CGOK	2,003			60.0%	60.0%
13	Centerenergo	CEEN	1,990	78.3%			78.3%
14	Dniproenergo	DNEN	1,979	50.0%	44.3%		94.3%
15	Krasnoarmiyska Zahidna #1 Coal Mine	SHCHZ	1,941		55.1%		55.1%
16	Poltavsky Iron Ore	PGOK	1,852				0.0%
17	Dniprovsky Iron and Steel Integrated Works	DMKD	1,666		99.0%		99.0%
18	Zakhidenergo	ZAEN	1,492				-
19	Sun Interbrew Ukraine	SUNI	1,467		98.3%		98.3%
20	Marganets Ore Mining and Processing Plant	MGZC	1,321				-
	Total Mcap		**67,824**	8,434	45,006	2,774	85.8%
	% of total Mcap			*12.4%*	*69.3%*	*4.1%*	

Source: www.fundmarket.ua

Equity holdings of the business groups often change as the groups buy and sell equity depending on their business needs and the changing market conditions. So, some new portions of equity can enter or leave free float. Also, if an investor is interested in a large equity holding of a particular company whose free float is small, there is a possibility to negotiate the acquisition of the block with the current owners of the company. According to an analyst of Parex Asset Management, an investment company in Ukraine, interviewed by the author, such approach to equity acquisition is often practiced in the Ukrainian investment companies. Such approach is also often practiced when a foreign fund is interested in buying a block of Ukrainian equity in a thinly traded stock.

Professional investment industry in Ukraine is quite underdeveloped. Banks and insurance companies are the main institutional players in the Ukrainian stock market. According to the National Bank of Ukraine, in the end of 2007, USD 5.7 bln. of banks' assets were invested in securities. Out of them USD 704 mln., were kept in equity in the banks' trading portfolios (Table 2.8). Unfortunately, there is no data available on the value of the banks' assets held in the stock market equity (held as investment rather than for trading purposes).

Insurance industry is the largest amongst non-banking financial institutions in Ukraine as measured by assets. The total assets of insurance companies were worth USD 6.3 bln. in 2007; 37% of the assets (USD 2.3 bln.) were invested in equity (Table 2.8).

Collective investment funds and non-state pension funds are not yet a prominent feature in the Ukrainian investment landscape. Net assets of collective investment funds ("non-venture funds" in Ukrainian legislation; the funds available for non-corporate investors) reached USD 653 mln. in 2007. 40% of the assets (USD 261 mln.) were invested in equity (Table 2.8).

Table 2.8. Value of assets of financial institutions invested into the stock market equity, 2007.

	Number	Total assets, USD mln.	Assets invested in securities, USD mln.	Out of them, assets invested in the stock market equity, USD mln.	Assets invested in the stock market equity, % of total assets
Banks	143	110,800	5,680	704*	0.64%
Insurance Companies	446	6,300	2,520	2,331	37%
Investment funds (institutions of collective investments, non-venture)	184	659	462	264	40%
Pension funds	85	63	33	16	25%
Total	**858**	**117,822**	**8,695**	**3,315**	

Sources: State Commission for Regulation of Financial Services Markets in Ukraine; State Commission for Securities and Stock Market; Ukrainian Association of investment Business; National Bank of Ukraine.
*Value of stocks in the trading portfolio of banks.

Non-state pension funds have emerged only in 2003 and remain small. The number of registered non-state pension funds in 2007 was 96, out of which only 54 were active. The net assets of non-state pension funds account for USD 55 mln., out of which 25% (USD 14 mln.) is invested in the stock market equity (Table 2.8).

Free float of Ukrainian listed companies is concentrated mainly in the hands of institutional players. If assume that the free float of the Ukrainian stock market is 4% (as estimated in the World Bank (2006)), the value of the free float is USD 4.5 bln. then. Total institutional equity holdings account for USD 3,315 mln. (Table 2.8) and do not include equity held in the equity portfolios of banks (as investment rather than for trading purposes). If assume that the value of the banks' equity portfolios held for investment purposes equals the value of the banks' trading portfolios, then total institutional equity holdings will account for USD 4,115 mln., which is 90% of the total Ukrainian free float.

2.4. Legislation and Enforcement in the Area of Stock Market and Corporate Governance; Information Disclosure and Ownership Concentration in Public Companies

Effective legislation and enforcement of laws is vital for effective functioning of a stock market. Legislation creates the "rules of the game" and ensures fair treatment and security of operations of the stock market participants. Significant drawbacks in the stock market or corporate governance legislation and enforcement can result in refusal of companies to raise funds in the stock market, refusal of investors to buy stock market equity, or refusal of market intermediaries to facilitate the stock market operations, which can result in market failure.

Stock Market Legislation in Ukraine

In general, Ukrainian securities market legislation is in good compliance with international practice. The Law "On Securities and Stock Market" (2006) represents a major improvement over the prior Law "On Securities and Stock Exchanges" (1991), especially regarding internationally compliant disclosure requirements for listed companies, issues of transparency of ownership, and the new rules for insider information and insider trading (U.S. Department of Commerce, 2009). The Law "On National Depositary System and Particularities of Electronic Circulation of Securities in Ukraine" (1998) establishes the principles of depositary system operation. The Law "On Joint Investment Institutions" (2001) provides a framework for the establishment of mutual funds and investment funds.

A good compliance of Ukrainian securities market legislation with international principles was supported by the conclusion of a survey carried out by European Bank for Reconstruction and Development (EBRD, 2008 [1]). The survey measured the extent to which national securities market legislation in force 1 June 2007 in 29 transition countries complied with the objectives and principles of securities regulation of the International Organization of Securities Commission (IOSCO).

More than 200 questions, reflecting key issues of the regulations, were organized into the following 10 sections: (i) the powers of the market regulator, (ii) self-regulatory organizations, (iii) issuer and disclosure obligations, (iv) collective investment schemes, (v) market intermediaries, (vi) secondary markets, (vii) clearance and settlement, (viii) accounting and auditing standards for financial disclosure, (ix) money laundering, (x) regulation of various financial instruments. The questions were sent to local practitioners in the transition region. Based on the

Table 2.9. Quality of securities market legislation in transition countries.

Compliance of national securities market legislation in force 1 June 2007 with the International Organization of Securities Commissions Objectives and Principles of Securities Regulation (EBRD, 2008 [1]). The study is based on a survey that consists of 200 questions reflecting key issues of the regulations. The questions were answered by local practitioners in each transition region.

Very high compliance (No countries)	High compliance (14 countries)	Medium Compliance (8 countries)	Low compliance (4 countries)	Very low compliance (3 countries)
	Bulgaria	Armenia	Albania	Belarus
	Croatia	Bosnia and Herzegovina	Azerbaijan	Tajikistan
	Czech Republic	Macedonia	Georgia	Turkmenistan
	Estonia	Kazakhstan	Uzbekistan	
	Hungary	Kyrgyz Republic		
	Latvia	Mongolia		
	Lithuania	Montenegro		
	Moldova	Russia		
	Poland			
	Romania			
	Serbia			
	Slovak Republic			
	Slovenia			
	Ukraine			

Source: European Bank for Reconstruction and Development.

results of the survey, each country was placed into a grouping that indicated its level of adherence to international standards for securities markets legislation. No countries in the survey were considered to be in "very high compliance", a result that would mean the international principles were fully transposed into the national legislation. Fourteen countries, including Ukraine, were rated as being in "high compliance", meaning that laws are relatively sound in most areas highlighted by the principles. The results of the survey are presented in Table 2.9.

Corporate Governance Legislation and Enforcement in Ukraine

Investor protection is an important element of effective functioning of a stock market. When minority shareholders finance companies, they face a risk that may not receive the returns on their investments because the controlling shareholders or managers expropriate them. Corporate governance is, to a large extent, a set of mechanisms through which outside investors protect themselves against expropriation by the insiders.

The legal approach to corporate governance suggests that the legal system (both laws and their enforcement) is the key mechanism in the protection of minority shareholders (La Porta et al. (2000)). To a large extent, potential shareholders choose to finance companies because their rights are protected by the law. These laws, and the quality of their enforcement by the regulators and courts, are vital elements of effective functioning of a financial system (La Porta et al. (1997), (1998)).

An example of importance of regulation for functioning of a stock market comes from Poland and the Czech Republic, two transition economies whose judiciaries in the early 1990s were generally viewed as ineffective. At that time the Polish government introduced a strict securities law that provided shareholder protection. As the system of courts did not work effectively in the country, the law provided for a creation of a powerful Securities and Exchange Commission with significant enforcement powers that did not require reliance on courts. As a result, the Polish stock market started developing actively with both new and already listed companies raising equity in the market. By contrast, in the Czech Republic, neither strict securities law, nor a powerful market regulator were introduced. Probably as a result, the Czech stock market has seen massive expropriation of minority shareholders from both companies and mutual funds. In contrast to the Polish market, the Czech market stagnated, with many companies being delisted and virtually no funds raised by companies through the stock market (Coffee (1999), Pistor (1999), Glaeser et al. (2001)).

Among sound legislation in the areas of regulation of the operation of the stock market, depositary system, and investment institutions, legislation in the area of corporate governance until recently was very weak in Ukraine. The enforcement of laws has been weak too due to ineffective operation of courts and low power of the stock market regulator. This had a considerable negative influence on the development of the Ukrainian stock market.

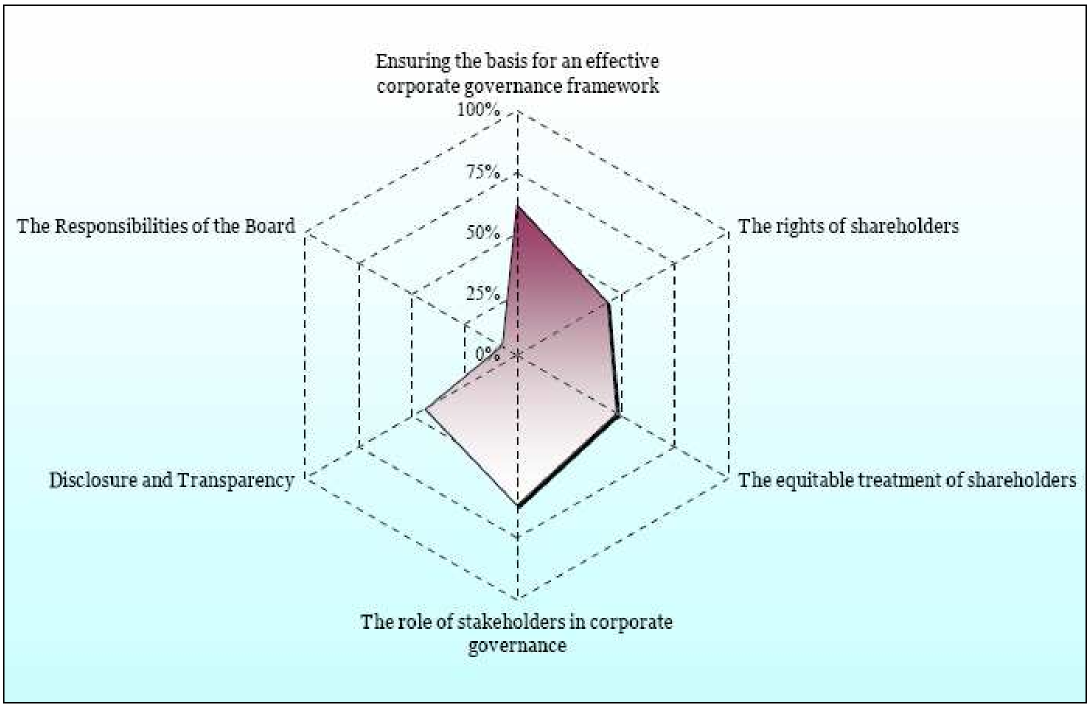
Until October 2008, corporate governance in Ukraine was regulated by the Law "On Business Associations" adopted in 1991. The law regulated the activities of five different types of companies, including joint-stock companies. According to an EBRD corporate governance study for Ukraine (EBRD, 2008 [2]), the law was weak in the areas of financial transparency, ownership structure disclosure, and minority shareholders protection. The study pointed that among the priority actions identified for Ukraine by international experts, the most commonly mentioned was the need for a new law on joint-stock companies, which would establish clear rules regarding director liability, transparency, disclosure, and the protection of minority shareholder rights. Self-regulating organizations in Ukraine were reported, for the most part, passive in promoting high corporate governance standards.

The results of a broad EBRD study of corporate governance in Eurasia in 2007 (EBRD, 2007) have shown that disclosure and transparency requirements in Ukraine are low, as well as the level of protection of shareholders' rights; equal treatment of shareholders is not guaranteed. The study investigated the law on the books and benchmarked each country's legislation to the OECD Principles of Corporate

Governance. 100% score corresponded to complete adherence of a country's legislation to the OECD principles. The total of 134 questions subdivided into six sections were considered. The general level of corporate governance in Ukraine was scored at 43%. Graphical results for each of the six sections of the study are presented in Figure 2.1. The disclosure and transparency requirements were found low, 40% score, as well as the provision of protection of the rights of shareholders, 41% score. The legislation was found weak in providing equitable treatment of shareholders, 48% score.

Figure 2.2. Corporate governance framework in Ukraine: assessment of the law on the books.

The extremity of each axis represents an ideal score: the fuller the 'web', the better the corporate governance framework.
Each of the criteria of the Ukrainian corporate government legislation was benchmarked against the OECD Principles of Corporate Governance (EBRD, 2007).



Another example of weak corporate governance legislation in Ukraine is a low level of prospectus disclosure requirements. According to an EBRD study of securities market legislation in transition countries (EBRD, 2008 [1]), prospectus disclosure practices in the CIS countries, including Ukraine, are generally of a lower standard than in Central and Southern European transition countries and prospectuses often omit risk-sensitive information. In particular, the study stated that doubts may be cast on the reliability of prospectuses in Russia, Ukraine, Kazakhstan, and Tajikistan due to the mild sanctions for providing inaccurate or misleading information.

Over the past decade there were numerous attempts to pass a new law on joint-stock companies, but, according to an EBRD study (EBRD, 2008 [2]), these attempts were frustrated by forces in parliament that were concerned about how transparency and fair rules would negatively affect their personal businesses. A new Law "On Joint Stock Companies" was finally adopted and came into force in October 2008. The law was drafted in consultation with international experts, it is in line with the Organization for Economic Cooperation and Development Principles and is largely compliant with European Union corporate governance directives. The adoption of the law is viewed as a significant step towards the establishment of a comprehensive corporate governance framework.

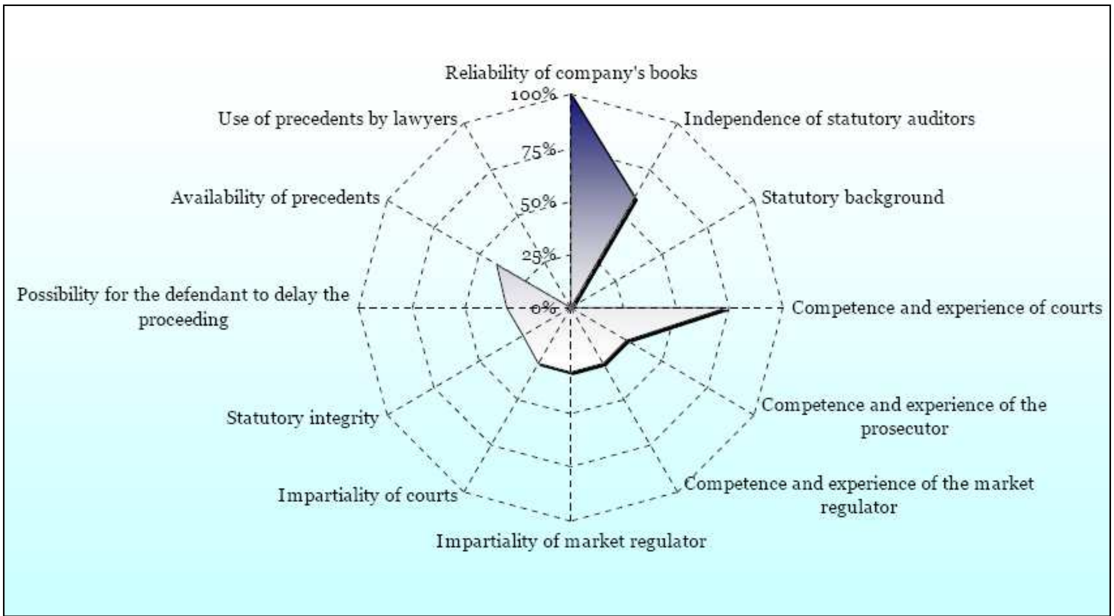
Weak legislation in the area of corporate governance is weakened even more by the problems with legal enforcement. Private enforcement is weakened by the drawbacks in corporate legislation and corrupt court system, public enforcement is slackened by low competence and experience of the prosecutor and lack of power of the market regulator. An EBRD study of securities market legislation in transition countries (EBRD, 2008 [1]) performed a separate study of the effectiveness of private and public enforcement mechanisms in 29 transitional countries, including Ukraine. Private enforcement was considered as three possible lawsuits: (i) against the issuer, who sold the shares, (ii) against the underwriter, who concluded the contract with investors, and (iii) against the auditor, who made a mistake in opining on the consolidated financial statements. Public enforcement mechanism foresaw two actions: administrative action by the market regulator and criminal action by the prosecutors, provided that administrative or criminal provisions have been breached. The study concluded that available civil actions are perceived to be complex in Ukraine and capacity and competence of courts in corporate cases need to be improved. The prosecution authorities were found to have little experience in securities cases. Insider trading was considered a serious risk but investigation and prosecution practices were found limited.

The study also concluded that, in addition to the weaknesses in the legislative framework, Ukraine had an ineffective court system, which created problems in enforcing the country's few existing corporate governance rules. The low level of corporate governance expertise among judges, together with less-than-perfect legislation, led to contradictory decisions and a significant number of appeals.

Another EBRD study investigated how the law works in practice in a broad range of Eurasian countries, including Ukraine (EBRD, 2007). The study assessed practical effectiveness of each country's legislation based on the following case study: "A minority shareholder discovers that substantial assets of the company have been sold to another company belonging to the management at a discount. What to do?" The survey was based on a questionnaire and involved working with leading corporate governance lawyers in the region. Ukraine's general result of 38% out of 100% evidenced weak protection of minority shareholder's rights. More detailed results of the study for Ukraine are presented in Figure 2.2. In particular, the study have found that competence and experience of courts were quite high, 75% score (as opposed to the study discussed above), while competence and experience of prosecutor were found much lower, 31% score (in line with the EBRD (2008 [1])). The courts and the market regulator were found not to give equal treatment to all shareholders, impartiality of courts and impartiality of market regulator got the score of 31% and 30% respectively.

Figure 2.3. Corporate governance framework in Ukraine: Assessment of how the law works in practice.

The extremity of each axis represents an ideal score: the fuller the 'web', the better the corporate governance framework.
The survey assessed practical effectiveness of Ukrainian legislation based on the case study: "A minority shareholder discovers that substantial assets of the company have been sold to another company belonging to the management at a discount. What to do?" (EBRD, 2007). The survey was based on a questionnaire and involved working with leading corporate governance lawyers in the region.



According to an International Finance Corporation study on commercial dispute resolution (International Finance Corporation, 2007), Ukrainian businesses were generally not satisfied with judicial proceedings and reported that, in their most recent disputes in court, the court decision was only completely adhered to in only 45% of cases, partially adhered to in 18% of cases, and not adhered to at all in 37% of cases. When asked what factors were important to businesses when selecting a dispute resolution method, 58% of respondents stated that the most important factor was obtaining an outcome that could be enforced.

Corruption is seen as one of the important reasons of the weak system of legal enforcement in Ukraine. Ukraine worsened in Transparency International's Year

2008 Corruption Perception Index (CPI). The country moved down to 134th place in 2008 on the list of 180 countries, from 105th place in 2007. In 2008, Transparency International rated Ukraine at 2.5 points on the CPI's 10-point scale, a decline from the 2007 rating of 2.7 points.

The regulator for the securities market in Ukraine, the State Commission for Securities and Stock Market (SCSSM), was found weak in enforcement of securities market regulations. According to a World Bank study (World Bank, 2006), SCSSM suffers from weak enforcement powers, and is confronted with a lack of budgetary and political independence. FTSE Quality of Markets Criteria (Europe Frontier) (FTSE, 2009)[8] supports the conclusion. The study suggests an appraisal of frontier stock markets in Europe in a form of a matrix based on a number of criteria. For each criterion a stock market can receive one of the three grades: Pass, Restricted, or Not Met. For the "Formal stock market regulatory authorities actively monitor market" criterion of the Market and Regulatory Environment block, Ukraine got "Not Met" grade.

Weak corporate governance legislation and enforcement results in a high level of corporate disputes in Ukraine. This discourages companies from going public and urges investors to be cautious when investing into Ukrainian stocks. According to the 2006 State Commission for Securities and Stock Market annual report, the level of corporate disputes in Ukraine in 2006 remained high compared to the previous year. Inadequate corporate legislation and weak enforcement were listed among the key reasons for the lack of improvements. SSMSC referred to a significant number of violations in the market, primarily violations of shareholders' rights during additional share issuances (share dilution resulting from issuing additional shares at below fair market value), asset stripping (the sale or transfer of company assets by

[8] Assessment criteria are grouped into five blocks: (i) Market and Regulatory Environment, (ii) Custody and Settlement, (iii) Dealing Landscape, (iv) Derivatives, and (v) Size of market.

management to a related party for below fair market value), and a low level of information disclosure.

To summarise, legal enforcement in Ukraine is weak. The system of courts in Ukraine has competence and experience in corporate cases though it is not effective due to the weak corporate governance legislation and high level of corruption. Public enforcement is weak due to the low competence and experience of prosecutors, while the stock market regulator has lack of power due to the limited budgetary and political independence. This creates obstacles to the development of the Ukrainian stock market.

Informational Transparency of Ukrainian Public Companies

Standard & Poor's and Financial Initiatives Agency performed a study of informational transparency of Ukrainian public companies (S&P/FIA, 2007). The study follows methodology developed by Standard & Poor's for assessing information transparency of a stock market and computes a transparency index that measures how full and timely the information important for investors is disclosed. The dataset includes 36 Ukrainian companies that are traded on PFTS stock exchange and have the highest market capitalization and volume of trading. The companies comprise about 77% of total market capitalization and 70% of total volume of trading on PFTS.

The study evaluates public companies based on 105 criteria divided into three blocks: i) ownership structure and shareholders' rights (34 criteria), ii) financial and operational information (46 criteria), and iii) composition and procedures of the Board of Directors and company management (25 criteria). For analysis, the study screens three sources of information: i) company annual reports, ii) web-sites, and iii) reports to the State Commission for Securities and Stock Market (SCSSM), reports to the PFTS stock exchange, and, in addition, prospectuses for additional stock offerings, which are publicly available. According to the weighting system, the fact of public availability of certain information (not depending on the source) gives 80% of the maximum points for a criterion. Additional 20% are added if the information is also available in two other sources (10% for each source). This approach is justified by the fact that replication of the same information in different sources increases the availability of the information for investor. The index of transparency for each company is found as average of the maximum available points for each criterion.

The average index for the Ukrainian market as a whole was found very low, 23.9% with the highest value of the index for Raiffaisen Bank Aval, 48.8%, and the lowest value of the index for Dnieprospetsstal, 10.3%. The ownership structure and shareholders' rights block had the highest information transparency, 27.1%, it was followed by the financial and operational information block, 24.4%, and the composition and procedures of the Board of Directors and company management block, 18.6%. The authors suggest that the main reason of such a low level of disclosure is not only in low regulatory disclosure requirements but rather in a lack of motivation of the stock issuers for the disclosure. The importance of the stock market as a source of capital is not high in Ukraine, due to the low liquidity and high availability of bank capital. At the same time, the authors note that Ukrainian companies that go for an IPO in the international stock markets have considerably higher transparency.

Among the industries, the most transparent is financial industry, 39.7% (Table 2.10). This is because banks, in addition to the reporting to SCSSM, have also to report to the National Bank of Ukraine. The National Bank of Ukraine has high requirements for the transparency of ownership structure of banks and performs a strict control over the financial and operational information disclosure of banks. The rest of the industries have considerably lower transparency. Power engineering industry has transparency score of 23.8%. The companies in the industry surpass a number of other industries by transparency because many of them have a high share of state ownership. These companies are often in the centre of public attention and therefore the government applies efforts to increase their transparency. The companies from mechanical engineering industry, metallurgy, and fuel industry are less transparent (21.4%, 19.7%, and 19.1% respectively).

Table 2.10. Information disclosure of Ukrainian stocks by industry.

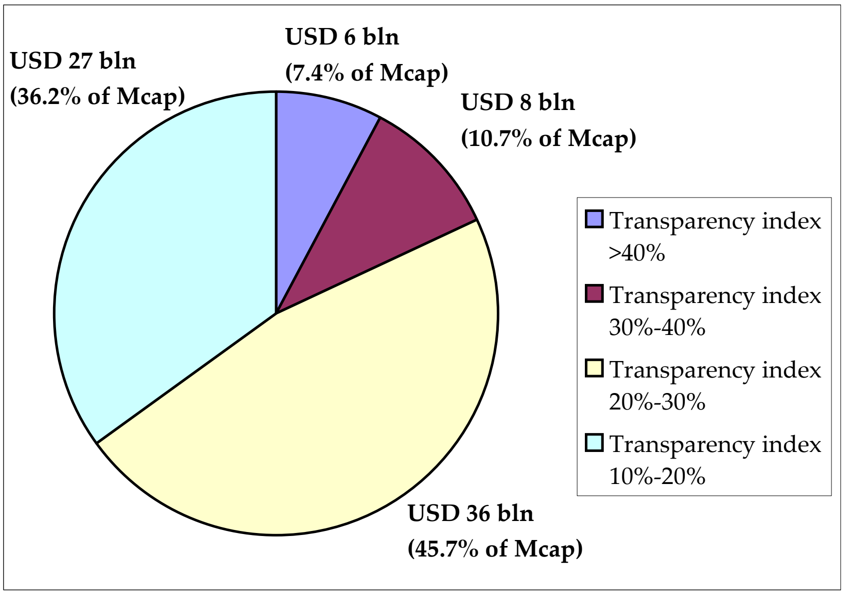
The Table presents the results of S&P/FIA study of informational transparency of Ukrainian public companies in 2007 (S&P/FIA, 2008). The dataset includes 36 Ukrainian companies that are traded on PFTS stock exchange and have the highest market capitalization and volume of trading. The companies comprise about 77% of total market capitalization and 70% of total value traded of PFTS.

Industry/ number of companies	Total score, %	Ownership structure and shareholders' rights, %	Financial and operational information, %	Composition and procedures of the Board of Directors and company management, %
Banks (5)	39.7	42.3	42.1	31.6
Power engineering (7)	23.8	28.3	23.7	18.3
Mechanical engineering (4)	21.4	26.2	20.1	18.2
Metallurgy (15)	19.7	23.4	19.5	15.2
Fuel industry (2)	19.1	21.7	19.4	15.4
Total	**23.9**	**27.1**	**24.4**	**18.6**

Companies with relatively high level of disclosure take quite low percentage of the market capitalization (Figure 2.3). Companies with the disclosure index of 40% or more take only 7.4% of the market capitalization. Companies with the disclosure index of 30%-40% take 10.7% of the market capitalization, while companies with the disclosure index of 20-30% take 45.7% of the market capitalization. The least transparent companies (disclosure index of 10%-20%) take 36.2% of the market capitalization.

Figure 2.4. Structure of the market capitalization of Ukrainian companies by their transparency index.

The Diagram presents the results of S&P/FIA (2008) study of informational transparency of Ukrainian public companies in 2007. The dataset includes 36 Ukrainian companies that are traded on PFTS stock exchange and have the highest market capitalization and volume of trading. The companies comprise about 77% of total market capitalization and 70% of total value traded of PFTS.



Ownership Concentration in Ukrainian Public Companies

S&P/FIA (2008) also studies concentration of the ownership of the companies in the sample. It considers each share holding as independent and not as a part of a consolidated block unless a share agreement between the owners exists. The results of the study show a high level of ownership concentration in the Ukrainian stock market. Only 5 companies out of the 36 studied had dispersed stock ownership (Table 2.11). These companies take only 4.1% of the total market capitalization. 31 companies have at list one shareholder who owns more than 25% share stake in the company. Out of the 31 companies, 25 companies are controlled companies (with the ownership by the largest shareholder of more than 50%). The share of concentrated stock holdings (>25%) was 75.1% of the total market capitalization of the companies in the sample, and the share of controlling interest (>50%) was 62.6% of the total market capitalization of the companies in the sample.

Table 2.11. Ownership concentration in Ukrainian companies.

The table presents the results of S&P/FIA (2008) study of informational transparency of Ukrainian public companies in 2007. The dataset includes 36 Ukrainian companies that are traded on PFTS stock exchange and have the highest market capitalization and volume of trading. The companies comprise about 77% of total market capitalization and 70% of total value traded of PFTS.

	Number of companies	**Share of the companies in the total Mcap, %**	**Share of the concentrated holdings in the total MCap, %**
Companies with dispersed ownership structure (the largest holding less than or equal to 25%)	5	4.1%	-
Companies with at least one large shareholder (>25%)	31	95.9%	75.1%
out of them controlled companies (the largest holding more than 50%)	*25*	*81.1%*	*62.6%*
Total	**36**	**100%**	

The majority of companies with concentrated stock holdings are non state owned. 22 out of 31 companies with the largest stake of 25% of share capital or more, are non state owned (Table 2.12). Non-state stakes of more than 25% of share capital take 58.7% of the total market capitalization of the companies in the sample. In particular, the controlling non-state stakes (>50%) take 49.6% of the total market capitalization of the companies in the sample.

Out of 31 companies with concentrated stock holdings (>25%), 9 are state owned. The majority of them (7) are state controlled (>50%).

As shown in the Section "Institutions in the Ukrainian Equity Market", non-state ownership in Ukraine mainly refers to the ownership of large business groups.

Table 2.12. The types of ownership in the companies with high ownership concentration.

The table presents the results of S&P/FIA (2008) study of informational transparency of Ukrainian public companies in 2007. The dataset includes 36 Ukrainian companies that are traded on PFTS stock exchange and have the highest market capitalization and volume of trading. The companies comprise about 77% of total market capitalization and 70% of total value traded of PFTS.

Ownership	Number of companies	Share of the companies in the total Mcap, %	Share of the concentrated holdings in the total MCap, %
Companies with the largest holding of more than 25%			
State	9	23.0%	16.4%
Non-state	22	72.9%	58.7%
Total	**31**	**95.9%**	**75.1%**
Out of them, companies with the largest holding of more than 50%			
State	*7*	*16.0%*	*13.0%*
Non-state	*18*	*65.1%*	*49.6%*
Total	***25***	***81.1%***	***62.6%***

2.4. Process of Trading on PFTS

PFTS is a dealership-type market. Independent brokers post their firm quotes together with desired quantities in an electronic trading system. The electronic trading system, PFTS NEXT, allows brokers to trade the PFTS-listed securities, inter-regionally from their offices. The trades are done in an on-line mode through a private network. The information posted by the brokers such as the name of the stock, bid and ask prices and bid and ask quantities, is visible on the screen to all authorized subscribers to the trading system. Trades are performed online by one broker accepting a bid/offer of another broker within the specified quantity. Brokers can act as agents (executing an order of an investor) or as principals, trading for their own accounts. Normally there is no separately set commission to a broker. When a broker acts as an agent, he suggests to investor a price, which includes remuneration to the broker from the deal.

An electronic order-driven trading platform was started in PFTS in 2009. It operates in parallel with the dealership-type market (similar to the London Stock Exchange). Before, PFTS was unsuccessfully trying to introduce order-driven trading in 2002 and 2007. Success of the new attempt of launching of an order-driven trading system in PFTS cannot be assessed as yet.

PFTS provides timely and complete disclosure of information about the trades executed in its electronic system. Composite information about trading volume, best closing bid and offer prices, closing trade price for each stock is provided daily in the PFTS web portal (www.pfts.com). PFTS also publishes a daily risingetin, the PFTS Inform, which provides information on PFTS trading activity, the Association's activities, decisions of the PFTS Board and committees, etc. Real time information with the details of trades executed on PFTS, both intraday and historical, is available through PFTS Online (http://terminal.pfts.com). PFTS Online service is available to the subscribed users only, though anyone can subscribe to it. Along with own information disclosure, PFTS works in cooperation with numerous distributors of financial information. Ukrainian (Interfax Ukraine, Ukrainian News, UNIAN, LigaBusinessInform, Ukrinform, etc.) and international (Bloomberg, Thomson Reuters, Interactive Data (Europe), SIX Telekurs Ltd., etc.) providers of financial services distribute PFTS data in real time mode through over 1,000 terminals all over the world.

According to the FTSE Quality of Markets Criteria (Europe Frontier) assessment (FTSE, 2009), PFTS got "Pass" for the "Efficient trading mechanism" criterion, and

"Pass" for "Transparency – market depth information / visibility and timely trade reporting process" criterion.[9]

There are no market makers in the Ukrainian stock market. In the past a system of market makers was introduced on PFTS but due to low liquidity of the market it did not last long and was cancelled.
Short selling is not permitted in Ukraine.

The brokerage industry is highly competitive in Ukraine. In 2008, 246 investment companies and banks from 22 cities of Ukraine performed operations with securities on PFTS (PFTS, 2008). SCSSM reported that there were 348 licensed brokers in Ukraine in 2008 (SCSSM, 2008). According to the FTSE Quality of Markets Criteria (Europe Frontier) appraisal (FTSE, 2009)[10], PFTS got "Pass" for the "Brokerage – Sufficient competition to ensure high quality broker services" criterion of the Dealing Landscape block.

According to the information from an interview of the author of the thesis with Oleg Pikarskiy, Head of Brokerage Department of a Ukrainian investment company Kinto, a low percentage of trades is executed without preceding telephone contact between the counterparty brokers. According to Oleg Pikarskiy, usually, by posing the quotes, brokers signal their interest in a certain stock but the posted price and quantity are only indicative. Through a phone call, the party, which initiates a trade, can negotiate a better price for the trade. Only trades with the stocks that have a very narrow spread are likely to be executed at the quoted prices without a preceding telephone call. In the majority of other cases, trade prices are negotiated.

[9] The assessment criteria are grouped into five blocks: (i) Market and Regulatory Environment, (ii) Custody and Settlement, (iii) Dealing Landscape, (iv) Derivatives, and (v) Size of market. For each criterion a stock market can receive one of the three grades: Pass, Restricted, or Not Met.

[10] The assessment criteria are grouped into five blocks: (i) Market and Regulatory Environment, (ii) Custody and Settlement, (iii) Dealing Landscape, (iv) Derivatives, and (v) Size of market. For each criterion a stock market can receive one of the three grades: Pass, Restricted, or Not Met.

After the parties agree about the terms of the trade by phone, one of the parties reports about the trade to the PFTS electronic system. The counterparty has to confirm the report during 10 minutes after receiving the report (PFTS Trading Rules 2006). After the report is confirmed, information about the trade such as the name of the stock, price, quantity, and time of the trade appears in the electronic system PFTS and becomes visible to other market participants.

The trading session in PFTS lasts from 11 a.m. till 5 p.m.

Until recently, clearing and settlement services for domestic corporate and private securities were mainly conducted by user- and exchange-owned depositary Interregional Securities Union (MFS), which interfaced with PFTS. There was also another depositary, the National depositary of Ukraine, which performed a small percentage of settlement operations. In 2008 the two depositaries merged into All Ukraine Securities Depositary (AUSD).

The MFS offered delivery-versus-payment (DVP) settlement services but in the great majority of cases market participants settled securities on a free-of-payment basis (securities and money do not have to be pre-deposited). There were fewer than 20 DVP transactions a year (USAID, 2006 [2]). The total value of securities (shares, corporate and municipal bonds) accounted by the MFS reached USD 51 bln. in 2008 (MFS, 2008). MFS enjoyed an excellent reputation among key market participants for its honesty, competency and transparency of operations (USAID, 2006 [2]).

The software of MFS was found effective and operated in compliance with internationally recognized standards. According to a study of Ukraine's Securities Depository System (USAID, 2006 [2]), MFS met six of the nine standards recommended by the Group of Thirty (G30) in conjunction with the International Securities Services Association for clearance and settlement systems in the global securities markets (see details in Table 2.13). Because Ukrainian legislation was not in compliance with certain international standards, MFS could not have met the other three.

Table 2.13. Compliance of MFS with the Nine Standards for Clearance and Settlement set by the Group of Thirty (G30) in conjunction with the International Securities Services Association.

The Table presents results of a study of Ukraine's Securities Depository System (USAID, 2006 [2]).

	Standard	MFS Compliance with the standard
1	T+1 trade confirmation and affirmation	Yes
2	Confirmations extended to clients, especially large institutions	Yes
3	Multilateral netting	No*
4	Central stock depository	No*
5	Delivery vs. payment	Yes
6	Irrevocable payment	Yes
7	T+3 settlement	Yes
8	Stock borrowing and lending procedures	No*
9	Coding Standards	Yes

* Lack of internationally compliant Ukrainian legislation prohibits compliance.

According to the FTSE Quality of Markets Criteria (Europe Frontier) assessment (FTSE, 2009), PFTS got "Pass" for the "Settlement - Rare incidence of Not Meted trades" criterion of the Custody and Settlement block of criteria.[11]

The PFTS stock market regulations do not require that the transactions with PFTS-listed securities performed by a PFTS broker with a third party (further referred to as "third party trades") be reported to PFTS at the time of trade execution. An example of a third party trade can be an order of an investor executed by a PFTS broker from the broker's own stock of securities and without a need to deal with other PFTS brokers for executing the order. The third party trades can be voluntarily (since June 2008 – obligatory) reported to PFTS on the next two (since June 2008 – one) days after the trade execution before the opening of the trading session (between 9 a.m. and 11 a.m.). Brokers have a motivation to report their third party

[11] Assessment criteria are grouped into five blocks: (i) Market and Regulatory Environment, (ii) Custody and Settlement, (iii) Dealing Landscape, (iv) Derivatives, and (v) Size of market. For each criterion a stock market can receive one of the three grades: Pass, Restricted, or Not Met.

trades. In the end of each month PFTS publishes volumes of trading by each PFTS member and creates ratings of top-brokers by volume. These ratings are viewed by the brokers as important for promoting their services in the market.
From June 2008 till the end of 2008 2,739 third party trades were reported with the total volume of USD 475 mln., which is 19% of total PFTS equity value traded in 2008.

Not only third party trades are reported before the opening of the trading session but also the trades of non-standard parameters. Non-standard parameters trades are the trades whose volume is less than the size of the minimum lot set by PFTS for each security or whose execution price is less than the best bid or higher than the best offer at the time of reporting of the trade. Non-standard parameters trades have to be reported between 9 a.m. and 11 a.m. during next two trading days after the trade execution. (PFTS Trading Rules 2006).

There are other trades with PFTS-listed securities that are executed off-exchange and are not reported to the exchange. Since Ukrainian legislation does not require that all trades with the exchange-listed securities to be executed on a stock exchange, the proportion between the off-exchange trades and the trades executed on an exchange is hard to estimate.

The volume of trades reported before the opening of the trading session is extremely large. For example, in 2005-2006, 44% of the total volume of trading on PFTS was reported before the opening of the trading session[12]. This suggests that a large portion of third party trades was actually reported, despite it was not obligatory, since non-standard parameters trades are not likely to take a large portion of the total volume of trading.

[12] Own calculations based on PFTS trading data, 2005-2006.

From the information presented above we can conclude that about half of the volume of transactions performed by PFTS brokers are not reported to PFTS in a real-time mode.

2.5. Insights of the Ukrainian investment market practitioners on the Ukrainian stock market operation

In the initial stage of working at the thesis, the author wanted to better understand the operation of the Ukrainian stock market. Since the literature about the Ukrainian stock market is quite scarce, and it was even more scarce in the mid-2006, the author decided to conduct interviews with the practitioners of the Ukrainian investment market. The interviews gave the author a better understanding of the Ukrainian stock market in general, as well as provided with some special interesting insights about the market. The aim of this section of the chapter is to present the practitioners' views on some of the questions, which were studied by the international organizations and are discussed above, as well as to present some interesting facts about Ukrainian investment market, which were not covered in the literature. This is expected to provide a better context for the reader and to help to better understand the empirical findings of the thesis.

Six professionals from five well-known investment companies in Ukraine were questioned in summer 2006. One of the respondents was an acquaintance of the author, he answered the questionnaire and helped in organizing of another three interviews. Two interviews were organized by the author herself by looking up for investment companies in the business directory and contacting them directly by e-mail and telephone.

Five of the respondents were questioned in person during a specially organized meeting, while one answered the questions in writing and sent them back to the author by e-mail. The details on the respondents and the names of the companies can be found in Table 2.14.

Table 2.14. Details about the respondents who answered the questionnaire.

Name of the Respondent	Company	Job Title	Gender	Age Group	Highest Qualification
Volodymyr Nesterenko	Concord Capital	Analyst	Male	21-30	MA
Sergiy Lesyk	Millennium Capital	Head of Research	Male	31-40	MA, CFA
Volodymyr Ovcharenko	Kinto	Director of Research	Male	41-50	Specialist Degree*
Victor Botte	Kinto	Fund Manager	Male	41-50	PhD, CEFA
Alexander Sandul	Foyil Securities	Director General	Male	21-30	MBA
Denys Kolesnichenko	Parex Asset Management	Analyst	Male	21-30	Specialist Degree*

* Specialist Degree is a 5-year university degree specific for post-Soviet countries.

All the companies are based in Kiev, the major financial centre of Ukraine. Most of the companies have their own managed equity funds and brokerage divisions. The companies are among the most active stock traders on PFTS. In the PFTS rating of the most active equity traders in 2006, Concord Capital was 7th (2nd among non-bank traders) out of 130, Millenium Capital was 11th (4th), Kinto – 20th (9th), and Foyil – 21th (10st). Parex Asset Management did not have their own brokerage division.

The interviews were conducted in the form of semi-structured interviews. They had prearranged questions but were flexible, which allowed freedom to modify questions and pursue topics in more detail depending upon the interviewee's responses. Also the use of semi-structured interviews allowed to get personal insights of the respondents on subjects not directly addressed by the interviwer. Additionally, the face-to-face format of the majority of interviews allowed any answers that lack clearness to be clarified immediately in order to remove any confusion. The interviews lasted between 60 and 100 min. They were recorded and notes also were taken.

Since the interviews were conducted in the initial stage of work at the thesis, many of the questions included in the questionnaire became not relevant for the final version of the thesis. Only the relevant questions are discussed. The questions refer to the problems of the Ukrainian stock market operation and the asset management industry in Ukraine. The full questionnaire is presented in Appendix 2.1.

The views of the investment practitioners on the problems of the Ukrainian stock market supported our findings from analysing reports of the international organizations. Most of the respondents stated that weak company legislation and corrupt judiciary system are among very important problems of the Ukrainian stock market operation and development.

One of the respondents said:

> “Many companies do not hurry to enter the stock market. Aggressive business environment is one of the reasons of that. Because of the weak legislation, banditry, and high level of corruption there are schemes that allow grabbing the control over a company. That is why the majority shareholders tend to buy out the company stocks from the minority shareholders and leave only around 5% to float.”

Another important problem stated was a lack of transparency. One of the respondents said:

> “Owners are often afraid to be transparent, they do not want to show their true revenues and profits in order to decrease their tax burden. Also, few companies are ready to reveal their ownership structure. One of the reasons is a weak system of the property rights protection in Ukraine, the owners feel more secure if they do not make the information public."

A few respondents mentioned a problem of low credibility of companies' accounting reports. One of the respondents said:

> “The process of company valuation is complicated by the lack of credence to the reported companies’ accounts. The numbers for sales and income are understated with the goal to decrease the tax burden. In order to value a company correctly, the investment analysts make adjustments based on other available information about the company.

> Since the Ukrainian stock market activity is low, many companies do not see it as an important source of additional capital. Thus, they give preference to hiding the true numbers and decreasing their tax burden rather than aiming at increase of their stock price.
> …Even though many stock issuers are audited by one of the big-four auditing companies according to the GAAP standards, only few publish their GAAP accounts."

One of the respondents gave clarifications on how companies' accounts can be distorted having mentioned that large percentage of operations in big industrial-financial groups are performed with linked entities. For example, one of the companies controlled by an industrial-financial group can buy some products from another company controlled by the same group and later sell the products back without actual delivery of the products. Nothing will change in actual operations of the two companies, though this manipulation will allow to report extra expenses, which, in turn, will allow to decrease tax burden.

> "[Even if the reported numbers itself are correct], there is another problem that in a big industrial-financial group a high percentage of operations is performed with linked entities, which allows manipulation and reporting the numbers that do not represent the facts. For example, in the beginning of 2006 Standard & Poors' was giving a rating to one of the most efficient industrial-financial groups in Ukraine, in connection with an issue of Eurobonds. The press release stated that 70% of the company operations were performed with linked entities, which called the transparency of the company's operations into question."

The problem of low credibility to the companies' accounting reports complicates the company valuation process and requires from the investment analysts finding additional information and making adjustments for a fair valuation.

The problem is one of the reasons why the PFTS does not perform calculations of the multiples (P/E, P/B, and other) for the listed companies. The ratios based on adjusted information are calculated by the investment companies themselves.

As discussed in the previous sections of the chapter, professional investment industry is very underdeveloped in Ukraine. According to the Ukrainian Association of Investment Business, there were only 8 open-end, 28 interval, and 67 closed-end funds (non-venture) in 2006 in Ukraine[13]. The assets under management of the funds in the end of 2006 were USD 12.3 mln., USD 7.5 mln., and USD 252.2 mln. respectively.

The main reasons of the low activity in the Ukrainian professional investment markets are seen in the low level of property rights protection of minority shareholders and low liquidity of the Ukrainian stock market.
Victor Botte, a Fund Manager of Kinto, gave interesting insights on the fund management industry of Ukraine that add to the understanding of its low development as yet.

According to Victor Botte, it is easier to attract general public into the open-end funds than to the interval and closed-end funds due to the possibility of withdrawing from the fund at any time. This possibility is important to Ukrainians in the conditions of political instability in Ukraine and taking into account still low trust to investment industry after their negative experiences in 1990s when many newly-organized investment trusts went bankrupt or disappeared with the collected money. At the same time, the diversification requirements set by the Law of Ukraine "About Institutions of Mutual Investment" (2001) made it very difficult to achieve such returns that would be attractive for investors. The law intended to protect investors, though in the market conditions in Ukraine in the 2000s, the law became an obstacle to the development of professional investment industry. The diversification requirements are presented in Table 2.15.

[13] Open-end funds are the funds whose securities can be bought or sold by investors at any time. Interval funds are the funds whose securities can be bought by investors at any time but sold only during the specified in the prospectus periods (intervals). Closed-end funds are the funds whose securities can be bought from the fund at the opening of the fund. During the time of operation of the fund the securities of the fund can be traded in the stock market. In the end of the fund operation, the fund is obliged to buy back its securities from the investors. (Ukrainian Association of Investment Business).

Table 2.15. Diversification requirements set by the Law of Ukraine "About Institutions of Mutual Investment" (2001).

The table shows maximum proportions of each asset class that can be held in an open-end or an interval fund.

	2001	After alterations in 2009
Stocks of Ukrainian issuers	no more than 40%	no restriction
Stocks of foreign issuers	no more than 20%	no restriction
Corporate bonds	no more than 20%	no restriction
Municipal bonds	no more than 10%	no more than 40%
Government bonds	no more than 25%	no more than 50%
Money market instruments	no more than 30%	no more than 50% (together with bank metals)
Real estate	no more than 5%	no more than 10%
Bank Metals	Not allowed	-
Other securities	no more than 5%	no more than 20%

As explained by Victor Botte, bank deposits were the main competitors to the other investment choices in Ukraine. The deposit rates were very high (15-17%) and they had a guaranteed provision of up to UAH 15,000 (equivalent of about USD 3,000). Investors expected that higher risk of investment into a mutual fund should have been compensated by a return, which would be higher than the bank deposit rate. This is where the diversification requirements created limitations:

> “We need to guarantee our investors a significantly higher level of profitability than the bank deposit rate and be able to cover the portfolio management costs. Only stocks can give returns higher than bank deposits. The return on the most risky corporate bonds is 16-18%, less risky give 12-14%. Municipal bonds provide 10-11%, government bonds – 7-8%, their yield is lower than inflation[14].
> When you compose a portfolio, due to the diversification requirements you can invest only up to 40% in stocks, 20% - in corporate bonds, 30% - in bank deposits, and the residuary 10% are losing in advance. Taking all these into

[14] The inflation in Ukraine in 2006 was 11.6%.

> account, you must be sure that the returns from investment in stocks will cover all the expenses."

To the question of the author whether any capital can be invested in foreign stocks, Victor Botte added that the existing difficulties created by the foreign exchange regulations make investment funds refuse this option:

> "There is a norm that up to 20% can be invested in the stocks of foreign issuers. But this is problematic at the moment because of the difficulties created by the foreign exchange regulations. In order to carry out operations with foreign currency, a company should have a license from the Central Bank; this creates many restrictions and makes investment companies refuse buying foreign stocks."

Kinto was one of the pioneers in the fund management industry in Ukraine and became one of the leaders of the market. It is interesting that the company, despite all the difficulties and restrictions related to the mutual fund investment in Ukraine, did manage to earn above-deposit-rate returns for its investors. At the time of the interview (August 2006), Kinto had an open-end fund "Classical" (USD 2.4 mln. of assets under management in 2006, opened in July 2004) and an interval fund "Prosperity" (USD 1.7 mln. of assets under management in 2006, opened in September 2003). According to the end of 2006 results, fund "Classical" brought average annual return of 54.3%, while return in 2006 was 27.5%. Fund "Prosperity" brought average annual return of 73.1%, while return in 2006 was 46.0% (www.kinto.com). Index PFTS has brought a higher return in 2006 (41.3%) than the fund "Classical" and approximately the same return as the fund "Prosperity" though.

Due to a quite difficult task of being able to provide a rate of return on a diversified fund that would be attractive to general public, very few open-end and interval funds were created in Ukraine. In 2009, Verkhovna Rada (the Parliament of Ukraine) considerably weakened the diversification requirements, which is expected to contribute into the development of mutual investment industry. The new requirements are presented in Table 2.15.

Due to weaker diversification restrictions, the number of closed-end funds in Ukraine is significantly higher compared to the open-end funds. But it is found harder to attract individual investors into these funds.

At the same time, there are still some diversification restrictions even for the closed-end funds. Ukrainian legislation does not allow holding less than 70% in securities in a closed-end fund:

> "Russian legislation allows holding a part of the fund assets in cash, whereas Ukrainian does not. In crisis times we would have been able to sell stocks and hold cash for a while but we cannot do that; our legislation does not allow holding less than 70% in securities even in a closed-end fund. That is why we try to buy fundamentally undervalued stocks and do active management."

Due to less diversification requirements, a closed-end fund of Kinto "Synergy-2" (USD 10.8 mln. of assets under management in 2006) outperformed index PFTS in 2006 and has brought considerably higher returns than the open-end and the interval funds. Average annual return of "Synergy-2" was 61.6% since its opening in May 2005, and 65.2% according to the results of 2006 (www.kinto.com).

To summarize, in conditions of low liquidity and low level of property rights protection of minority shareholders, the development of Ukrainian professional investment industry was even more restrained by highly restricting portfolio diversification requirements for mutual funds set by Ukrainian legislation.

2.6. Relation of the Specific Features of the Ukrainian Stock Market to the Models Selected and the Results Obtained in the Thesis

Summary of the Specific Features of the Ukrainian Stock Market

- Ukrainian stock market is a dealership market where brokers post bid and ask quotes at which they are willing to trade. The market does not have market makers. Instead, multiple dealers facilitate the trades.
- Institutional investors prevail among the traders in the stock market; presence of private investors is very limited.
- Foreign institutions prevail among the traders in the stock market. Domestic industry of investment and pension funds is under developed and the funds play a minor role in the stock market trading. Among the domestic institutions, insurance companies and banks are the most active traders.
- Dominance of institutional investors in the market results in much larger, on average, trade sizes in the Ukrainian stock market compared to the trade sizes in the developed markets.
- Various market data is available in the Ukrainian stock market. The data is carefully gathered by the stock exchange PFTS and has a good quality.
- Free floats for blue chip companies are very low (about 4%). Large stakes in the Ukrainian public companies belong primarily to the financial industrial groups and the state.
- Ukrainian stock market has low liquidity.
- Informational transparency of Ukrainian public companies is low.
- Level of property rights protection was low till adoption of the new Law "On Joint Stock Companies" in 2008. System of legal enforcement is weak in Ukraine. This highly increases risks of investing into Ukrainian stocks.
- The level of corporate government of the Ukrainian public companies is low.

- Due to the low liquidity and low informational transparency of the Ukrainian stock market, majority of trades are negotiated over the phone before being performed through the electronic trading system.
- Due to the low free float, large trades are often negotiated directly with the block holders.
- Voluntary reporting of the third party trades (till May 2008) resulted in non-reporting of a part of the trades; because of this a part of the market information was lost for market participants/observers.

Relation of the Specific Features of the Ukrainian Stock Market to the Models Selected and the Results Obtained

The Ukrainian stock market is a dealership market where brokers post bid and ask quotes at which they are willing to trade. The presence of data on the quotations allowed us to use the benchmark method for estimation of the effective bid-ask spread in Chapter 4. An important benefit of the benchmark method is that it is simple, while allows finding reliable results. Another benefit of the benchmark method is that it allows estimating effective bid-ask spreads separately for trades of different sizes and directions (purchases or sales). Alternative methods, which are based on econometric models, such as Roll (1984), Glosten and Harris (1988), and Huang and Stoll (1997), either do not allow to estimate effective spread relative to the trade size and trade direction or require higher frequency of the data, which is not available for Ukraine due to the low liquidity of the market.

A specific feature of the Ukrainian stock market of prevalence of institutional investors among the traders in the stock market and mere presence of private investors had an important influence on the results in Chapter 4. The specific feature was reflected in much larger size of trades, on average, in the Ukrainian stock market compared to developed stock markets, in terms of both the number of stocks per trade and the trade value. Grouping of all Ukrainian trades into small, medium, and large based on the normal market size of the trade for each stock, resulted in that small Ukrainian trades could be compared to the medium-sized trades in developed markets, while medium Ukrainian trades – to large trades in developed markets, and large Ukrainian trades – to extra large trades in developed markets. When this specific feature was taken into account, the findings for the ratio of the effective bid-ask spreads for different trade sizes in Ukraine came in line with the findings in other literature.

A distinctive feature of the Ukrainian stock market is availability of various market data, which is carefully gathered by the stock exchange and has good quality. The data includes quoted bid-ask spreads and detailed stock-by-stock intra-day trading data. This allowed us to be able to estimate almost any liquidity measure developed in the literature. In Chapter 5 we chose to tests the efficacy of some of the most popular in the literature liquidity measures, such as quoted bid-ask spread, turnover, Amihud's measure, the proportion of zero daily returns, the proportion of no-trading days, and the volatility of return, for the Ukrainian data. Moreover, the availability of data on no-trading days allowed us to test the efficacy of the proportion of no-trading days liquidity measure, a new measure suggested in Bekaert et al. (2006) but not applied in the original study due to unavailability of the data needed. The measure proved to be one of the most efficient liquidity measures for the Ukrainian stock market.

Due to the unique feature of the Ukrainian stock market of low free floats for blue chip companies and higher free floats for second and third tier companies, turnover liquidity measure was found not to perform well for Ukrainian stocks.

Low liquidity of the Ukrainian stock market resulted in good applicability of the percentage of zero daily returns liquidity measure. This measure did not perform well at high liquidity markets (Bekaert et al. (2006)) because for highly liquid stocks zero-return days did not necessarily associate with no-trading and new orders for these stocks could be accommodated without any influence on price. On the other hand, this measure was found to perform well for emerging markets, including our findings for the Ukrainian stock market, since in low liquidity markets, arrival of any new trading volume is often seen as a sign of arrival of new information about a stock and often results in the price change.

As mentioned above, the Ukrainian stock market is a dealership market, where brokers post bid and ask quotes at which they are willing to trade and they revise the quotes based on their beliefs about the true market price and their desired level of the inventory holdings. Spread decomposition models of Stoll (1989), Glosten and Harris (1988), and Huang and Stoll (1997) were developed for markets with a similar market structure – the dealership market of Nasdaq and the hybrid market of NYSE (as well as many other spread decomposition models). This gives the grounds for applicability of the models for the Ukrainian stock market too, which is done in Chapter 6. (More details on the reasons of why the models were chosen for the research in the thesis are given in Chapter 6, Section 6.2, "Spread Decomposition Models Applied in the Thesis").

Ukrainian stock market is a multiple dealer market as opposed to NYSE where a few market makers have to facilitate trades in a stock. This specific feature of the Ukrainian stock market implies that Ukrainian brokers experience much less inventory pressure than the market makers in NYSE that are obliged to trade and to provide liquidity to the market. Ukrainian brokers have freedom to hold their inventory close to their desired level, which implies that inventory holding costs of Ukrainian brokers should be close to zero. This assumption allows us to find an important for our study result: to separate the asymmetric information cost component from the sum of the asymmetric information cost and inventory holding cost components provided by the estimation of the Huang and Stoll (1997) model.

High information asymmetry, a distinctive feature of the Ukrainian stock market, was found not to be reliably captured by the spread decomposition models. The estimate of the asymmetric information component of the bid-ask spread of 14-17% seems to be too low for a market with so high information asymmetry as Ukraine. The result is probably due to the over simplicity of the assumptions about the price development in the spread decomposition models applied. The models assume that the direction of previous trade is the only source of private information that brokers have. In the real world, brokers usually have other sources of private information such as, for example, personal contacts with company management, contacts with other parties who are close to company management, contacts in the companies' banks, etc. In Ukraine, where corporate governance rules and professional ethics are still often ignored, usage of these and other sources of private information is quite possible. Inflow of private information through such sources is not observed, and therefore spread decomposition models cannot capture it. The asymmetric information cost component of 14-17% seems to reflect only that part of private information, which is learned from the order flow. The findings of the spread decomposition models of low information asymmetry in Ukraine together with the specific feature of the Ukrainian stock market of the high information asymmetry, led us to a conclusion that the spread decomposition models applied in the study have low applicability in the emerging stock market of Ukraine.

2.7. Conclusion

The chapter has acquainted the reader with the Ukrainian stock market. It presented a brief history of the stock market development, described the market in the context of other Eastern European stock markets, and presented descriptive statistics of the largest stock exchange in Ukraine, PFTS.

Market capitalization of PFTS is quite high, USD 111.8 bln., number of listed companies accounts for 335. Though trading activity in PFTS is low with small free float being one of the most important reasons of it. The market is quite concentrated (market capitalization of the top-ten companies accounts for 45% of the total market capitalization) though fairly diversified by industry.

The large stakes in the Ukrainian public companies belong primarily to the financial industrial groups and the state. The investors into the free float are mainly institutions such as banks and insurance companies, while investment companies and private pension funds are not yet a prominent feature in the Ukrainian investment industry.

Securities market legislation is in a good compliance with international practice. Though company legislation until recently (October 2008) was weak. This caused considerable problems with corporate governance and property rights protection of minority shareholders. In addition to weak company legislation, Ukrainian securities market suffers from weak legal enforcement, both private and public.

Information transparency of Ukrainian public companies is low. Index of informational transparency estimated by Standard & Poors' and Financial Initiatives Agency for Ukraine was only 23.9% out of the highest possible score of 100%.

Ukrainian public companies have highly concentrated ownership structure. Out of 36 companies with the highest market capitalization and trading volume only 5 had dispersed ownership, while 6 were partially controlled (largest holding >25% but less than 50%), and 25 were controlled companies (largest holding >50%) (Table 2.11)

The main Ukrainian stock exchange PFTS is a dealership-type market. Multiple brokers post their quotes in an electronic trading system, which is viewed by market observers as highly transparent and effective. The depositary system is found compliant with the majority of international standards for clearance and settlement.

Though there is a significant problem with data reporting on PFTS as the trades performed by PFTS brokers with third party traders (not PFTS brokers) are not reported at the time of there execution but only on the next trading day before the opening of the trading session. These trades take a considerable part of the market and account for about 44% of PFTS total trading volume. As a result, a sizable part of executed trades are reported without the information about the actual time of their execution, which makes this part of the data lost for many kinds of the market microstructure studies.

Interviews conducted with the stock market practitioners supported the conclusions of other studies that some of the main problems of the Ukrainian stock market are weak company legislation, corrupt judiciary system, and low level of transparency of public companies. The interviews also revealed that in conditions of low liquidity and low level of property rights protection of minority shareholders, the development of Ukrainian professional investment industry was even more restrained by highly restricting portfolio diversification requirements for mutual funds set by Ukrainian legislation.

Chapter 3

Data

3.1. General Description of the Data

The dataset was obtained from PFTS Online, the official source of PFTS data. The dataset contains transaction prices and price quotations for all PFTS-listed securities, both real-time and historical.

In particular, the dataset identifies the following:

- the intraday best bid and ask quotes and quantities for each stock
- best closing bid and ask quotes and quantities for each stock
- Information about each trade, in particular, PFTS Code, which is stock identifier, trade price, trade quantity, date, and time of trade.

The author had access to PFTS Online from mid-November till mid-December 2006. PFTS Online contains data starting 1997, though until 2005 trading activity in the market was very low. Total volume of trading in PFTS in 2004 was only USD 206.8 mln., compared to USD 643.9 mln. in 2005 and USD 1,168.3 mln. in 2006. The number of actively traded companies until 2005 was very low too. Top-ten companies by trading volume took 80% of the total PFTS trading volume in 2004. This number decreased to 45.8% in 2005 and to 40.1% in 2006. Therefore, for our study we chose the data period from January 2005 to November 2006.

Many of the listed stocks in PFTS are very small (by market capitalization) and have low trading frequency. Therefore, out of all the listed stocks, which accounted for more than 260, we chose those stocks that had market capitalization of more than USD 10 mln. and at least a few trades per year during 2005-2006. This left us with 59 stocks.

The trading session in PFTS lasts from 11 a.m. till 5 p.m. From 9 a.m. till 11 a.m. trades with the non-members of PFTS and the trades of non-standard parameters are reported. These trades were normally executed during two previous days before the day on which they were reported. Since many parts of our study require to know the time of execution of a trade, the trades reported before 11 a.m. are excluded from the dataset. Exclusion of the trades has lead to the decrease of the number of observed trades in our dataset by 34.2%. To be more accurate, our study of liquidity (Chapter 5) requires data on all executed trades, therefore the trades reported before 11 a.m. are kept in the dataset for this chapter. Description of this dataset can be found in Chapter 5.

The datasets described below are employed in all other chapters: the study of the cost of trading (Chapter 4), the decomposition of the bid-ask spread (Chapter 6), and the study of portfolio returns net of the cost of trading (Chapter 7).

3.2. Correction for Outliers

Due to low trading frequency, volatility of stock returns in the Ukrainian stock market is quite high. For some stocks in certain periods it was recorded excessively high. For example, USCB price was very volatile in January 2006. Standard deviation of USCB daily return was 26.2% during this time, whereas during the other months of 2005-2006 it was 9.4%, on average. The outlying prices can present bias in the mean estimates of the effective bid-ask spread and in the estimated coefficients of the spread decomposition models. In order to find unbiased estimates of coefficients in our study, we correct our data for outliers. Mean return is taken as a basis for excluding the outliers because it allows to clean the data from the abnormal values of trade prices, which is needed for our study. The following rule is employed: for each stock we exclude all the trades whose return lies outside two standard deviations from the mean return for the stock. This rule also allows to clean our data from typing errors. Application of the rule has led to exclusion of 5.4% of all trades and left us with 11,297 trades executed with 59 stocks in 2005-2006. Also all the quotes were checked for the ask price to be greater than the bid price. No cases of the bid price to be greater than the ask price were identified.

3.3. Descriptive Statistics

During 2005-2006 the Ukrainian stock market did not experience any considerable shocks and had been gradually growing. Figure 3.1 shows the behaviour of the main Ukrainian stock market index, index PFTS, during this time.

Figure 3.1. Index PFTS in 2005-2006.

Table 3.1 presents descriptive statistics for our dataset. The descriptive statistics are computed based on the data corrected for outliers. Trading in PFTS is done in

Table 3.1. Descriptive statistics of the stocks in the dataset, 2005-2006.

Mean price is weighted by the number of trades for each stock.
Data is corrected for outliers. Companies are sorted by PFTS Code.

	Company Name	PFTS Code	Industry	MCap, USD, mln.	Mean Price, USD	Number of Trades	Volume Traded, USD, mln.	Average Volume per Trade, USD
1	Alchevsk Coke	ALKZ	Mining & Coke	72.30	0.34	33	0.28	8,648
2	Alchevsk Iron & Steel	ALMK	Metallurgy	2,534.38	0.24	145	35.43	244,653
3	Avdiyivka Coke	AVDK	Mining & Coke	644.40	3.33	254	11.65	45,842
4	Azot Cherkasy	AZOT	Chemical	181.14	1.84	46	4.46	97,839
5	Azovstal	AZST	Metallurgy	1,709.23	0.54	485	10.99	22,632
6	Raiffeisen Bank Aval	BAVL	Finance	1,184.68	0.08	538	47.24	87,760
7	Centerenergo	CEEN	Power Engineering	308.45	0.84	370	15.34	41,470
8	Donetskgirmash	DGRM	Mechanical Engineering	18.57	0.41	65	1.45	22,460
9	Donetsk Coke	DKOK	Mining & Coke	60.31	0.24	209	3.54	16,987
10	Donetsk Metal Rolling	DMPZ	Metallurgy	24.36	0.04	20	0.18	9,187
11	Kominmet	DMZK	Metallurgy	10.18	0.10	18	0.29	16,113
12	DniproAzot	DNAZ	Chemical	156.78	0.00	74	11.67	158,141
13	Dniproenergo	DNEN	Power Engineering	292.73	74.48	215	15.48	72,009
14	Dniprooblenergo	DNON	Power Engineering	225.93	37.58	118	4.71	39,746
15	DniproSpetsStal	DNSS	Metallurgy	178.59	166.09	136	7.01	51,687
16	Donbasenergo	DOEN	Power Engineering	139.29	5.89	196	6.98	35,638
17	Donetsk Metal Plant	DOMZ	Metallurgy	100.98	0.28	342	6.44	18,810
18	Druzhkivsky m-build	DRMZ	Mechanical Engineering	59.14	0.28	69	0.84	12,116
19	Dnipropetrovsk Pipe	DTRZ	Tube Rolling	60.12	56.92	320	11.01	34,423
20	Forum	FORM	Finance	257.37	6.96	18	0.75	41,439
21	Galnaftogaz	GLNG	Petrochemical	113.93	0.01	18	11.38	624,754

22	Galychyna Refinery	HANZ	Petrochemical	300.59	0.34	91	3.49	38,310
23	Svitlo Shakhtarya	HMBZ	Mechanical Engineering	22.59	0.20	44	0.64	14,607
24	Khmelnitskoblenergo	HMON	Power Engineering	37.52	0.28	28	2.24	79,219
25	Khartsyzk Tube	HRTR	Tube Rolling	202.36	0.37	8	0.11	13,946
26	Kyivenergo	KIEN	Power Engineering	169.16	1.56	179	7.37	41,088
27	AvtoKrAZ	KRAZ	Mechanical Engineering	104.13	0.10	26	0.73	28,473
28	Krymenergo	KREN	Power Engineering	43.03	0.25	90	3.69	40,880
29	ArcelorMittal Kryvyi Rih	KSTL	Metallurgy	2,966.60	0.77	113	2.59	22,974
30	Luganskteplovoz	LTPL	Mechanical Engineering	79.57	0.36	530	18.07	34,094
31	Megabank	MEGA	Finance	64.44	1.85	15	14.84	1,017,927
32	Ilyich Iron and Steel Works	MMKI	Metallurgy	1,954.81	0.58	461	7.46	16,191
33	Motor Sich	MSICH	Mechanical Engineering	198.43	95.37	264	8.84	33,467
34	Maruipol Heavy Machinery	MZVM	Mechanical Engineering	143.03	9.30	428	15.35	35,865
35	Nikopol Ferroalloy	NFER	Metallurgy	414.54	1.37	35	0.73	21,062
36	INTERPIPE Nyzhnodniprovsky Tube Rolling Plant	NITR	Tube Rolling	438.11	8.15	389	19.86	51,071
37	Novomoskovsk Pipe	NVTR	Tube Rolling	80.35	6.70	140	5.55	39,548
38	Poltavsky Iron Ore	PGOK	Mining & Coke	1,155.21	10.00	262	22.19	84,589
39	South Ore Mining and Processing Plant	PGZK	Mining & Coke	316.31	0.15	158	5.31	33,534
40	Rodovid Bank	RODB	Finance	51.47	513.89	5	0.27	49,248
41	Stakhanov Ferroalloy	SFER	Metallurgy	129.08	0.01	43	0.56	13,127
42	Komsomolets Donbasa	SHKD	Mining & Coke	64.24	0.19	46	1.29	27,677
43	Sumy Frunze	SMASH	Mechanical Engineering	249.51	3.51	403	14.23	35,337
44	Stirol	STIR	Chemical	534.38	19.74	273	10.20	37,328
45	Stakhanovsky Wagon	SVGZ	Mechanical Engineering	35.95	31.31	47	4.15	87,653

46	Turboatom	TATM	Mechanical Engineering	150.88	0.36	77	2.38	30,741
47	Ternopiloblenergo	TOEN	Power Engineering	10.20	0.17	8	0.25	30,652
48	Ukrnafta	UNAF	Petrochemical	2,455.80	45.11	624	56.73	90,918
49	Ukrsotsbank	USCB	Finance	1,406.68	0.38	316	18.25	57,750
50	Ukrtelecom	UTEL	Telecommunications	3,261.30	0.17	851	17.41	20,467
51	Yasynuvatsky m-build	YAMZ	Mechanical Engineering	39.10	1.71	11	1.00	91,674
52	Yasinivsky Coke	YASK	Mining & Coke	46.37	0.34	193	11.44	59,217
53	ZaporizhCoke	ZACO	Mining & Coke	162.08	1.36	148	3.17	21,334
54	Zakhidenergo	ZAEN	Power Engineering	371.32	29.09	363	14.41	39,737
55	Zaporizhzhya Aluminum	ZALK	Metallurgy	109.63	0.18	138	2.08	14,993
56	Zaporizhiaoblenergo	ZAON	Power Engineering	134.18	0.75	23	1.84	80,943
57	Zaporizhzhya Ferroalloy	ZFER	Metallurgy	157.56	0.13	148	5.62	38,080
58	Zhytomyroblenergo	ZHEN	Power Engineering	81.14	0.66	43	1.91	44,727
59	Zaporizhstal	ZPST	Metallurgy	135.95	1.16	585	15.26	26,103
	Total			**26,610.43**		**11,297**	**529**	**46,798**

This dataset is applied in Chapter 4, Section 4.4, Subsections "Quoted and effective bid-ask spread", and "Determinants of the bid-ask spread", and in Chapter 7.

Ukrainian currency, hryvnya, and all the estimations in the thesis are done in Ukrainian currency too. Though for the reader's convenience, all the monetary values in the descriptive statistics are stated in U.S. dollars. The exchange rate applied is 5.09 UAH/USD, which was an average official exchange rate during 2005-2006[15].

The companies in the dataset are of different sizes. The market capitalization of the companies varies from USD 10.2 mln. for DMZK to USD 3,261 mln. for UTEL. Altogether, the 59 companies account for USD 26.6 bln. in market capitalization, which is 72.7% of the total market capitalization of PFTS.

[15] National Bank of Ukraine data, www.bank.gov.ua

Average stock prices vary considerably across companies, from USD 0.005 for DNAZ to USD 514 for RODV. The reason for this is considerable differences in stocks' par values. The number of trades for each stock varies from 5 for RODV to 851 for UTEL.

Some of the companies have very low volume of trading, as, for example, HRTR, USD 0.11 mln., while others were traded much more heavily, as UNAF, USD 56.7 mln. Altogether, trading volume of 59 companies during 2005-2006 was USD 529 mln. and accounted for 58.3% of the total PFTS trading volume during the period.

Average volume per trade varied considerably across the stocks. Due to the prevalence of institutional trading in the Ukrainian stock market, average volume per trade in PFTS is quite large. Average volume per trade during 2005-2006 ranged from USD 8,648 for ALKZ to USD 1,017,927 for MEGA.

The number of trading days in 2005-2006 accounted for 471. The number of closing bid-ask quotes varies from 133 for SHKD and YAMZ to 471 for many other stocks. For some stocks the number of closing quotes is less than the number of trading days during the period of observation because the stocks came into listing in PFTS later than in January 2005.

3.4. Details on the Smaller Dataset of 15 Most Liquid Stocks

Some parts of the analysis in the thesis, such as study of the cost of trading for different trade sizes and trade directions and study of determinants of the bid-ask spread (Chapter 4), and application of the spread decomposition models (Chapter 6), require high frequency transaction data.

Out of 59 stocks, described above, we chose 15 most liquid – stocks with high market capitalization and high number of trades. The descriptive statistics for them are presented in Table 3.2. The stocks take 38% of the total PFTS market capitalization and 33% of the total PFTS trading volume. Market capitalization among the chosen 15 stocks ranges from USD 60 mln. for DTRZ to USD 3,261 for UTEL. The number of transactions for the stocks ranges from 262 for PGOK to 851 for UTEL. Average volume per trade is USD 43,866 and ranges from USD 16,191 for MMKI to USD 90,918 for UNAF.

Table 3.2. Descriptive statistics for 15 most liquid stocks, 2005-2006.

Mean price is weighted by the number of trades for each stock. Companies are sorted by PFTS Code.

	Company Name	PFTS Code	Industry	MCap, USD, mln.	Mean Price, USD	Number of Trades	Volume Traded, USD, mln.	Average Volume per Trade, USD
1	Azovstal	AZST	Metallurgy	1,709.23	0.54	485	10.99	22,632
2	Raiffeisen Bank Aval	BAVL	Finance	1,184.68	0.08	538	47.24	87,760
3	Dniproenergo	DNEN	Power Engineering	292.73	74.48	236	16.99	72,009
4	Dnipropetrovsk Pipe	DTRZ	Tube Rolling	60.12	56.92	320	11.01	34,423
5	Luganskteplovoz	LTPL	Mechanical Engineering	79.57	0.36	530	18.07	34,094
6	Maruipol Heavy Machinery	MZVM	Mechanical Engineering	143.03	9.3	428	15.35	35,865
7	INTERPIPE Nyzhnodniprovsky Tube Rolling Plant	NITR	Tube Rolling	438.11	8.15	389	19.86	51,071
8	Poltavsky Iron Ore	PGOK	Mining & Coke	1,155.21	10	262	22.19	84,589
9	Sumy Frunze	SMASH	Mechanical Engineering	249.51	3.51	403	14.23	35,337
10	Stirol	STIR	Chemical	534.38	19.74	273	10.2	37,328
11	Ukrnafta	UNAF	Petrochemical	2,455.80	45.11	624	56.73	90,918
12	Ukrsotsbank	USCB	Finance	1,406.68	0.38	347	20.04	57,750
13	Ukrtelecom	UTEL	Telecommunica tions	3,261.30	0.17	851	17.41	20,467
14	Zakhidenergo	ZAEN	Power Engineering	371.32	29.09	363	14.41	39,737
15	Zaporizhstal	ZPST	Metallurgy	135.95	1.16	585	15.26	26,103
	Total			**13,477.60**		**6,634**	**309.99**	**46,728**

This dataset is applied in Chapter 4, Section 4.4, Subsections: "Relation of the Cost of Trading to the Trade Size", "Difference in the Cost of Trading for Sales and Purchases", and "Determinants of the bid-ask spread", and in Chapter 6.

3.5. Assigning of the Trade Direction

The trade direction (purchase or sale) is not identified in the PFTS data, though these data are necessary for estimating effective bid-ask spreads (Chapter 4) and for applying trade-indicator spread decomposition models (Chapter 6).

Two approaches are used in literature to infer the direction of a trade: (i) comparison of the trade price to adjacent trades (techniques commonly known as "tick tests") or (ii) comparison of the trade price to the midquote of the prevailing bid/ask quote (known as Lee and Ready (1991) procedure).

The tick test is a technique which infers the direction of a trade by comparing its price to the price of the preceding trade. The test classifies each trade into four categories: an uptick, a downtick, a zero-uptick, and a zero-downtick. A trade is an uptick (downtick) if the price is higher (lower) than the price of the previous trade. When the price is the same as the previous trade (a zero tick), if the last price change was an uptick, then the trade is a zero-uptick. Similarly, if the last price change was a downtick, then the trade is a zero-downtick. A trade is classified as a buy if it is an uptick or a zero-uptick; a trade is classified as a sale if it is a downtick or a zero-downtick. The tick test was the primary method of identification of trade direction in earlier literature when quote data was not available (for example, Dann et al. (1977), Holthausen et al. (1987)). The analysis of efficiency of tick test has proven high ability of this method in identifying trade direction(Lee and Ready (1991)).. 74% of transactions in the Australian Stock Exchange were found to be correctly classified (Aitken and Frino (1996)). The primary limitation of the tick test is its relative imprecision if it has been a long time since the last trade, which is a particular concern for the stocks with low trading frequency (there are many stocks with low trading frequency in the Ukrainian stock market).

Later, when quoted bid-ask spread data became available, a new method of identifying buy and sale trades was suggested, which is usually referred to in literature as the Lee and Ready (1991) procedure. The method assigns "sale" direction to the trades that took place at a price lower than the midpoint of the prevailing bid/ask quotes and "buy" direction to the trades that took place at a price higher than the midpoint of the prevailing bid/ask quotes. This method is often given preference in recent literature. Ellis et al. (1999) found that 81.4% of Nasdaq trades were correctly identified by Lee/Ready method. Lee and Radhakrishna (2000) used a unique dataset (TORQ), which allowed to trace the true trade direction for many trades. The study found that for about 40% of the executed trades the direction of trade could not be unambiguously identified as either purchase or sale. The major source of the ambiguity was in the stopped trades and market crosses[16]. Though, in those cases where trades could have been unambiguously classified, Lee/Ready method had a 93% overall agreement rate with TORQ classifications.

In our study, Lee/Ready methodology is used for identifying the trade direction in the Ukrainian stock market:

$$\begin{aligned} Trade_{i,t} &\equiv SELL \quad \text{if } P_{i,t} < MQ_{i,t} \\ Trade_{i,t} &\equiv BUY \quad \text{if } P_{i,t} > MQ_{i,t} \end{aligned}$$

Where $P_{i,t}$ is the price of the trade for a stock i at time t and $MQ_{i,t}$ is the midquote for a stock i at time just before time t. The midquote is calculated as an average between the best bid and the best ask quotation issued at a time just preceding the trade.
If a trade took place at the midquote, we cannot identify whether it was a purchase or a sale and therefore exclude it from the estimation. 5.9% of observations (after correction for outliers) were excluded due to this reason.

[16] A NYSE specialist may stop a market order, guaranteeing by this execution at the stop price (the prevailing quote) while attempting to execute the order at a better price. The subsequent execution of a stopped market order is difficult to classify unambiguously as either a buy or a sell. Market cross is a market order matched against another market order. Market crosses are also difficult to classify unambiguously since both sides of the trade can be deemed to have initiated the transaction.

A laborious process of matching trades with preceding quotes for 2005-2006 data was carefully done in Ryzhkov (2007). Yuriy Ryzhkov has kindly provided the author with the matched data.

Each trade was matched with the closest in time bid/ask quote preceding the trade. For some stocks on some days the best quote issued by a broker did not change for a few hours. In these cases long time will be documented between a trade and the issuance of preceding quote.

For 0.2% of all trades the closest previous quote was the closing quote on the previous day; majority of these trades were executed in the first forty minutes after opening of the trading session. For the trades and quotes executed/issued on the same day, average time between the trade and the issue of the closest quote preceding the trade was 1 hour and 7 minutes. Minimum time was 0 minutes, while maximum time was 5 hours and 59 minutes. Standard deviation of the average time was 1 hour and 36 minutes.

59% of all trades were matched with preceding quote with a difference in time of 30 min. or less.

3.6. Division of Stocks Into Groups Based On Trade Size

Certain parts of the cost of trading study (Chapter 4) and the study of decomposition of the bid-ask spread (Chapter 6) require division of trades into groups by trade size.

Two different measures of trade size are often applied in the market microstructure literature. The U.K. studies tend to divide trades into size groups based on the relative trade size. As a basis, the normal market size is taken. According to the London Stock Exchange definition, the normal market size (NMS) for a given stock is 2.5% (or 1/40th) of the average daily trading volume over the prior twelve months (Hansch et al., 1999). The size of each trade is related to the normal market size of a trade for a stock (Hansch et al. (1999), Bernhardt et al. (2005), Naik and Yadav

(2003)). The U.S. studies usually divide trades into size groups based on the absolute trade size. This can be either the number of stocks per trade (Lee (1993), Huang and Stoll (1996)) or dollar value of a trade (Stoll, 2000).

The number of stocks per trade seems to be an inappropriate measure of trade size in the Ukrainian stock market. The median trade size over 2005-2006 varies from 200 stocks per trade for DNEN to 665,850 stocks per trade for BAVL (Table 3.3). Such a big difference in the size of the median trade is driven by considerable differences in stock prices. For example, average stock price for DNEN was USD 74.5, while for BAVL it was much smaller, USD 0.08. This suggests that a trade with the same number of stocks can be small for one company though large for another company and this approach to defining trade size does not seem to be appropriate for Ukraine.

The definition of the trade size based on the value traded was applied in Ryzhkov (2007). It will be discussed below.

We have chosen to define trade sizes based on the relative size of trades. PFTS does not define the normal market size. Median trade size (number of shares traded) is seen as an appropriate measure of the normal market size for a stock. Relative trade size for each trade is calculated as a ratio of the size for this trade (number of shares traded) to the normal trade size for the stock. Trades executed in 2005 are related to the median trade size for each stock during 2005. Trades executed in 2006 are related to the median trade size for each stock during 2006.

Average value of the relative trade size varied from 3 to 5 NMS for the majority of the stocks. Therefore we set the following rule of division of the stocks into size groups: small trades are the trades of less than 2 NMS, medium trades are the trades of 2 NMS or more but less than 6 NMS, and large trades are the trades of 6 NMS or more. The same division into groups relative to the normal market size was used in Hansch et al. (1999).

In Ryzhkov (2007) the stocks were divided into size groups based on the volume of each trade in monetary terms. The division was based on the Ukrainian brokers' view that a large trade in PFTS is one of at least UAH 1 mln. (about USD 200,000). Ryzhkov (2007) considered small trades as those of less than UAH 0.1 mln, medium as those of UAH 0.1 mln - UAH 1 mln, and large as those of more than UAH 1 mln. The approach assigned small size to 63% of all trades, medium size – to 26% of all trades, and large size – to 11% of all trades. Our division based on the relative trade size has given a similar breakdown: small, medium-sized, and large trades took 69.7%, 19.4%, and 11% of all trades respectively.

Table 3.3. Median trade size and the number of small, medium, and large trades for Ukrainian stocks during 2005-2006.

Company	Median trade, number of shares traded	Median trade, volume traded, USD	Number of small trades (<2NMS)	Number of medium-sized trades (≥2 NMS and <6NMS)	Number of large trades (≥6 NMS)	Total
AZST	19,000	10,233	408	107	34	549
BAVL	665,850	52,566	287	75	78	440
DNEN	200	14,897	150	45	29	223
DTRZ	500	28,462	217	81	26	325
LTPL	41,190	14,961	428	108	57	593
MZVM	1,000	9,299	323	101	43	468
NITR	3,000	24,446	278	94	57	429
PGOK	3,000	30,009	206	50	43	298
SMASH	3,000	10,540	318	87	45	450
STIR	500	9,868	194	61	43	297
UNAF	800	36,091	485	81	103	670
USCB	25,000	9,511	162	54	42	257
UTEL	70,000	12,187	605	176	50	831
ZAEN	500	14,544	274	55	43	372
ZPST	10,000	11,564	460	160	62	681
Total		**19,279***	**4,794**	**1,333**	**755**	**6,882**
% of Total			**69.70%**	**19.40%**	**11.00%**	**100.00%**

* Average volume of median trades

The distribution of the number of trades by trade size for each stock is presented in Table 3.3. The volume traded for each trade size is presented in Table 3.4. As expected, small trades are the most numerous in number, 4,794, though take the smallest share by volume, 13.9%. Medium trades accounted for 1,333 in number and took 16.6% of total volume. Large trades were the least numerous in number, 755, though took the largest share by volume, 69.5%.

Table 3.4. Total volume traded during 2005-2006 for small, medium, and large trades.

Company	Small trades (<2NMS), USD	Medium trades (≥2 NMS and <6NMS), USD	Large trades (≥6 NMS), USD	Total volume, USD
AZST	2,599,233	3,386,880	5,001,555	10,987,668
BAVL	2,631,101	3,632,316	40,979,978	47,243,395
DNEN	1,735,975	2,179,733	13,078,398	16,994,106
DTRZ	2,432,809	3,205,129	5,367,626	11,005,564
LTPL	2,502,004	2,856,766	12,715,408	18,074,178
MZVM	2,209,224	2,964,042	10,180,838	15,354,103
NITR	2,496,630	4,428,330	12,938,741	19,863,700
PGOK	3,056,485	3,667,782	15,465,813	22,190,080
SMASH	2,516,712	3,015,895	8,694,097	14,226,704
STIR	1,068,018	1,546,904	7,585,356	10,200,279
UNAF	6,773,476	5,174,183	44,780,205	56,727,865
USCB	1,683,565	3,099,299	15,256,429	20,039,293
UTEL	5,308,011	5,130,337	6,973,705	17,412,054
ZAEN	2,360,682	2,069,938	9,975,037	14,405,656
ZPST	3,732,591	5,125,349	6,406,687	15,264,627
Total	**43,106,516**	**51,482,882**	**215,399,874**	**309,989,273**
% of Total	**13.9%**	**16.6%**	**69.5%**	**100.0%**

3.7. Limitations of the Data

PFTS data has some limitations. First, it does not reflect all the trades executed with PFTS-listed securities. Ukrainian legislation does not require that all trades executed with an exchange-listed security to be reported to the stock exchange. As a result, some trades with PFTS-listed securities can be performed over the counter with no reporting to PFTS. There is official data on the total volume of over the counter trades executed with all stocks (both listed and not listed) though no separate data on the volume of these trades with the exchange-listed stocks. Based on our knowledge of the Ukrainian stock market, we tend to conclude that majority of trades with the stocks in the free float are executed with the intermediation of PFTS brokers, while large blocks of stocks held by business groups can be bought or sold off-exchange, through direct negotiation between the interested parties.

Second, some of the trades executed by PFTS brokers with PFTS-listed stocks were not reported to PFTS. Trades, which were performed directly between a PFTS broker (a member of PFTS) and an outside investor (non-member of PFTS) (further referred to as third party trades) were not obligatory (until May 2008) to be reported to PFTS. Brokers could have voluntarily reported these trades to PFTS at a specially allotted time (before the opening of the trading session (before 11 a.m.) during the next two trading days after the trade execution). As a result a portion of the third party trades, which stayed unreported, are lost for our study. Though we expect that percentage of such trades is not high. Despite reporting of the third party trades was not obligatory, brokers had a motivation to report the trades. Higher trading volume increases the position of a broker in the rating of PFTS brokers, which is published by PFTS monthly and is based on the volume traded by each broker. This is the only rating of brokers issued in Ukraine and a higher position in the rating is viewed as an important constituent of a broker's reputation. Taking into account that the reported third party trades take quite a large portion of the total trades (44.2% of the total PFTS volume and 34.8% of the total PFTS number of trades), we tend to conclude that majority of the third party trades are actually reported to PFTS. This means that the dataset for our liquidity study (Chapter 4, the dataset includes both third party trades and the trading session trades) reflects actual PFTS trading volume quite accurately.

Another important limitation of the data is that reported data on the third party trades do not contain actual time of trade execution but only the time of trade reporting. Our study in Chapters 4 and 6 requires data on the actual time of trade execution. Therefore all the trades reported before 11 a.m. are lost for the study, which considerably decreases our dataset.

As we do not include the reported third party trades in our study in Chapters 4 and 6, in order to conclude whether our estimates found for the trades performed during the trading session can be attributed to the Ukrainian stock market as a whole, it is important to compare the properties of the third party trades with the properties of the trades performed during the trading session. Table 3.5 reports the descriptive statistics for the two sets of trades.

Sales dominate among the third party trades. The share of sales is 70%, while share of purchases is 30%. The shares for the trading session trades are 57% and 43% respectively. Dominance of sales among the third party trades is not surprising. (Trade direction is determined from the point of view of an investor. If investor sells stocks to a broker, a trade is a sale; if an investor buys stocks from a broker, a trade is a purchase). A broker can buy for his own inventory the stocks that an investor wants to sell, though if an investor wants to buy stocks and the broker does not have the stocks in his inventory, he cannot sell the stocks to investor without trading with other brokers. If a broker needs to trade with another broker to execute a trade, the trade will not be a third party trade anymore but will need to be a trading session trade. Therefore third party sales are more likely to occur than third party purchases.

In terms of trade size, third party sales have a very similar structure to the trading session sales. For example, small, medium, and large third party sales took 63.8%, 22.1%, and 14.1% respectively of the total number of the third party sales, while small, medium, and large trading session sales took 68.0%, 21.5%, and 10.5% respectively of the total number of the trading session sales. The proportions based on the volume traded are also similar for the third party sales and the trading session sales. This suggests that the third party sales and the trading session sales are similarly distributed in terms of trade size and trade volume and, therefore, the estimation results found based on the trading session sales can be extrapolated on all the sales in PFTS.

In terms of trade size, the structure of the third party purchases is quite different from the structure of the trading session purchases. Proportion of small third party purchases is much less than the proportion of small trading session purchases. The opposite is true for large trades. Large trades take 25% of the total number of the third party purchases, while large trades take only 11% of the total number of the trading session purchases. In terms of volume traded, the ratios are 85% and 69% respectively. Moreover, average volume of a large third party purchase is USD 0.41 mln., while average volume of a large trading session purchase is smaller, USD 0.29 mln. The finding is surprising as we did not expect that proportion of large trades among the third party purchases will be higher than for the trading session trades. We expected that the third party trades should be executed from the brokers' own inventory, and since inventory of a broker is quite limited, small trades should dominate among the third party purchases. The result points at that the third party trades are not necessarily executed from the brokers' own inventory. Though the trades are executed not through transacting with the other brokers. Probably, having received a large buy order, a broker can contact the owners of the large blocks of shares directly and execute the order with them directly, without a need to transact with other PFTS brokers.

So, if the distribution of sales in terms of trade size is similar for the third party trades and the trading session trades, the respective distribution of purchases is quite different. Third party purchases have less of small trades and more of large trades in their structure compared to the structure of the trading session trades. Large trades are done through negotiation, and trade prices for block trades can differ considerably (in either direction) from the prices for trades of normal size. Since large third party purchases are, on average, larger than large trading session purchases and their proportion in the structure of the third party trades is higher than in the structure of the trading session trades, the estimation results found for the large trading session purchases should not necessarily hold for the large purchases in PFTS as a whole.

Since the third party trades were not required to be reported to PFTS, we expected that the number of reported large purchases will be quite low, since these trades are viewed as the those that have the highest information content. Though a large number and volume of the reported third party trades suggests that brokers do not tend to hide the trades. One of the reasons of it can be a delay allowed for reporting the trades. At the time when the trades are reported (one or two trading days after the day of the trade execution), the value of information may have decreased.

To summarize, a portion of trades with PFTS-listed stocks can be executed over-the-counter, without reporting to PFTS. There is no data available on the number and volume of the trades. The trades executed with a PFTS broker and a third party are not reported to PFTS at the time of trade execution but can be voluntarily reported during the next two trading days after the opening of the trading session. Taking into account that: (i) brokers have a motivation to report the trades, (ii) the proportion of the reported third party trades is quite high (44% of the total PFTS trading volume), and (iii) the proportion of reported large purchases is quite high (large purchases are considered the most informative trades, their reporting may be not in the interest of brokers), we tend to conclude that majority of the third party trades are reported to PFTS. The distribution of sales is very similar for the third party trades and for the trading session trades, so the estimation results found for the trading session sales can be quite confidently extended on all PFTS sales. Though among the third party purchases, the proportion of large trades is higher than that among the trading session purchases. Moreover, third party large purchases are, on average, larger, than the trading session large purchases. So, the estimation results for the large trading session purchases have to be extended on all PFTS large purchases with caution.

Table 3.5. Distribution of trades reported before the opening of the trading (from 9 a.m. till 11 a.m.) and during the trading session (from 11 a.m. till 5 p.m.)

		Sales					Purchases					All trades	% of all reported trades
		Small	**Medium**	**Large**	**Total**	**Sales as % of all trades**	**Small**	**Medium**	**Large**	**Total**	**Purchases as % of all trades**		
Reported from 9 a.m. till 11 a.m.	Number of trades	1,666	576	369	**2,611**	*70.0%*	557	281	279	**1,116**	*30.0%*	**3,727**	*34.8%*
	%	*63.8%*	*22.1%*	*14.1%*	***100.0%***		*49.9%*	*25.1%*	*25.0%*	***100.0%***			
	Volume traded, USD mln.	12.57	22.94	90.66	126.17	*48.7%*	6.01	13.49	113.58	133.08	*51.3%*	**259.24**	*44.2%*
	%	*10.0%*	*18.2%*	*71.9%*	***100.0%***		*4.5%*	*10.1%*	*85.3%*	***100.0%***			
Reported from 11 a.m. till 5 p.m.	Number of trades	2,710	858	417	**3,985**	*57.0%*	2,184	489	334	**3,007**	*43.0%*	**6,992**	*65.2%*
	%	*68.0%*	*21.5%*	*10.5%*	***100.0%***		*72.6%*	*16.3%*	*11.1%*	***100.0%***			
	Volume traded, USD mln.	25.19	32.34	131.89	189.43	*58.0%*	20.73	21.28	95.29	137.31	*42.0%*	**326.73**	*55.8%*
	%	*13.3%*	*17.1%*	*69.6%*	***100.0%***		*15.1%*	*15.5%*	*69.4%*	***100.0%***			
All reported trades	Number of trades											**10,719**	*100%*
	Volume traded, USD mln.											**585.97**	*100%*

Chapter 4

The Cost of Trading in the Ukrainian Stock Market

4.1. Introduction

Usually the decision to buy or sell a particular asset is based on the expectations about the future performance of this asset. But buying a stock with high expected returns might result in considerably worse performance than expected if trading costs for this stock are high. In the same way, a stock with lower expected gross returns may perform better than its rival stocks if the cost of trading for this stock is lower. This makes trading costs an important factor to consider when a portfolio is constructed or portfolio rebalancing decisions are made. This is especially important for active institutional investors who frequently transact in stocks.

Empirical literature has shown that the cost of trading a stock depends not only on individual features of a stock but also on the characteristics of a trade such as trade size and trade direction. The cost of transacting small and large quantities of the same stock can differ substantially. In the order-driven markets (like NYSE, Euronext Paris, Tokyo Stock Exchange) it is found that it is more expensive to execute a large order, while small orders are done at a lower cost (Lee (1993), Harris and Hasbrouck (1996), and Bernhardt and Hughson (2002)). On the contrary, in the dealership markets (like Nasdaq and London Stock Exchange) large orders are found less expensive to execute than small orders (Reiss and Werner (1996), Huang and Stoll (1996), and Hansch et. al (1999)). It is important for traders to predict the

cost of trading for the quantity they intend to trade in order to keep their strategy profitable. In this chapter, we study the cost of trading separately for small, medium-sized, and large orders in the stock market of Ukraine. Such an important for the stock market participants study has not been done for Ukraine before.
Literature has shown that the cost of trading is not symmetrical for institutional buy and sell orders. Buy orders were found more expensive in rising markets (Holthausen et al. (1987), Chan and Lakonishok (1993), Keim and Madhavan (1998), and Chiyachantana et al. (2004)), while in falling markets, sell orders were found more expensive (Chiyachantana et al. (2004) and Bikker et al. (2007)). Most previous studies in the area of the cost of trading were conducted using data primarily from rising market conditions. In this chapter, we investigate the cost of trading separately for rising and falling market conditions and add more evidence to the literature to confirm the asymmetry documented in Chiyachantana et al. (2004). Also, we add to knowledge by estimating how the cost of buy and sell orders differs in falling and rising markets in the Ukrainian stock market, which has not been done before.

The cost of trading differs across the stocks. What factors are the determinants of the width of the bid-ask spread for a stock? The importance of various stock characteristics, in particular stock risk and liquidity, in determining the width of the bid-ask spread is studied in the last section of the chapter. In conducting the study we follow the framework of Stoll (2000). Understanding the determinants of the bid-ask spread can be helpful in predicting the cost of trading for the stocks and designing stock selection procedures and trading strategies that lower transaction costs and, as a result, maximize net returns on an equity portfolio.

A study of the cost of trading is important not only for investors and traders but also for exchanges, brokers, and regulators. The cost of trading is an important determinant of the quality of a stock market. Brokers regularly conduct the cost of trading studies to document their performance. Regulators often try to promote policies that lower transaction costs. Therefore, the study is expected to be of value for the PFTS stock exchange and for the Ukrainian stock market regulator, the State Commission for Securities and Stock Market.

The chapter is organized as follows. Section 2 provides a review of literature, Section 3 presents the methodology and data, Section 4 discusses results, and Section 5 concludes.

4.2. Review of Literature

Analysts usually distinguish two components of the cost of trading: explicit and implicit costs. Explicit costs are direct costs of trading and include broker commissions and taxes. Implicit costs are not directly paid by traders but indirectly increase the cost of equity trading. They include bid-ask spread, price impact costs, delay costs, and opportunity costs.

In the NYSE, brokers that act as agents and are intermediaries between traders and market makers earn commission. Market makers act as principals. They work for their own account and earn the difference between bid and ask prices.

In the Ukrainian stock market, as opposed to the NYSE, brokers act as both agents and principals. When a broker needs to trade with other brokers in order to execute an order of his client, he acts as an agent. In this case he earns commission. Though commission in the Ukrainian stock market is not directly stated. A broker suggests a price to his client that already includes commission and the client has either accept the price, or negotiate it, or switch to another broker. When a broker executes a client's order or an order from another broker from his own inventory, the broker acts as a principal and earns the bid-ask spread.

Quoted Bid-Ask Spread

Suppliers of liquidity, such as market makers, stand ready to trade at prices they quote. The demanders of liquidity are active traders who place market orders to trade immediately. Immediate sales are usually done at the bid price, and immediate purchases – at the ask price. The spread between the bid and the ask is one of the measures of the cost of trading.
Bid-ask spread arises because stock market intermediaries have to cover the costs of doing their business. Microstructure literature has shown that the quoted spread reflects a number of costs: i) order processing costs (Demsetz (1968), Stoll (1985)), ii) inventory holding costs (Stoll (1978), Amihud and Mendelson (1980), Ho and Stoll (1981)), and iii) asymmetric information costs (Glosten and Milgrom (1985), Copeland and Galai (1983)); also bid-ask spread can reflect monopoly or cartel power of the liquidity suppliers.

The *order processing cost* is the oldest cost identified in literature. Early writers, as Demsetz (1968), viewed the bid-ask spread as a payment for services provided by suppliers of liquidity. The supply of liquidity, like any other business activity, requires real economic resources – labour and capital – to execute trades and theses resources must be paid for. In other words, the order processing cost refers to different kinds of costs related to order execution such as office rent, salaries to the employees, costs of finding counterparts for a trade, etc.

Some authors argue that market makers use spread to compensate for the risk they take due to holding some unwanted *inventory* positions. Because of their role of liquidity suppliers, market makers have to constantly post quotes and must be ready to play as counterparts for each trade; as a result, they falling an inventory risk due to positions away from their desired target inventory level. These positions can lead to losses of market makers in case of adverse price movement. The relationship between the spread and inventory costs has been studied, among others, by Stoll (1978), Ho & Stoll (1981) and Amihud & Mendelson (1980).

The existence of the *information asymmetry cost* grounds on the idea that a market maker always loses to informed traders, but recovers his losses with gains he earns from transactions with uninformed traders. With the presence of asymmetric information, a supplier of liquidity faces the danger that a bid or ask will be accepted by someone with superior information. Informed traders buy at the ask if they have information justifying a higher price, and they sell at the bid if they have information justifying a lower price. When the information becomes known, informed traders gain at the expense of the suppliers of immediacy. The equilibrium spread is expected to cover such losses. As Bagehot (1971) first noted, if suppliers of immediacy are to avoid losses, uninformed traders must pay a spread sufficient to compensate suppliers of immediacy for the losses to informed traders. The relationship between information asymmetry and the bid-ask spread has been the subject of numerous studies (Copeland & Galai (1983), Glosten & Milgrom (1985), Easley & O'Hara (1987), and others).

Market power has long been recognized as a potential source of the bid-ask spread. Dealers with market power will increase the spread relative to their costs. The cost of trading in this setting is the real resources extracted as monopoly rents to accomplish trades (Stoll, 2000).

Values of the estimates of the quoted spread vary widely across the stocks of various liquidity as well as across different stock exchanges of the world. For example, in NYSE, relative quoted bid-ask spread (spread as a percentage of the midquote) varies from 0.5% for the most liquid (largest market capitalization) stocks to 4-6% for the most illiquid (smallest market capitalization) stocks (Loeb (1983), Keim (1989), and Huang and Stoll (1996)). The relative quoted spreads for liquid stocks (25 highest market capitalization stocks on each exchange) across a wide selection of developed and emerging stock markets were estimated in Jain (2003), the results are presented in Table 4.1. As the table show, the cost of trading is smaller in developed markets and larger in emerging markets. Out of 51 exchanges studied in Jain (2003), quoted bid-ask spread was the highest in the Ukrainian stock market (15.3%).

Table 4.1. Estimates of relative quoted bid-ask spread for liquid stocks for a selection of stock markets around the world during January-April 2000 found in Jain (2003).

Developed Markets		Emerging Markets					
		Eastern Europe		East Asia		Latin America	
US, NYSE	0.20%	Poland	1.15%	China	0.20%	Argentina	1.74%
US, Nasdaq	0.41%	Czech Republic	3.66%	Taiwan	0.35%	Mexico	1.76%
France	0.40%	Hungary	4.55%	Hong Kong	0.59%	Colombia	3.08%
U.K.	0.88%	Russia	5.38%	Philippines	1.97%	Peru	4.35%
Germany	0.91%	Ukraine	15.30%	Indonesia	6.01%	Brazil	7.34%

Effective Bid-Ask Spread

For several reasons quoted bid-ask spread is not an accurate estimate of the true cost of equity transacting. First, quoted bid-ask spread may overstate the true spread because trades are often executed inside the quoted spread. Second, both the bid and ask prices have a systematic tendency to rise (fall) following a purchase (sale), so the true round-trip trading costs are less than the quoted spread suggests. Third, large block transactions are often prearranged and need not occur at the quoted bid or ask prices.

Effective spread equals quoted spread when all purchases occur at the bid and all sales occur at the ask. When trades take place within the spread (if price improvement is suggested to traders), the effective spread paid by traders is smaller than quoted spread. In the same way, when larger orders are executed at the prices outside the quoted bid-ask spread, effective spread is larger than quoted spread.

Effective spread is the estimate of the cost of trading, which is most commonly used by practitioners. Retail traders primarily compare their execution prices against the bid and offer prices that prevailed when the orders were submitted (Harris, 2003).

Figure 4.1 shows the relation between quoted spread, effective spread, and price improvement.

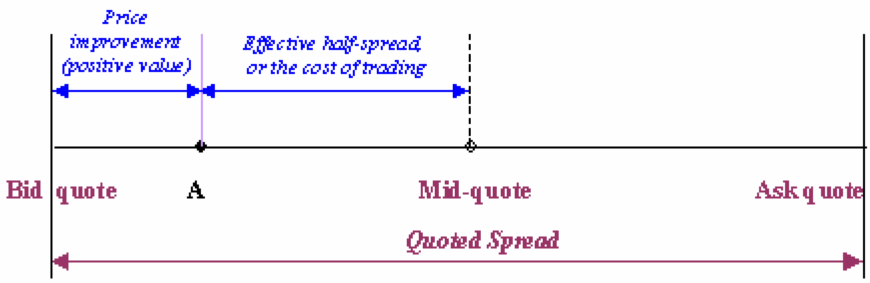
There is a number of methods of estimating effective bid-ask spread. The benchmark method suggests estimating effective bid-ask spread as a doubled deviation of the trade price from the prevailing mid-quote at the time of trade, which is the benchmark (Naik and Yadav (2003) and Stoll (2000)). The limitation of this method is that it requires bid and ask quotes data, which are not always available.

The covariance method of estimating effective bid-ask spread suggested by Roll (1984) infers implied bid-ask spread (a concept in Roll (1984) similar to effective spread) directly from a time series of trade prices. The idea behind the Roll model is that market prices are not independent because the recorded transactions occur at either bid or ask price. This implies that one would find negative serial dependence in observed prices when a specialist is involved in transactions. Roll (1984) has shown that the covariance between successive price changes equals one-half of the squared implied spread with a negative sign, which implies that implied spread equals $2\sqrt{-cov}$, where *cov* is the serial covariance of successive price changes. Roll interpreted the implied spread as a measure of the spread at which transactions actually occur. Using daily data for NYSE and American Exchange stocks for the period 1963 to 1982 Roll found that implied spread equals 0.30% or about 8.9 cents on a $30 stock.

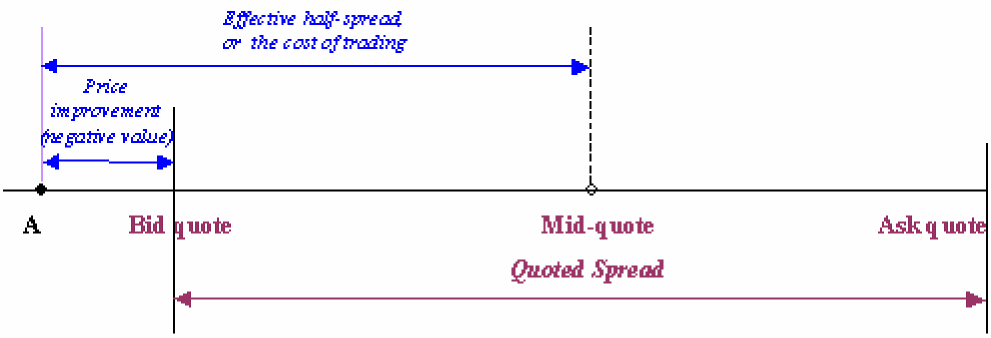
Stoll (1989) and Huang and Stoll (1995)) criticize Roll's measure of spread for not taking into account permanent price changes following a trade, which is correct only in the absence of asymmetric information and inventory costs in the market. Huang and Stoll (1996) find that for more recent data on the NYSE (1991), the Roll implied half-spread is 3.4 cents, which is less than the effective half-spread calculated using the benchmark method. This reflects the fact that quotes on the NYSE do permanently change in response to trades, consistent with the presence of asymmetric information.

Figure 4.1. Quoted spread, effective spread, the cost of trading, and price improvement for a hypothetical trade A. (A similar figure can be drawn for a purchase).

a) Trade A is executed within the quoted spread



b) Trade A is executed outside the quoted spread



The models of Huang and Stoll (1997) and Madhavan, Richardson, Roomans (1997) suggest a simple and effective method of estimating effective bid-ask spread from the time series of trade prices. The basic idea of the approach is to regress the price change from the successive transactions on the change in the trade direction variable (which equals one if trade was a purchase and minus one if trade was a sale). The models also allow to estimate the components of the bid-ask spread. This approach is explained in detail in Chapter 6.

Empirical findings in literature show that effective spread is usually less than quoted spread. Lee (1993) found that for 500 NYSE common stocks during 1988-1989 effective spread was by as much as 50% smaller than quoted spread. Huang and Stoll (1997) estimated that effective spread for a sample of 20 stocks in the Major Market Index in 1992 ranged from a low of 9.9 cents per share for IBM to a high of 13.5 cents per share for Procter and Gamble. The quoted spreads for the companies were 15.9 cents and 19.6 cents respectively. Stoll (2000) estimated that on NYSE/AMEX in December 1997-February 1998 the overall effective spread was 11.16 cents per share, while quoted spread was 15.74 cents per share. In Nasdaq, the spreads were 21.40 cents per share and 25.14 cents per share respectively.
On the London stock exchange, effective spread for the FTSE-100 stocks in August 1994 was 0.54% while quoted spread was 1.25% (Hansch et al. (1999)). On Euronext Paris, effective spread for 55 largest stocks during the first six months of 2001 was estimated at 0.250%, while quoted spread at 0.259% (Gajewski and Gresse (2007)).

Price Impact

There are other frictions that increase the cost of equity trading. Many researchers have documented that large equity trades move stock prices in the direction of the trade. This incurs additional cost of trading for the buyers/sellers of large block of stocks. The cost is usually called the price impact cost, or the market impact cost. The price impact is the deviation of the transaction price from the "unperturbed price" that would have prevailed in the market if the trade had not occurred. The approach to measuring price impact is similar to the benchmark method for measuring effective bid-ask spread, where the benchmark price is a measure of unperturbed price. Therefore, price impact for large, or institutional, trades is often considered as the cost of trading for these trades.

Investors can incur very substantial price impact costs when they trade large amounts of thinly traded stocks or relatively large blocks of heavily traded stocks, irrespective of whether the trades are liquidity or information motivated.

Price impact cost is difficult to measure because the unperturbed price is not observable. Many different measures of the unperturbed price exist in literature, among them three main groups can be distinguished: pre-trade, post-trade, and mixed benchmarks. A pre-trade benchmarks used in literature are i) a stock price observable a few seconds before a block trade (Smith et al. (2001)), ii) a price at the moment when the block order was passed to the broker (Bikker (2007)), iii) a previous day closing price, or closing price 1 week or 3 weeks before the block trade (Keim & Madhavan (1996)). Post-trade benchmarks such as the day of the trade closing price and the post trade day's closing price were applied in Beebower and Priest (1980). A mixed benchmark such as weighted average of the pre-trade and post-trade prices was used for estimating price impact in Berkowitz et al (1988).

Empirical findings document various values of the price impact cost. Bikker (2007) found that a big Dutch pension fund during the first three months of 2002 incurred the price impact costs of 0.2% for purchases and 0.3% for sales. Keim & Madhavan (1996) report that the price impact of the block trades of an American passive investment management firm during 1985-1992, estimated based on 1 day, 6 days and 22 days pre-trade benchmarks were 1.60%, 2.82%, and 4.66% respectively for purchases, and -1.50%, -4.32%, and -7.40% respectively for sales.

Estimation of the price impact costs is out of the scope of this chapter. We focus at studying effective spread rather than the price impact of large trades. Therefore the extensive price impact literature is not discussed in further detail. Though we find it important to present the basic information about the price impact measurement because this measure of the cost of trading is used in some of the literature, which we refer to later in this chapter.

Delay Costs and Opportunity Costs

Delay costs reflect the risk of adverse price movements that can occur when trading is postponed.

The estimates of this cost can rarely be found in literature due to the difficulties with obtaining the necessary data, namely the date of the decision to trade.

Opportunity costs represent the cost associated with missed trading opportunity. Many trades are motivated by information and the information has value that decays over time. Unexecuted orders lay on the trader the cost of unused information. An order may be left unexecuted because the trader cannot locate the shares to complete the order or the price has moved out of the range of prices the portfolio manager is willing to pay. For example, Treynor (1981) suggested to measure the cost of trading as a difference in performance between a portfolio based on the actually made trades and a hypothetical portfolio whose returns are computed based on the assumption that trades were executed at prices observed at the time when the decision to trade was made.

Unfortunately, similar to the case with estimating the delay cost, researchers rarely have sufficiently detailed data to measure the opportunity cost.

Other Measures of the Cost of Trading

Lesmond et. al (1999) suggested a new approach to measuring the cost of trading. The model developed in the paper is based on the adverse selection framework of Glosten and Milgrom (1985) and Kyle (1985) and suggests that the marginal informed investor does not transact until his anticipated profit from the trade exceeds his cost. The transaction cost represents a limit that must be exceeded before the security's return will reflect new information. A zero return is observed every time the anticipated return does not cover the transaction cost.

The menu of the cost of trading measures is supplemented with realized spread and perfect foresight spread (Huang and Stoll (1996)), adverse selection spread (Naik and Yadav (2003)), traded spread (Stoll (2000)) and other measures. These measures try to capture special aspects of the process of trading or estimate the cost of trading from the view of a broker rather than a trader.

Effects of Trade Size

Theoretical literature has predicted and empirical literature has shown that there exists a relationship between the cost of trading and the trade size.

For NYSE, Keim and Madhavan (1996) documented that the percentage costs for the largest trades are much higher than for smaller trades (1.16% and 0.32% correspondently). A similar pattern was found in Huang and Stoll (1996), large trades were executed with the effective spread of 8.5 cents per share, while small trades with the effective spread of 7.7 cents per share. Lee (1993) found that large trades were executed at on average 3 cents per share higher price than small trades. The fact that large orders receive worse prices in NYSE was also documented in Bernhardt and Hughson (2002), Glosten and Harris (1988), Easley, Kiefer, and O'Hara (1997), Lee (1993), and Harris and Hasbrouck (1996).

Traditional explanation for the proportional relationship between trade size and the cost of trading is that large trades impose large inventory exposure on the market maker and therefore require additional compensation, which is accomplished by the trade clearing at a worse price. A difficulty with such explanation is that a market maker rarely takes the other side of such trades, indeed he might not participate in the trade at all, as many large trades bypass the specialist completely and are done through syndication (O'Hara (1998), p. 70).

Development of information-based models in 1980s gave a new insight on the possible reason of higher cost of trading for larger trades. Large traders have trouble finding liquidity because large liquidity suppliers suspect that block traders have superior information (Seppi (1990), Barclay and Warner (1993), and Hansch et al. (1999)). There are two main reasons behind this suspicion. First, large traders can afford to invest more in research and therefore have higher chances to know more about a stock. Second, it is probable that the reason behind trading a large block of shares is a desire to maximize profit from information that the trader has. Therefore, in order to protect themselves from losses, brokers demand price concessions when trading with block traders.

Block liquidity suppliers demand these price concessions for the same reason that market makers include an asymmetric information component in their bid-ask spread. Block liquidity suppliers suspect that, in particular, large anonymous traders are well informed (informed traders prefer to be anonymous in order not to get a reputation of informed traders and therefore not to be suggested higher, information-corrected prices in future) (Harris (2003), p. 326).

It is interesting that relationship between trade size and the cost of trading that is opposite to the one found for NYSE, was documented for the dealership type markets like London Stock Exchange (LSE) and Nasdaq. For the London Stock Exchange, Reiss and Werner (1996) found that larger trades receive better prices (only for unusually large orders the cost of trading starts to grow with the trade size). Hansch et. al (1999) found that in the LSE price improvement is smaller for small trades (0.073%), larger for medium-sized trades (0.083%) and the largest for large trades (0.089%).

On Nasdaq, Huang and Stoll (1996) found that small trades were executed with effective half-spread of 19.9 cents per share, while large trades, with effective half-spread of 13.5 cents per share.

The empirical findings in literature suggest that in the markets with open limit order book structure (like NYSE and Euronext Paris) the cost of trading grows in the trade size, while in the markets with dealership structure (like London Stock Exchange and Nasdaq) the cost of trading falls in the trade size.

According to conventional wisdom, in dealership markets, large trades are also expected to be more information motivated than small trades. But the asymmetric information theory fails to explain the relationship between the cost of trading and the trade size in dealership markets. There should exist some sources of concession for larger trades that are able to overweigh the asymmetric information considerations for these trades in dealership markets. The differences in dealer behaviour are found to be the reason of better price for larger trades in dealership markets (Christie and Schultz (1994), Christie, Harris, and Schultz (1994), Bernhardt et. al (2005), and Rhodes-Kropf (2005)).

Bernhardt et. al (2005) studies closely larger trades in LSE and argues that structural features of dealership markets provide an explanation of the smaller cost of trading for larger trades. The key structural feature is the timing of competition for an order. In an open limit order book market, like NYSE or Paris Bourse, price competition is simultaneous. All market participants willing to fill their orders bid simultaneously. The liquidity provider with the best quoted price fills the order. In contrast, in a traditional dealer market, even though the information on dealers' quotes is open, brokers themselves choose a dealer with whom to trade and then negotiate the final price with him[17]. During the negotiation stage there are no other dealers to spur the competition. If broker is unhappy with the price, he can either accept the price but change dealers in the future, or can find another dealer and start the negotiation process again. This process is time consuming and can result in information leakage, which can reduce the profit from trading a stock. There is also no guarantee that the new dealer will offer a better price. The lack of temporal competition is supported by the fact that brokers typically do not even first contact the dealer with the best quote.
Even though an individual order is not exposed to competition, Bernhardt et al. (2005) argue that there still exists intertemporal competition and that this

[17] In a traditional dealer market trading is organised in the following way: a trader submits an order to a broker and a broker executes it through a dealer; broker is an agent, who does not trade for his own account and executes orders for his clients, whereas dealer trades for his own account.

competition generates the negative relationship between the trade size and the cost of trading. The broker's equilibrium strategy is to switch dealers if, for a given order size, he does not get sufficient price improvement. The dealer's problem is to weigh two revenue opportunities and choose the one, which will maximize his revenue. First opportunity is to suggest no price improvement to the broker and receive a higher one-time profit, and the second opportunity is to suggest enough price improvement to the broker and keep getting revenue from trading with the broker in the future.

Bernhardt et. al (2005) tests the predictions of their model using a sample of 25 FTSE 100 stocks in 1991. The study is possible because the data set allows to identify brokers and dealers both over time and across stocks, and hence to track trades by a particular broker across dealers. The results show that price improvement offered on each trade i) rises with the value of the relationship, and ii) holding the relationship fixed, falls with the current order size.

The results indicate that London dealers screen broker identities and that it is not order size per se but rather the enduring relationship that determines the price improvement offered. With that, if relationship is kept fixed, the relation between the cost of trading and the order size is the same as in the open limit order market structure. Altogether, this evidence indicates that enduring trading relationships are primary to understanding pricing and trading in a traditional dealership market.

A similar explanation of price improvement in dealership market is suggested in Rhodes-Kropf (2005). The model of Rhodes-Kropf (2005) assumes that some customers can make counteroffers to the posted quotes. Those customers who can negotiate may be larger, own a negotiation technology, have lower discount rates, posses greater skill, and so forth, but they do not necessarily have less or more information than a customer who cannot negotiate. Therefore dealers bid below their true value, leaving the surplus up for negotiation. Since customers have negotiation power, brokers cannot avoid suggesting them price improvement. In case of not suggesting a price improvement to a customer with market power, the broker will lose this customer. Small customers are unlikely to have market power and trade at the quoted prices. Larger customers negotiate price improvement and trade at a better than quoted price.

At the same time, in the dealership markets, information contents of trades has the same influence on the bid-ask spread as in the open limit order book markets. Information motivated trades are expected to be more expensive than uninformed trades. Informed traders has to stay anonymous and therefore trade at quoted prices. Uninformed traders submit to examination from their broker and receive a price improvement (for details on how examination can be done, see Harris (1993), pp. 11-22). Seppi (1990) noted that with negotiated improvements the transaction is not anonymous. In order to secure their price improvement in the future, repeat customers have to stay anonymous when they trade on information or they will not be trusted and suggested a price improvement in the future otherwise. Therefore, when motivated by information, repeat customers stay anonymous and trade at the quotes. Barclay and Warner (1993) and Hansch et al. (1999) also argue that dealers examine customers to asses their information. So, informed customers remain anonymous and trade at the quotes, while the uninformed submit to examination and receive a price improvement. An increase in the fraction of informed customers widens bid-ask spread as in a standard asymmetric information model.

To summarize, in the order driven markets, traders cannot be examined. Trade size is viewed as a sign of the information content of a trade. As a result, larger orders tend to be executed at worse prices than smaller orders. In the dealership markets, traders are examined for the information content of their trade. Uninformed traders submit to examination and receive price improvement. Informed traders stay anonymous and trade at quoted prices. The value of price improvement that a broker agrees to provide depends on how much the broker values relationship with the trader. Normally, relationships with the traders with larger orders are considered more valuable since they bring more business to their brokers. So, larger trades in the dealership markets receive more price improvement and are executed at better prices than smaller trades.

That spreads could vary across trade sizes reveals a difficulty to measuring the cost of trading: there is no one market price for trading a stock. Examining only the small-trade spread cannot provide a good indication of the cost of trading in a market. Therefore, the spreads for various trade sizes have to be studied in order to get a fuller picture of the cost of trading in a market.

Difference in the Cost of Trading for Sales and Purchases

Empirical research in finance documents an asymmetry in the cost of trading between buyer- and seller-initiated *institutional* trades with many studies showing that institutional purchases are more expensive than institutional sales.
Researchers have found that block purchases have a larger permanent price impact than block sales (Holthausen, Leftwich, and Mayers (1987, 1990), and Gemmill (1996)). The same result was documented for institutional purchases and sales (Chan and Lakonishok (1993), Chan and Lakonishok (1995), Keim and Madhavan (1998) (with an exception for the largest trades)).
Majority of literature attributes the asymmetry to higher portion of informed trading in institutional purchases than in institutional sales. Kraus and Stoll (1972) noted that "blocks are sold not bought" pointing at a higher information content of purchases, which prompts institutional traders to split their block purchase orders into smaller parts in order to reveal less information and cause less adverse stock price movement. Similarly, Keim and Madhavan (1996) points that purchases are more likely to be based on private information because they create new long positions. Chan and Lakonishok (1993) argue that institutional investor typically has limited alternatives to sell an asset since the number of stocks in his portfolio is limited, and therefore the decision to sell does not necessarily convey negative information. In contrast, the choice of buying a specific stock out of virtually all the

stocks traded in the market, is more likely to convey positive firm-specific information.

Saar (2001) develops a theoretical model that goes further in explanation of the asymmetry. The model relates the cost of institutional trading to the underlying economic environment and demonstrates that a stock's history of price run-ups and run-downs influences the asymmetry. The model predicts that purchases have greater price impact than sales following a long period of price run-ups. The opposite is true after a series of price run-downs.

The idea of Saar (2001) is further developed in Chiyachantana et al. (2004). The study suggests that the cost of trading is higher for institutional purchases when the market condition is rising, while when the market condition is falling, sales are more expensive than purchases. Due to their large sizes, institutional trades tend to be affected by market conditions and pay a higher premium for liquidity when they trade on the same side of the market. In a rising market, buy orders are likely to be an evidence of a shift to a higher expected equilibrium price. Therefore, suppliers of liquidity are cautious of buy orders and increase the prices in the face of a strong buying interest. Though suppliers of liquidity are not so cautious about the institutional sell orders in a rising market condition and therefore do not decrease the prices as much when they face a selling interest. When the market condition is falling, the situation is the opposite.

Chiyachantana et al. (2004) examine two distinct calendar periods, four quarters of 1997 and first quarter of 1998 (the rising phase) for 39 countries and first three quarters of 2001 (the falling phase) for 36 countries. Price impact in the study is defined in a few different settings depending on the benchmark price. The benchmarks include previous day closing price, the price prevailing at the time the institutions release an order to a trading desk (a benchmark, which is the closest to the benchmark in this study), and a volume-weighted average price for a day. The empirical results confirm the hypothesis that in the rising (falling) markets the cost of trading for purchases (sales) is greater than that for sales (purchases). The finding is robust to the use of all alternative measures of price impact. In the rising market condition, the price impact (with benchmark as the price prevailing at the time the institutions release an order to a trading desk) of institutional purchases was 0.49%, whereas the price impact of institutional sales was 0.31%. In the falling market condition they were 0.13% and 0.53% respectively. Institutions pay for consuming liquidity when they buy in rising markets and sell in falling markets. On the contrary, when trading against the market, institutions effectively provide liquidity and, therefore, face lower cost of trading. This is despite the fact that institutional decisions are quite evenly split between purchases and sales in both periods (Chiyachantana et al. (2004)).

Indeed, the studies that documented higher cost of trading for purchases than for sales (Keim and Madhavan (1998), Chan and Lakonishok (1993), and Chan and Lakonishok (1995); similar to Chiyachantana et al. (2004), the studies applied either pre-trade benchmark, or mixed, or both) used the data from the periods when the market condition was rising.

A study of the cost of trading for a Dutch pension fund during falling market of the first quarter of 2002 (Bikker et al. (2007)) found that sales were more expensive than purchases (0.3% and 0.2% correspondently), which is consistent with the predictions in Chiyachantana et al. (2004). (Bikker et al. (2007) applies a similar to Chiyachantana et al. (2004) benchmark price, which is the price at the moment, when the order was passed to the broker).

Determinants of the bid-ask spread

Empirical findings in literature document that there are considerable differences in the bid-ask spreads of the stocks within a stock market as well as across stock markets (Loeb (1983), Keim (1989), Huang and Stoll (1996), and Jain (2003)). A number of studies investigate the factors that determine the width of the bid-ask spread for a stock. Stoll (2000) hypothesize that the bid-ask spread depends on the factors related to a stock's liquidity and risk. Liquidity related factors considered in the study are daily dollar trading volume, number of trades per day, and firm size. Increase in any of them is expected to increase liquidity of a stock and therefore to narrow its bid-ask spread. Risk of a stock is measured in Stoll (2000) by stock return variance and stock price (stocks with high return variance and low price tend to be riskier). Increase in risk for a stock is expected to widen the stock's bid-ask spread because of the higher probability of losses brokers can incur if they hold a risky stock in their inventory.

Stoll (2000) runs a cross-sectional regression of the quoted bid ask spread on five determinants for 3890 NYSE/AMEX and Nasdaq stocks and finds highly significant and consistent results. Every coefficient has its expected sign and is significantly different from zero. The explanatory variables are able to explain more than 60% of the cross-sectional variance in the bid-ask spreads. Referring to previous literature, Stoll (2000) concludes that the relationship has changed little over time and adds: "The empirical relation is very strong… Few empirical relations in finance are this strong."

Naik and Yadav (2003) study the difference in spreads for the London Stock Exchange stocks before and after market reform and run a regression similar to that in Stoll (2000). The number of explanatory variables in the regression is restricted to three: the volume of trading for a stock, stock price, and stock variance. Naik and Yadav (2003) run the regression for 76 stocks over three three-months periods of 1994, 1996, and 1998 and find that all the coefficients have their expected signs and are significantly different from zero; more than 50% of the differences in the bid-ask spreads before and after the reform is explained.

The cost of trading in Euronext Paris and London Stock Exchange is studied in Gajewski and Gresse (2007). Having found significant differences in the cost of trading of the matched stocks in the two exchanges, Gajewski and Gresse (2007) study the economic factors and institutional specifics that best explain the differences. Similar to Stoll (2000), the study employs determinants of the bid-ask spread such as trading volume, number of trades per day, floating market capitalization for a stock, return variance, and stock price. Also, following the predictions of Hasbrouck and Sofianos (1993) and Kavajecz (1999), imbalances between purchases and sales are added.

Gajewski and Gresse (2007) employ data for 55 pairs of matched stocks over 6 months of 2001 and find that trading volume, return variance, and order imbalances have their expected signs and are significantly different from zero. Whereas, as opposed to Stoll (2000), floating market capitalization, stock price, and number of trades per day were found insignificantly different from zero. The explanatory power of the regression is high with the adjusted R-squared of 58.8%.

In what follows, I am going to examine several aspects of the cost of trading that the studies that I have just explained consider. The aspects of the cost of trading will be examined for the stocks in the Ukrainian stock market.

4.3. Methodology and Data

Our analysis of the cost of trading includes estimation of the quoted bid-ask spread, effective bid-ask spread (following the benchmark method), and price improvement.

The relative quoted bid-ask spread is defined as:

$$QS_{iT} = \frac{A_{iT} - B_{iT}}{(A_{iT} + B_{iT})/2} \qquad (4.1)$$

Where QS_{iT} is the relative quoted bid-ask spread, A_{iT} is the best quoted closing ask price for a stock *i* on the day T, and B_{iT} is the best quoted closing bid price for a stock *i* on the day T.

Average relative quoted spread for each stock is calculated as average of the daily values over the period of observation.

Since the bid-ask quotes data are available for the Ukrainian stock market, we chose to apply the benchmark method for estimation of the effective bid-ask spread. Effective half-spread for a sale trade is defined as:

$$ES_{it}^{sale} = \frac{MQ_{it} - P_{it}}{MQ_{it}} \qquad (4.2)$$

Where ES_{it}^{sale} is the effective half-spread for a sale trade for a stock *i* at the time *t*, P_{it} is the trade price for a stock *i* at the time t, and $MQ_{it} = (A_{it} + B_{it})/2$ is the quote midpoint prevailing several minutes/hours before the trade (for more details on matching trade prices with the preceding midquotes, see Chapter 3)[18].

Effective half-spread for a purchase is defined as:

$$ES_{it}^{purchase} = \frac{P_{it} - MQ_{it}}{MQ_{it}} \qquad (4.3)$$

Where $ES_{it}^{purchase}$ is the effective half-spread for a buy trade for a stock *i* at the time *t*, P_{it} is the trade price for a stock *i* at the time *t*, and $MQ_{it} = (A_{it} + B_{it})/2$ is the quote midpoint prevailing several minutes/hours before the trade (for more details on matching trade prices with the preceding midquotes, see Chapter 3)[19].

[18] In our dataset intraday quotes are available only for the stocks with high liquidity. For the stocks with medium and low liquidity, for effective spread calculation, best closing quotes are taken instead of intraday quotes.
[19] In our dataset intraday quotes are available only for the stocks with high liquidity. For stocks with medium and low liquidity, for effective spread calculation, best closing quotes are taken instead of intraday quotes.

Average effective half-spreads for sales and purchases for each stock are calculated as average of the individual estimates over the period of observation.
Average effective spread is found as the sum of the average effective spread for sale trades and average effective spread for buy trades.

Price improvement for a sale trade is defined as:

$$PI_{it}^{sale} = \frac{P_{it} - B_{it}}{B_{it}} \tag{4.4}$$

Where PI_{it}^{sale} is the price improvement for a sale trade for a stock *i* at the time *t*, P_{it} is the trade price for a stock *i* at the time t, and B_{it} is the best quoted bid price for a stock *i* prevailing several minutes/hours before the trade (for more details on matching trade prices with the preceding midquotes, see Chapter 3).

Price improvement for a purchase is defined as:

$$PI_{it}^{purchase} = \frac{A_{it} - P_{it}}{A_{it}} \tag{4.5}$$

Where $PI_{it}^{purchase}$ is the price improvement for a buy trade for a stock *i* at the time *t*, P_{it} is the trade price for a stock *i* at the time t, and A_{it} is the best quoted ask price for a stock *i* prevailing several minutes/hours before the trade (for more details on matching trade prices with the preceding midquotes, see Chapter 3).

Definition of the rising, falling, and neutral market conditions

For estimation of the effective bid-ask spread and price improvement in different market conditions, the 2005-2006 period is divided into three sub-periods relative to whether market condition was rising, falling, or neutral.

According to the Vanguard Group, while there is no agreed-upon definition of a falling market, one generally accepted measure is a price decline of 20% or more over at least a two-month period (or decline of 0.33%, on average, per day).

Ukrainian stock market is far not that active as NYSE. If we follow the Vanguard Group rule, the majority of periods would be regarded as a neutral market condition. Therefore, we modified the rule and considered market condition as falling (rising) if for at least 25 consecutive days there was a clear declining (growing) trend with average daily decline (growth) of the index during this period of at least 0.15%.

The main index of the Ukrainian stock market is index PFTS. Based on the values of the index and according to the rule described above, during 2005-2006 market was in the rising condition for 290 days, in the falling condition for 220 days, and in the neutral condition for 127 days. The PFTS index over the period of observation (2005-2006) is depicted in Graph 3.1 (Chapter 3). Description of each of the periods is presented in Table 4.2.

Table 4.2. Descriptive statistics for rising, falling, and neutral market condition sub-periods within the period of observation.

Market condition	Period order in time	Start date	End date	Number of days in the period	Start of the period index value	End of the period index value	Change of the index	Average daily change of the index
Rising	2	06/04/05	10/05/05	34	278.1	317.2	14.1%	0.41%
Rising	4	22/06/05	14/09/05	82	194.0	360.1	85.6%	1.04%
Rising	7	17/01/06	12/05/06	115	345.8	464.8	34.4%	0.30%
Rising	10	03/08/06	29/08/06	26	379.1	425.6	12.3%	0.47%
Rising	12	28/09/06	31/10/06	33	394.0	423.3	7.4%	0.23%
Total for Rising				**290**				
Falling	1	13/01/05	05/04/05	82	346.6	278.1	-19.8%	-0.24%
Falling	3	11/05/05	21/06/05	40	317.2	294.0	-7.3%	-0.18%
Falling	5	15/09/05	24/10/05	39	360.1	330.1	-8.3%	-0.21%
Falling	8	13/05/06	15/06/06	32	464.8	374.3	-19.5%	-0.61%
Falling	11	30/08/06	27/09/06	27	425.6	394.0	-7.4%	-0.27%
Total for Falling				**220**				
Neutral	6	25/10/05	16/01/06	81	330.1	345.8	4.8%	0.06%
Neutral	9	16/06/06	02/08/06	46	374.3	379.1	1.3%	0.03%
Total for Neutral				**127**				

4.4. Estimation and Discussion of Results

Quoted and effective bid-ask spread

Table 4.3 reports average quoted and effective bid-ask spreads for a wide sample of Ukrainian stocks. The estimations are done based on the dataset for 59 Ukrainian stocks over 2005-2006. Descriptive statistics of the data are presented in Chapter 3. The quoted bid-ask spread varies from 4.9% for UTEL to 129.5% for HRTR. For the group of top-15 stocks by quoted spread (the group considered as the group of most liquid Ukrainian stocks) quoted bid-ask spread is 8.8%. The cost of trading for liquid

Table 4.3. Quoted and effective bid-ask spreads for Ukrainian public companies in 2005-2006.

Quoted bid-ask spread is found by applying Formula (4.1). Effective bid-ask spread is found as a sum of formulas (4.2) and (4.3). The estimations are done based on the dataset for 59 Ukrainian stocks over 2005-2006.

	Company	Quoted bid-ask spread			Effective bid-ask spread		
		Value	St. err.	Obs.	Value	St. err.	Obs.
1	UTEL	4.88%	0.15%	470	3.16%	0.10%	800
2	UNAF	5.56%	0.26%	470	2.20%	0.10%	587
3	ZAEN	7.54%	0.25%	470	3.23%	0.17%	341
4	NITR	7.66%	0.24%	471	3.79%	0.23%	366
5	ZPST	8.33%	0.52%	365	3.66%	0.14%	550
6	MMKI	8.53%	0.31%	470	5.32%	0.23%	433
7	KSTL	8.63%	0.33%	305	3.86%	0.33%	106
8	MZVM	8.79%	0.42%	397	5.10%	0.22%	402
9	DNSS	8.82%	0.33%	284	5.37%	0.41%	128
10	STIR	9.07%	0.26%	470	5.13%	0.30%	257
11	AZST	9.19%	0.26%	470	5.01%	0.20%	456
12	DTRZ	10.40%	0.58%	313	3.89%	0.24%	301
13	CEEN	10.70%	0.37%	471	4.63%	0.24%	348
14	MSICH	11.58%	0.41%	471	5.74%	0.39%	248
15	DOEN	12.22%	0.30%	471	5.50%	0.37%	184
16	DNON	13.11%	0.54%	471	5.22%	0.46%	111
17	NVTR	13.59%	0.39%	471	7.47%	0.43%	132
18	SMASH	14.14%	1.08%	469	6.13%	0.41%	378
19	DOMZ	14.33%	0.42%	470	9.11%	0.35%	322
20	KIEN	14.37%	0.34%	471	7.62%	0.34%	169
21	DNEN	14.50%	0.45%	471	4.66%	0.28%	202
22	BAVL	14.74%	0.63%	470	4.32%	0.18%	506
23	LTPL	15.53%	1.01%	471	6.14%	0.36%	498
24	RODB	17.48%	1.15%	151	8.82%	2.00%	5
25	ZACO	18.95%	0.98%	396	10.06%	1.17%	140
26	DGRM	19.21%	0.61%	185	8.35%	0.83%	61
27	ZFER	20.57%	0.55%	470	11.87%	0.76%	139
28	GLNG	22.04%	1.02%	416	17.18%	3.77%	17
29	PGOK	23.22%	1.31%	469	8.42%	0.60%	247
30	YASK	24.21%	1.35%	469	8.66%	0.63%	182
31	SHKD	24.29%	1.84%	133	12.19%	1.27%	44
32	PGZK	25.27%	0.86%	284	12.71%	1.12%	149
33	ZAON	25.56%	0.67%	222	11.14%	1.91%	21
34	ZALK	28.70%	1.04%	465	13.79%	0.91%	130

35	DKOK	31.00%	1.52%	373	13.09%	0.86%	196
36	DRMZ	31.43%	0.82%	256	8.88%	0.74%	65
37	TATM	34.50%	0.91%	470	14.21%	1.67%	73
38	KRAZ	35.97%	2.04%	222	17.47%	2.62%	24
39	FORM	36.18%	1.78%	222	13.29%	1.98%	17
40	AVDK	37.28%	2.05%	470	8.05%	0.52%	239
41	NFER	39.63%	0.73%	471	18.45%	1.84%	33
42	YAMZ	40.24%	1.66%	133	11.72%	1.74%	10
43	HANZ	41.80%	1.05%	457	25.25%	2.02%	86
44	DNAZ	46.66%	1.80%	448	25.51%	1.69%	69
45	MEGA	53.28%	2.49%	169	29.58%	6.41%	14
46	AZOT	57.30%	1.72%	344	16.06%	2.19%	43
47	ALMK	62.02%	2.82%	428	25.18%	2.62%	136
48	DMPZ	66.47%	1.62%	201	40.44%	5.46%	19
49	USCB	67.97%	2.79%	438	14.16%	1.19%	297
50	SFER	78.69%	1.27%	466	33.42%	2.22%	40
51	ZHEN	84.29%	2.64%	470	19.27%	2.83%	40
52	HMBZ	86.45%	2.05%	284	23.36%	1.86%	41
53	KREN	87.37%	2.67%	470	23.22%	2.16%	85
54	HMON	104.28%	0.98%	471	53.49%	5.19%	27
55	SVGZ	104.34%	2.53%	353	48.94%	11.61%	45
56	DMZK	104.39%	2.12%	381	25.47%	6.30%	17
57	TOEN	120.83%	1.63%	248	81.68%	10.04%	8
58	ALKZ	123.95%	2.93%	241	36.34%	5.42%	31
59	HRTR	129.50%	2.30%	249	55.51%	12.71%	8

stocks in Ukraine exceeds that of all developed and most emerging stock markets. It is 44 times higher than in NYSE, 10 times higher than in LSE, more than 2 times higher than in the Prague stock exchange, and 1.6 times higher than in RTS (Russia) (compared to the estimates from Jain (2003), see Table 4.1).

Some of the main reasons of such a high cost of trading, as evidenced from the study about the Ukrainian stock market presented in Chapter 2, are seen in the low trading activity in the Ukrainian stock market, low transparency of public companies, and weak company legislation and legal enforcement in Ukraine.

The results of estimation of the effective bid-ask spread are also reported in Table 4.3. Effective bid-ask spread varies from 2.2% for UNAF to 81.7% for TOEN. It is important to note that for some stocks the number of observations for estimation of the effective bid-ask spread is very low (as low as, for example, 5 for RODV and 8 for HRTR and TOEN). Therefore the estimates of effective spread for the stocks with a low number of observations may be unreliable.

Effective bid-ask spread for every stock is smaller than the quoted spread for the stock reflecting ability of the brokers to negotiate price improvement over the quoted spread. Effective spread takes from 20.8% of the quoted spread (for USCB) to 78.0% of the quoted spread (for GLNG). That effective spread is smaller than quoted spread is in line with the findings in literature (Lee (1993), Huang and Stoll (1997), Hansch et al. (1999), Stoll (2000), Naik and Yadav (2003), and other).

Relation of the Cost of Trading to the Trade Size

Due to the low trading frequency in many Ukrainian stocks with lower liquidity, it is not possible to study influence of trade size on the cost of trading for all the stocks in the dataset since the number of observations for many of them is too low. Therefore the study of the question is done only for a group of 15 most liquid Ukrainian stocks. The stocks are AZST, BAVL, DNEN, DTRZ, LTPL, MZVM, NITR, PGOK, SMASH, STIR, UNAF, USCB, UTEL, ZAEN, and ZPST. Period of observation: 2005-2006. Descriptive statistics for these stocks, as well as the approach to assigning trade direction (sale or purchase), and the definition of small, medium, and large trades are presented in Chapter 3.

Estimation results of the average effective spread relative to the trade size are presented in Table 4.4 (the row "Total" for each of the trade sizes). Average effective spread for a group of stocks relative to the trade size is found in two steps. First, average effective spread for each stock is found over the period of observation for each of the trade sizes. Then average across all the stocks within each trade size group is found.

Table 4.4. Estimation results for the effective bid-ask half-spread.

The companies included in the sample are 15 most liquid Ukrainian stocks, time period 2005-2006. They are: AZST, BAVL, DNEN, DTRZ, LTPL, MZVM, NITR, PGOK, SMASH, STIR, UNAF, USCB, UTEL, ZAEN, and ZPST.
For sales, effective spread is estimated as a percentage difference between the midquote preceding the trade and the trade price. For purchases, effective spread is estimated as a percentage difference between the trade price and the midquote preceding the trade.
All estimates are significant at 1% significance level.

All Trade Sizes							
	Sales			Purchases			
Market condition	**Obs**	**Mean**	**St. Error**	**Obs**	**Mean**	**St. Error**	**Mean effective spread**
Rising	1596	2.20%	0.08%	1637	1.75%	0.04%	3.95%
Falling	1097	2.99%	0.11%	732	2.23%	0.07%	5.22%
Neutral	603	2.18%	0.10%	521	1.71%	0.06%	3.89%
Total	**3296**	**2.46%**	**0.06%**	**2890**	**1.87%**	**0.03%**	**4.33%**
Small Trades							
	Sales			Purchases			
Market condition	**Obs**	**Mean**	**St. Error**	**Obs**	**Mean**	**St. Error**	**Mean effective spread**
Rising	1034	2.27%	0.11%	1158	1.84%	0.05%	4.11%
Falling	783	3.18%	0.15%	513	2.23%	0.08%	5.41%
Neutral	432	2.43%	0.13%	381	1.76%	0.07%	4.19%
Total	**2249**	**2.62%**	**0.08%**	**2052**	**1.92%**	**0.04%**	**4.54%**
Medium Trades							
	Sales			Purchases			
Market condition	**Obs**	**Mean**	**St. Error**	**Obs**	**Mean**	**St. Error**	**Mean effective spread**
Rising	375	1.87%	0.09%	283	1.54%	0.08%	3.41%
Falling	228	2.48%	0.19%	131	1.95%	0.16%	4.43%
Neutral	101	1.93%	0.20%	87	1.40%	0.11%	3.33%
Total	**704**	**2.08%**	**0.09%**	**501**	**1.62%**	**0.07%**	**3.70%**
Large Trades							
	Sales			Purchases			
Market condition	**Obs**	**Mean**	**St. Error**	**Obs**	**Mean**	**St. Error**	**Mean effective spread**
Rising	187	2.51%	0.24%	196	1.51%	0.11%	4.02%
Falling	86	2.57%	0.26%	88	2.69%	0.35%	5.26%
Neutral	70	0.97%	0.11%	53	1.90%	0.28%	2.87%
Total	**343**	**2.21%**	**0.15%**	**337**	**1.88%**	**0.12%**	**4.09%**

Small trades are the most expensive to execute, they have the highest effective bid-ask spread of 4.54%, whereas medium-sized trades are the cheapest, with the effective bid-ask spread of 3.70%. The cost of trading for large trades is 4.09%.

That small trades are the most expensive to execute is in line with the findings in other literature for dealership markets (Reiss and Werner (1996), Hansch et. al (1999), and Huang and Stoll (1996)). A broker knows that he will have to agree to a price improvement for larger customers (other brokers in case of our data) and therefore, in order not to incur negative profits, widens his bid-ask spread beyond its true value leaving the surplus up for negotiation. Since small customers do not have market power and have to buy and sell at the quoted prices, they pay the surplus left for negotiation for the larger customers. Indeed, small trades receive the smallest price improvement, 1.84% of the bid quote for sale trades and 1.15% of the ask quote for buy trades, relative to 2.21% and 1.78% respectively for medium-sized trades and 2.38% and 1.53% respectively for large trades (Table 4.5).

As vast majority of investors in the Ukrainian stock market are institutions, rather than individuals (for more details see subsection "Institutions in the Ukrainian Stock Market" of Section 2.2, Chapter 2), there are not many of really small trades. Average volume of a small trade in PFTS is USD 19,300. Small trades in the Ukrainian stock market can often be compared by their volume to the medium-sized trades in the developed markets.

Tables 4.4 and 4.5 show that medium-sized trades in Ukrainian stocks are executed at the lowest cost of 3.70% with a high price improvement of 2.21% for sales and 1.78% for purchases. As medium-sized trades in the Ukrainian stock market can be compared to the large trades in the London stock exchange[20], our results are in line

[20] Average trade sizes in the Ukrainian stock market are much larger than in the developed stock exchanges since Ukrainian stock market is dominated by trading from institutional clients (equity investment by individuals is very underdeveloped in Ukraine, see Chapter 2 for more details). For example, in this study a medium-sized trade is between 2 and 6 NMS (normal market size), and large

Table 4.5. Estimation results for price improvement.

The companies included in the sample are 15 most liquid Ukrainian stocks, time period 2005-2006. They are: AZST, BAVL, DNEN, DTRZ, LTPL, MZVM, NITR, PGOK, SMASH, STIR, UNAF, USCB, UTEL, ZAEN, and ZPST.
For sales, price improvement is estimated as a percentage difference between the trade price and the best bid quote preceding the trade. For purchases, price improvement is estimated as a percentage difference between the trade price and the best ask quote preceding the trade.
All estimates are significant at 1% significance level.

All Trade Sizes						
	Sales			Purchases		
Market condition	**Obs**	**Mean**	**St. Error**	**Obs**	**Mean**	**St. Error**
Rising	1596	1.93%	0.07%	1637	1.19%	0.05%
Falling	1097	2.31%	0.14%	732	1.66%	0.09%
Neutral	603	1.49%	0.10%	521	1.14%	0.07%
Total	**3296**	**1.97%**	**0.06%**	**2890**	**1.30%**	**0.04%**
Small Trades						
	Sales			Purchases		
Market condition	**Obs**	**Mean**	**St. Error**	**Obs**	**Mean**	**St. Error**
Rising	1034	1.81%	0.09%	1158	1.02%	0.05%
Falling	783	2.12%	0.15%	513	1.48%	0.11%
Neutral	432	1.38%	0.11%	381	1.08%	0.08%
Total	**2249**	**1.84%**	**0.07%**	**2052**	**1.15%**	**0.04%**
Medium Trades						
	Sales			Purchases		
Market condition	**Obs**	**Mean**	**St. Error**	**Obs**	**Mean**	**St. Error**
Rising	375	2.01%	0.13%	283	1.69%	0.13%
Falling	228	2.61%	0.31%	131	2.19%	0.23%
Neutral	101	2.03%	0.28%	87	1.46%	0.16%
Total	**704**	**2.21%**	**0.13%**	**501**	**1.78%**	**0.10%**
Large Trades						
	Sales			Purchases		
Market condition	**Obs**	**Mean**	**St. Error**	**Obs**	**Mean**	**St. Error**
Rising	187	2.38%	0.28%	196	1.50%	0.13%
Falling	86	3.18%	0.60%	88	1.87%	0.24%
Neutral	70	1.38%	0.19%	53	1.08%	0.28%
Total	**343**	**2.38%**	**0.22%**	**337**	**1.53%**	**0.11%**

trade is 6 NMS or more, whereas for LSE, for example in Bernhard et al. (2005), a medium-sized trade is between 0.25 and 1 NMS, and a large trade is 1 NMS or more. Therefore the trades attributed to the medium size in the Ukrainian stock market can be compared to the large trades in LSE, and the trades attributed to the large size in the Ukrainian stock market can be compared to very large and unusually large in LSE.

with the findings in Reiss and Werner (1996), which document that large trades (but not the unusually large) are the cheapest to execute in the London Stock Exchange.

These trades receive a high price improvement because they are likely to come from more valued customers (other brokers in case of our data) who provide business to the brokers. If a broker refuses to provide price improvement to these customers, he can lose his business with these customers in future. (As mentioned in Chapter 2, the competition between brokers in PFTS is high, therefore wide opportunities exist in PFTS for changing brokers). With that, the trades are not too large to tempt the brokers to refuse price improvement.

Large trades in the Ukrainian stock market are more expensive than medium-sized trades. As large trades in the Ukrainian stock market can be compared to the very large and unusually large trades in LSE, our results are in line with the findings in Reiss and Werner (1996) that document that for very large orders the cost of trading starts growing with the order size. Bernhard et al. (2005) also shows that while price improvement rises with the value of the relationship in LSE, still sufficiently large orders get increasingly bad prices. According to Bernhard et al. (2005), reason of this is that temptation to refuse to offer price improvement rises with trade size.

Difference in the Cost of Trading for Sales and Purchases

The cost of trading for sales is found higher than that for purchases for every market condition (rising, falling, and neutral). On average, over the period of observation sales cost 2.46% in terms of effective half-spread, while purchases 1.87% (Table 4.4). During rising market, the cost of trading for sales and purchases was 2.20% and 1.75% respectively, in falling market it was 2.99% and 2.23% respectively, and in the neutral market brokers could have executed sales at 2.28%, while purchases at 1.71%. The result is unexpected as many other studies tend to find that purchases are more expensive than sales in the rising market, while the opposite is true in the falling market (Chan and Lakonishok (1993), Chan and Lakonishok (1995), Keim and Madhavan (1997), Chiyachantana et al. (2004), and Bikker et al. (2007)).

Despite the cost of trading for sales was found higher than for purchases for every market condition (rising, falling, and neutral), *relative* cost of trading (the cost of trading during rising and falling market relative to the cost of trading during neutral market) is in line with the pattern predicted in Chiyachantana et al. (2004). In neutral market, sales were executed at 2.28% and purchases at 1.71%. During rising market the cost of sales grew by 0.2 percentage points, (or by 9.2% of the neutral market cost of sale) to 2.20%, and the cost of purchases grew more, by 0.4 percentage points, (or by 23.4% of the neutral market cost of purchase) to 1.75%. So, relative to the neutral market, purchases during rising market became more expensive than sales. During falling market, the cost of sales grew by 0.81 percentage points, (or by 37.2% of the neutral market cost of sale) to 2.99%, and the cost of purchases grew much less, by 0.52 percentage points, (or by 30.4% of the neutral market cost of purchase) to 2.23%. So, relative to the neutral market costs, sales during falling market became more expensive than sales. The same pattern is predicted and documented in Chiyachantana et al. (2004).

Why actual cost of sales is higher than that of purchases in any market condition is not entirely clear. One of the possible explanations of this result can be that traders are more patient on the buy side than on the sell side, other things being equal, and therefore sales are more expensive because they have to pay for immediacy of the order execution.

Determinants of the bid-ask spread

We study the determinants of the cost of trading in two settings. First, we study the determinants of the cost of trading measured as quoted bid-ask spread and then measured as effective bid-ask spread. Quoted bid-ask spread measure allows to include a wider cross-section of stocks in the investigation (all 59 stocks in our dataset) due to availability of reliable estimates of this measure for a wide cross-section of stocks. Quoted bid-ask spread is reported daily not depending on whether any trades were executed for a stock in that day. Therefore a reliable estimate of the quoted bid-ask spread can be found for both liquid and illiquid stocks in the Ukrainian stock market. But since there are volume of trading related variables among the explanatory variables, the frequency of observations will have to be limited to annual. There is too low variation in volume variables from day to day or from month to month. Annual frequency is found the most appropriate in the setting.

Effective bid-ask spread is a more accurate measure of the cost of trading than quoted spread but a reliable estimate of effective bid-ask spread can be found only for the stocks with quite high trading frequency. This will limit the cross-section of stocks included in the estimation to 15 most liquid Ukrainian stocks but will allow to use a higher frequency of observations (monthly) due to more variation available in the dependant variables.

Stoll (2000) hypothesizes that the bid-ask spread depends on the factors related to a stock's liquidity and risk. Liquidity related factors considered in the study are daily dollar trading volume, number of trades per day, and firm size. Increase in any of them is expected to increase liquidity of a stock and therefore to narrow its bid-ask spread. Risk of a stock is measured in Stoll (2000) by stock return variance and stock price (stocks with high return variance and low price tend to be riskier). Increase in risk for a stock is expected to widen the stock's bid-ask spread because of the higher probability of losses brokers can incur if they hold a risky stock in their inventory.

Following Stoll (2000) we run following regression of the quoted relative bid-ask spread on stock's trading characteristics:

$$S_{it} = a_0 + a_1 \log DDV_{it} + a_2\sigma_{it}^2 + a_3 \log Mcap_{it} + a_4 \log Price_{it} + a_5 \log N_{it} + e_{it} \quad (4.6)$$

Where S_{it} is proportional quoted half-spread for stock i in period t, DDV_{it} is daily dollar volume for stock i in period t, σ_{it}^2 is return variance for stock i in period t, $Mcap_{it}$ market capitalization for stock i in period t, $Price_{it}$ is stock price for stock i in period t (calculated as average between daily closing bid and ask quote), N_{it} is average number of trades per day for stock i in period t, and e_{it} is the error term.
Daily dollar volume, price, and number of trades per day are calculated as averages of the daily values over a year for 2005-2006 period. Market capitalization is taken in the beginning of each year. Return variance is calculated based on daily stock returns over a year.

OLS estimation results for equation (4.6) are reported in Table 4.6. Return variance, price, and the number of trades per day have an expected sign and are significantly different from zero at least at 5% significance level. Bid-ask spread widens in return variance and narrows in the stock price and the number of trades per day. Market capitalization and daily dollar volume also have an expected sign but are insignificantly different from zero. Market capitalization was expected to capture the difference in the firms' sizes, which, in turn, is expected to increase the probability of locating a counterparty for a trade. Though for some of the Ukrainian large firms attractive to investors the free-float is low. Therefore, large market capitalization may not always be a measure of probability of locating a counterparty. Daily dollar volume is a volume-based proxy for a stock's liquidity. As will be shown in Chapter 5, volume-based proxies of liquidity do not perform well in the Ukrainian stock market (as well as they do not perform well for many other emerging markets (Bekaert et al. (2003) and Lesmond (2005))). Because of this we will substitute daily dollar volume with the number of no-trading days, which, as will be shown in Chapter 5, is one of the best liquidity measures for the Ukrainian stocks. Market Capitalization variable is excluded from the new regression specification since it was found insignificantly different from zero.

Table 4.6. Relation of quoted proportional bid-ask spread to the trading characteristics of stocks, initial specification.

The table presents results of estimating equation (4.6) using OLS method.
Estimation is performed for 59 Ukrainian stocks based on annual observations during 2005-2006.
*** represent statistical significance at 1% level, ** represent statistical significance at 5% level, and * represent statistical significance at 10% level.

	Coefficient	**Std. Err.**	**t**	**P>t**
Logarithm of daily dollar volume (LogDDV)	-0.0422	0.0297	-1.42	0.159
Return variance(σ^2 *)*	0.5667***	0.1958	2.89	0.005
Logarithm of market capitalization (LogMcap)	-0.0217	0.0218	-1.00	0.322
Logarithm of price (LogPrice)	-0.0232**	0.0115	-2.01	0.047
Logarithm of the number of trades per day ($\log N$ *)*	-0.1075***	0.0356	-3.02	0.003
Intercept	1.3247	0.5177	2.56	0.012
Adj R-squared	0.451			
Observations	97			

New specification of the spread determinants regression has the following form:

$$S_{it} = a_0 + a_1 \log NNTD_{it} + a_2\sigma_{it}^2 + a_3 \log Price_{it} + a_4 \log N_{it} + e_{it} \qquad (4.7)$$

Where S_{it} is proportional quoted half-spread for stock *i* in period *t*, $NNTD_{it}$ is the number of no-trading days for stock *i* in period *t*, σ_{it}^2 is return variance for stock *i* in period *t*, $Price_{it}$ is stock price for stock *i* in period *t* (calculated as average between daily closing bid and ask quote), N_{it} is average number of trades per day for stock *i* in period *t*, and e_{it} is the error term.

The OLS results of estimating equation (4.7) are reported in Table 4.7. All the explanatory variables have expected signs and are significantly different from zero at least at 10% significance level. As expected, quoted proportional bid-ask spread is higher for the stocks with lower liquidity (stocks with higher number of no-trading days and lower number of trades per day) and for the stocks with higher risk (stocks with higher return volatility and lower price). The result is in line with findings in other literature (Stoll (2000), Naik and Yadav (2003), and Gajewski and Gresse (2007)). Regression has a high explanatory power with over 45% of the cross-sectional variance in quoted bid-ask spreads explained.

Table 4.7. Relation of quoted proportional bid-ask spread to the trading characteristics of stocks, improved specification.

The table presents results of estimating equation (4.7) using OLS method.
Estimation is performed for 59 Ukrainian stocks based on annual observations during 2005-2006.
*** represent statistical significance at 1% level, ** represent statistical significance at 5% level, and * represent statistical significance at 10% level.

	Coefficient	**Std. Err.**	**t**	**Prob.**
Logarithm of the number of no-trading days ($\log NNTD$)	0.0017*	0.0009	1.86	0.067
Return variance(σ^2)	0.4685**	0.1987	2.36	0.020
Logarithm of price (LogPrice)	-0.0225*	0.0115	-1.96	0.053
Logarithm of the number of trades per day ($\log N$)	-0.1025***	0.0374	-2.74	0.007
Intercept	0.0666	0.1659	0.40	0.689
Adj R-squared	0.4552			
Observations	97			

Equation (4.7) takes into account only the determinants of the bid-ask spread, which are related to the order processing and inventory holding costs of the brokers. In order to take into account the difference in the informational efficiency of the Ukrainian stocks, an additional variable is added to the regression. S&P/FIA (2008) compute an index that measures transparency of Ukrainian stocks. The index is computed following the methodology developed by Standard & Poor's, and measures how full and timely the information important for investors is disclosed. The study evaluates Ukrainian public companies based on 105 criteria divided into three blocks: i) ownership structure and shareholders' rights (34 criteria), ii) financial and operational information (46 criteria), iii) composition and procedures of the Board of Directors and company management (25 criteria). The analysis was performed for one year, 2006, for 36 Ukrainian public companies. There is a drawback of including the index into regression since it will decrease the number of observations as the index is available not for all stocks and only for one year.

$$S_i = a_0 + a_1 \log NNTD_i + a_2 \sigma_i^2 + a_3 \log Price_i + a_4 \log N_i + a_5 InfoIndex_i + e_i \qquad (4.8)$$

Where S_i is proportional quoted half-spread for stock *i*, $NNTD_i$ is the number of no-trading days for stock *i*, σ_i^2 is return variance for stock *i*, $Price_i$ is stock price for stock *i* (calculated as average between daily closing bid and ask quote), N_i is average number of trades per day for stock *i*, and e_i is the error term.

The OLS results of estimating equation (4.8) are reported in Table 4.8. The informational index is found insignificantly different from zero. Moreover, inclusion of the index significantly decreased the number of observations and, as a consequence, decreased the statistical significance of results. The number of no-trading days and return variance variables were found insignificantly different from zero as opposed to the results in previous specification (Equation (4.7)). If the data for the informational index for more years and for a wider selection of stocks becomes available, the regression specification with the informational index can possibly bring more reliable results and show the importance of asymmetric information in determining the width of the bid-ask spread of Ukrainian stocks.

More frequent data is available for liquid Ukrainian stocks. This allows to estimate the regression on a higher than annual frequency. Higher frequency will allow to capture more variation in variables and increase the power of the regression but the

Table 4.8. Relation of quoted proportional bid-ask spread to trading characteristics of stocks: estimation with information index.

The table presents results of estimating equation (4.8) using OLS method.
Estimation is performed for 36 Ukrainian stocks based on annual observations in 2006.
*** represent statistical significance at 1% level, ** represent statistical significance at 5% level, and * represent statistical significance at 10% level.

	Coefficient	Std. Err.	t	Prob.
Logarithm of the number of no-trading days ($\log NNTD$)	0.0001	0.0015	0.05	0.964
Return variance(σ^2)	0.3955	0.3544	1.12	0.278
Logarithm of price (LogPrice)	-0.0348**	0.0138	-2.53	0.021
Logarithm of the number of trades per day ($\log N$)	-0.1206*	0.0673	-1.79	0.089
InfoIndex	0.0012	0.0037	0.33	0.744
Intercept	0.2839	0.2707	1.05	0.307
Adj R-squared	0.419			
Observations	25			

estimation will include a smaller cross-section of stocks. When estimating regression (4.6) and (4.7) we included 59 stocks of various liquidity at annual frequency during 2005-2006 and had total number of observations of 97. Now we include 15 liquid stocks in the estimation at monthly frequency (frequency used in Stoll (2000) and Gajewski and Gresse (2007)), during January 2005-November 2006 and have total number of observations of 275.

Averages of daily values are taken over each month during 2005-2006. For the midquote and effective spread, the variable with intraday frequency, first, average over the day is taken and then average of daily values is taken over a month. Return variance is computed at monthly frequency.

The explanatory variables in the new regression are the same as in the Equation (4.7) but the dependant variable is now the effective bid-ask half-spread instead of the quoted bid-ask half-spread:

$$ES_{it} = a_0 + a_1 \log NNTD_{it} + a_2 \sigma_{it}^2 + a_3 \log Price_{it} + a_4 \log N_{it} + e_{it} \qquad (4.9)$$

Where ES_{it} is effective half-spread for stock *i* in period *t*, $NNTD_{it}$ is the number of no-trading days for stock *i* in period *t*, σ^2_{it} is return variance for stock *i* in period *t*, $Price_{it}$ is stock price for stock *i* in period *t* (calculated as average between daily closing bid and ask quote), N_{it} is average number of trades per day for stock *i* in period *t*, and e_{it} is the error term.

The OLS results of estimating Equation (4.9) are presented in Table 4.9. The results are similar to the results of estimating Equation (4.7) apart from no significance of the number of trades per day in the new regression. Number of no-trading days, return variance, and price have expected signs and are significantly different from zero at least at 5% significance level. So, as expected, effective proportional spread is positively related to the measure of stocks illiquidity (number of no-trading days) and to the level of risk for a stock (return variance and inverse of stock price).

Table 4.9. Relation of effective proportional bid-ask spread to trading characteristics of stocks.

The table presents results of estimating equation (4.9) using OLS method.
Estimation is performed for 15 most liquid Ukrainian stocks during January 2005-November 2006 based on monthly observations.
*** represent statistical significance at 1% level, ** represent statistical significance at 5% level, and * represent statistical significance at 10% level.

	Coefficient	Std. Err.	t	Prob.
Logarithm of the number of no-trading days ($\log NNTD$)	0.0027***	0.0004	6.24	0.000
Return variance(σ^2)	6.6492***	0.7316	9.09	0.000
Logarithm of price (LogPrice)	-0.0018**	0.0007	-2.36	0.019
Logarithm of the number of trades per day ($\log N$)	0.0027	0.0037	0.73	0.464
Intercept	0.0069	0.0084	0.82	0.412
Adj R-squared	0.423			
Observations	275			

4.5. Conclusion

The chapter examined the cost of trading in the Ukrainian stock market during 2005-2006.

It was found that relative quoted bid-ask spread for Ukrainian stocks is large compared to many other stock markets and varies from 4.9% for the most liquid stocks to 129.5% for the least liquid stocks. The relative quoted bid-ask spread is lower in all developed and many emerging markets. For comparison, relative quoted bid-ask spread for liquid stocks is 0.2% in NYSE, 0.9% in the London Stock Exchange, 1.2% in the Warsaw Stock Exchange, and 4.6% in the Bucharest Stock Exchange (Jain (2003)).

A more accurate measure of the cost of trading, effective bid-ask spread, varies across the Ukrainian stocks of different liquidity from 2.2% to 81.7%. In line with findings in other literature, effective bid-ask spread is less than quoted bid-ask spread, which gives evidence that trades in the Ukrainian stock market are often executed within the quoted spread. In other words, traders are able to negotiate price improvement from brokers relative to the quoted stock prices. The reason of suggesting price improvement in the dealership market is an intention of brokers to keep long-term relationships with their clients (which are other brokers in case of our data) in order to secure future deals with them.

Due to the low trading frequency in many Ukrainian stocks with lower liquidity it is not possible to study influence of trade size on the cost of trading for all the stocks since the number of observations is too low. Therefore the study of the question is done only for a group of 15 most liquid Ukrainian stocks.
For the 15 most liquid Ukrainian stocks, average effective bid-ask spread is 4.33%. It is the highest for small trades, 4.54%, is lower for the medium-sized trades, 3.70%, and starts growing again for large trades, 4.09%. That the cost of trading for small

trade sizes is higher than for larger trade sizes was also documented in other literature for dealership markets (Reiss and Werner (1996), Hansch et. al (1999), and Huang and Stoll (1996)). The reason for it is that small trades are not viewed as valuable for brokers and therefore price improvement cannot be negotiated for them and they have to be executed near to the quotes. Larger trades are those that bring the most valuable business to the brokers and, in order to keep the relationship with the clients in the long-term, price improvement is suggested for these trades. The finding that the cost of trading for very large orders starts growing in the order size is in line with the findings in Reiss and Werner (1996) and Bernhard et al. (2005) for the London Stock Exchange. According to Bernhard et al. (2005), reason of this is that temptation to refuse to offer price improvement rises with trade size.

For the same reason as for the trade size study, the study of the influence of the trade direction on the cost of trading was also performed only for 15 most liquid Ukrainian stocks. The average cost of trading for an institutional sale was found higher than that for an institutional purchase in any market condition (rising, falling, or neutral market) for the reasons that are not entirely understood. Empirical findings in other literature tend to show that institutional purchases are more expensive than sales in a rising market, while the opposite is true in the falling market (Chan and Lakonishok (1993), Keim and Madhavan (1998), Chiyachantana (2004) and Bikker et al. (2007)).
At the same time, relative cost of trading in the Ukrainian stock market during falling and rising market compared to the cost of trading in neutral market follows the pattern predicted in Chiyachantana et al. (2004): in the falling market the cost of trading sales rises more than the cost of trading purchases relative to their values in the neutral market, while in the rising market the opposite is true.

A study of the determinants of the cost of trading showed that proportional quoted and effective bid-ask spreads depend on the stock liquidity (measured as the number of no-trading days and the number of trades per day[21]) with higher liquidity stocks, as expected, having narrower bid-ask spreads. Also, proportional quoted and effective bid-ask spreads depend on the risk of the adverse price change for a stock (measured as return volatility and stock price) with more risky stocks having wider bid-ask spreads. The result is in line with the findings for other exchanges, in particular, NYSE and Nasdaq (Stoll (2000)), London Stock Exchange (Naik and Yadav (2003)), and Euronext Paris (Gajewski and Gresse (2007)). Firm size (measured as market capitalization) was found not important in determining the width of the bid-ask spread, which is probably the result of a specific feature of the Ukrainian stock market that for many large companies free float is very low.

[21] Number of trades per day was found significantly different from zero only for the quoted spread regression and not for the effective spread regression.

Chapter 5

Liquidity of the Ukrainian Stock Market

5.1. Introduction

The role of liquidity in empirical finance has grown rapidly over the past decade and has begun to influence conclusions in asset pricing, corporate finance, and market efficiency.

A substantial body of empirical research has documented that liquidity affects prices and expected returns of financial assets in many different markets (Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), Loderer and Roth (2005)), influences companies' levels of leverage (Lipson and Mortal (2007)), and affects cross-listings and market segmentation (Domowitz et al. (2000) and Miller (1999)).

Liquidity and the cost of trading are closely related (Domowitz, 2000). Low liquidity is one of the major reasons of a high cost of trading.

Liquidity is an important factor to consider for investors and portfolio managers when making their investment decisions as low liquidity stocks can be costly and can require longer time to transact, which can result in an adverse influence on the net portfolio returns.

As an essential characteristic of a stock market and a significant input in many other areas of financial research, liquidity needs to be correctly and efficiently measured. A menu of reliable liquidity measures will allow researchers flexibility in choosing the liquidity measure that is most appropriate for their study and the data available.

The assumption that the available liquidity measures are able to capture liquidity of stocks is often not tested because of the limitations with the available data. As a consequence, there is little consensus on which measures are better and little evidence that various liquidity measures applied in the literature actually measure what they claim to measure. A few studies investigate the efficacy of various liquidity measures for the U.S. stock market (Lesmond at al. (1999), Hasbrouck (2006), Goyenko et al. (2009)) and a number of emerging stock markets (Lesmond (2005)) but, to our knowledge, none do that for the emerging stock market of Ukraine. To study the efficacy of liquidity measures in measuring liquidity in emerging markets is especially important since commonly used measures of liquidity were designed for developed markets and little is known about their applicability for emerging stock markets. A high investment interest enhanced by substantial returns in Ukraine highlights the importance of measuring liquidity of the Ukrainian stock market. The chapter contributes to literature by investigating the efficacy of a number of liquidity measures such as quoted bid-ask spread, turnover, Amihud's measure (Amihud, 2002), the proportion of zero daily returns (Lesmond et al., 1999), the proportion of no-trading days, and the volatility of return for measuring liquidity of the Ukrainian stock market.

In this chapter, first, liquidity of individual stocks in the Ukrainian stock market is measured. Then, the efficacy of different liquidity measures is studied and a selection of reliable liquidity measures is suggested. Finally, to show the place of Ukraine among other emerging markets, liquidity of the Ukrainian stock market is compared to the liquidity of other emerging markets based on different measures of liquidity.

The chapter is organized as follows. Section 2 provides a review of literature, Section 3 presents the methodology of the liquidity measures computation, the data and the methodology of analysis is described in Section 4, Section 5 discusses results, and Section 6 concludes.

5.2. Review of Literature

Liquidity is easily recognized but not so easily defined. Black (1971) describes a liquid market in the following intuitive way: "The market for a stock is liquid if the following conditions hold: (1) there are always bid and ask prices for the investor who wants to buy or sell small amounts of stock immediately; (2) the difference between the bid and ask prices (the spread) is always small; (3) an investor who is buying or selling a large amount of stock, in the absence of special information, can expect to do so over a long period of time at a price not very different, on average, from the current market price; (4) an investor can buy or sell a large block of stock immediately, but at a premium or discount that depends on the size of the block. The larger the block, the larger the premium or discount."

Kyle (1985) notes that ‘‘liquidity is a slippery and elusive concept, in part because it encompasses a number of transactional properties of markets." These include tightness (the cost of turning around a position over a short period of time), depth (the size of an order flow required to change prices by a given amount), and resiliency (the speed with which prices recover from a random, uninformative shock).

According to O'Hara (1998) liquid markets are those, which accommodate trading with the least effect on price.

The above definitions can be summarized by the definition of liquidity suggested in Bank for International Settlements (1999): "a liquid market is a market where participants can rapidly execute large-volume transactions with a small impact on prices”.

Empirically, four types of liquidity measures are identified in literature: (i) measures related to the cost of trading (such as bid-ask spread and price impact), (ii) measures related to the trading activity (such as turnover), (iii) compound liquidity measures, and (iv) alternative liquidity measures.

The main measures of liquidity related to the cost of trading include quoted bid-ask spread, effective bid-ask spread, and price impact (for more details on definition and measurement of effective bid-ask spread and price impact, see Chapter 4, Section 4.2). As a measure that directly shows the cost of transacting a stock, the bid-ask spread is considered by many researchers by far the most demonstrable measure of a stock liquidity. Jain (2003) estimates the daily quoted bid-ask spread for 51 stock exchanges over a four-months period and finds that the quotes are good indicators of the underlying liquidity. Lesmond (2005) applies quoted bid-ask spread as a benchmark for studying the efficacy of other liquidity measures. Effective bid-ask spread is taken as a benchmark liquidity measure in Goyenko et al. (2009).

Among the measures related to trading activity, turnover is the one most commonly applied in literature. Turnover can be computed in either of the two ways: as a ratio of the number of shares traded to shares outstanding (as, for example, in Lesmond, 2005) or as volume traded (in monetary form) to the market capitalization (as, for example, in World Bank World Development Indicators, 2006). Turnover is an ubiquitous liquidity measure. It is used in Rouwenhorst (1999), Bekaert et al. (2006), and Levine and Schmukler (2003) to name just a few and has many applications. The benefit of the measure is that it is able to capture trading frequency for a stock and is simple to construct but its drawback is that it fails to account for the cost per trade, which varies considerably across stocks. Turnover and the bid-ask spread are inversely related. The efficacy of turnover and other liquidity measures in measuring liquidity will be discussed later below.

A number of comprehensive liquidity measures were suggested in recent literature. The Amivest Investment Management liquidity measure combines turnover and the cost of trading sides of liquidity definition and suggests a measure that relates dollar volume of trading to security return. The measure was used, for example, in Berkman and Eleswarapu (1998) and Chen and Park (2006).

Amihud (2002) generalizes the liquidity measure to make it more adaptable to markets around the world. Amihud's measure relates the daily absolute return to the daily dollar trading volume for a stock. This ratio more closely follows the Kyle (1985) price impact definition of liquidity, or the response of price to order flow. This ratio gives the absolute price change per dollar of daily trading volume, or the daily price impact of the order flow. The Amivest liquidity measure, however, does not have the intuitive interpretation of measuring the average daily association between a unit of volume and the price change. Another advantage of the Amihud liquidity measure is that it can be calculated for the days when there is no price change, which is of particular concern in emerging markets. On the other hand, days of zero-returns are closely related to zero volume traded. If a zero volume day occurs, the measure cannot be computed due to zero in the denominator in the formula for the measure. Amihud's measure is positively related to the bid-ask spread as smaller spreads are associated with lower price impact and higher trading volumes.

Alternative liquidity measures are not directly related to measuring cost of trading, or volume for estimating liquidity. They are often substitutes for the established measures of liquidity and are applied in the markets with poor data availability or poor quality of data (which is often the case of emerging stock markets). Among the alternative measures proportion of zero daily returns, proportion of no-trading days, and volatility of return will be discussed.

Proportion of zero daily returns liquidity measure exploits the effect transaction costs may have on daily returns. The maintained hypothesis is that the marginal, informed trader will trade only if the value of information exceeds the marginal costs of trading Lesmond et al. (1999). If trading costs are sizable, Lesmond et al. (1999) argue that zero return days occur more frequently because new information must accumulate longer, on average, before informed trades can affect price. The model takes its roots in the asymmetric information models of Glosten and Milgrom (1985) and Kyle (1985). The cost of trading is a threshold that must be exceeded before return on a security will reflect new information. A security with high cost of trading will have less frequent price movements and more zero returns than a security with low cost of trading. Though the proportion of zero daily return measure of liquidity has a serious limitation as it does not measure no-trading days but zero return days, and zero return can occur on the days with non-zero trading. Proportion of no-trading days is seen in Lesmond et al. (1999) and Bekaert et al. (2006) as a measure that can better reflect liquidity than the proportion of zero daily returns, though the data for estimating the further was not available.

Volatility of return is not directly related to the definition of liquidity but is found highly correlated with liquidity measures and therefore is viewed as a liquidity proxy (Domowitz et al. (2000), Lesmond (2005)). Less liquid stocks usually have higher volatility of return.

There is very limited literature that studies how well different liquidity measures can measure liquidity and therefore the question regarding which measures perform better still stays open.

The bid-ask spread is considered in the literature as a reliable liquidity measure for any market since it directly measures the level of friction of trading a stock. Though the bid-ask spread data is not available for some markets, especially some emerging markets. Also, for some researchers it can be more convenient to infer liquidity from other data than the bid-ask spreads, even if the bid-ask spread data exist for the market under study. Therefore there is a need in studying efficacy of different liquidity measures in measuring liquidity.

A few recent papers contribute to filling the gap in literature (Lesmond (2005), Bekaert et al. (2006), and Goyenko et al. (2009)). They study the efficacy of liquidity measures using different methods, the main of which is correlation analysis. In the correlation analyses of the studies, the bid-ask spread often serves as a benchmark liquidity measure, to which all other liquidity measures are correlated.

Lesmond (2005) performs a detailed study of the efficacy of a number of liquidity measures in measuring liquidity in emerging markets. The study considers such liquidity measures as the bid-ask spread, turnover, Amihud's measure, Roll's measure, and LOT measure. The dataset includes 31 emerging markets for the period of 1987-2000 but covers only about 12% of listed companies in each market. The study applies several different techniques. First, correlation analysis is performed. Quoted bid-ask spread is taken as a benchmark to which all other liquidity measures are correlated. Second, a regression analysis is done. The bid-ask spread is regressed on each of the liquidity measures and a number of control variables. Finally, a factor analysis is performed in order to study the commonality in liquidity. The measures of liquidity are viewed as proxies for different aspects of liquidity. Roll's measure is regarded as a proxy for the effective spread, Amihud's measure – for price impact, turnover – for relative trading frequency, LOT measure – as a general liquidity cost estimate encompassing some portion of each liquidity component. The factor analysis provides some indication of whether a single liquidity factor is being captured by any, or all, of these liquidity estimators.

The correlation analysis in Lesmond (2005) is performed separately for each country and for all countries together. The correlation analysis is based on pooled data of quarter-firm estimates of liquidity measures.

The results of the correlation analysis show that turnover measures liquidity weakly at best. Turnover was found to be negatively and significantly correlated with the bid–ask spread in only 40% of the 23 emerging markets. It had the lowest correlation, where significant, among any of the liquidity measures. The correlation coefficient for all countries was found very low, only -6.5%. According to Lesmond (2005), these results cast doubt on a wide range of studies employing turnover as a principal liquidity proxy. Amihud's measure was found quite good for measuring liquidity. The measure was found to be very highly positively correlated with the spread regardless of country, with the correlation coefficient for all countries of 27.5%. Except for five of the 23 markets, Roll's model was found to be significantly associated with the bid–ask spread, with the correlation coefficient for all countries of 29.5%. In terms of the magnitude of the correlation coefficient, the LOT model appeared to be stronger related to the bid-ask spread than the other liquidity measures, with the correlation coefficient for all countries of 56.1%.

To determine how well each measure was able to capture the cross-sectional differences in each country's bid-ask spread, Lesmond (2005) performs rank correlations between the bid-ask spread and other liquidity measures. Each country's liquidity measure was ranked for each of the four liquidity estimators as well as for the bid-ask spread. This procedure allowed to eliminate outlier effects that could have been present in the all-country estimates. The results indicated that price-based liquidity measures (the LOT and the Roll) outperformed volume-based liquidity measures (the Amihud and turnover).

Slightly different result was found based on regression analysis. The analysis showed that the LOT measure and Amihud's measure dominated Roll's measure and turnover.

Factor analysis indicated that in almost half of the 31 markets, a single factor represented the common variation in all of the liquidity measures examined. This single factor appeared most correlated with the LOT estimate and, to a lesser extent, Amihud's measure. However, turnover did not appear to be related to any of the common variation in any of the other measures.

Lesmond (2005) also considers proportion of zero returns liquidity measure. While the correlation and regression results for this measure are not presented in their study, Lesmond (2005) notes that high degree of association is found between the proportion of zero returns and the bid-ask spread, regardless of a country.

Based on the results of the analyses, Lesmond (2005) conclude that the LOT measure, Amihud's measure, and Roll's measure have power in measuring liquidity in emerging equity markets, with the LOT measure found superior over the other two measures. The results, though, cast significant doubt on the use of turnover as a viable liquidity measure in emerging markets, either in assessing cross-country or within-country liquidity.

Bekaert et al. (2006) study how liquidity influences expected asset returns in emerging markets. Given the paucity of realized transaction cost data for emerging markets, Bekaert et al. (2006) cannot apply the bid-ask spread as a measure of liquidity and instead apply proportion of zero daily returns. As this is a fairly new liquidity measure in literature, a separate part of the paper is dedicated to studying the efficacy of the measure for measuring liquidity. Proportion of zero daily returns was suggested and applied in Lesmond et al. (1999). The measure was also applied in Lesmond (2005) but its efficacy was not carefully studied.

For their study, Bekaert et al. (2006) apply daily return data at the firm level from the Datastream research files. The dataset covers about 90% of the number of domestically listed firms in each country starting from the late 1980s. In order to test the efficacy of the proportion of zero daily returns for measuring liquidity, Bekaert et al. (2006) perform a correlation analysis of this measure with more established measures of liquidity. First, the proportion of zero daily returns is correlated with turnover and volatility of return, the other two measures that can be constructed based on the data available. Even though there is evidence that turnover does not have enough power in measuring liquidity in emerging stock markets (Lesmond, 2005), it is expected that negative sign of the correlation coefficient between turnover and proportion of zero daily returns would give some support to the hypothesis of the ability of the proportion of zero daily returns to measure liquidity. Bekaert et al. (2006) find that cross-sectional correlation coefficient between the average levels of turnover and the average proportion of zero daily returns is –35%. The correlation coefficient of the two liquidity measures across time within each country had average value of –16%. Both results support the hypothesis of ability of proportion of zero daily returns to measure liquidity. Correlation between proportion of zero daily returns and volatility has shown that there is no consistent pattern in the behaviour of the two measures.

Second, the proportion of zero daily returns is correlated with a more standard liquidity measure, the bid-ask spread. The data on the bid-ask spread is available only for a few countries in the dataset and for a shorter time period (from the mid to the late 1990s). Bekaert et al. (2006) find that the proportion of zero daily returns measure is highly correlated, 48% on average, with the mean bid-ask spread across all countries and time periods for which the bid-ask spreads are available. Lesmond (2005) also documented that the proportion of zero daily returns is highly correlated with bid-ask spreads for a broader collection of emerging equity markets. For the purpose of comparison, Bekaert et al. (2006) also correlate equity market turnover with the bid-ask spread and find average correlation coefficient of only –20%. Since the correlation coefficient between proportion of zero daily returns and the bid-ask spread was found much higher (48%), Bekaert et al. (2006) conclude that the proportion of zero daily returns appears to be picking up a component of liquidity and transaction costs that turnover does not.

Further, Bekaert et al. (2006) study how proportion of zero daily returns liquidity measure performs with the U.S. data. Similar correlations to the described above are performed with NYSE and AMEX data for 1962-2001 at annual frequency. The study finds that the proportion of zero daily returns is highly correlated with the more established liquidity measures. The correlation of the proportion of zero daily returns with the Amihud's liquidity measure was found to be 40%, and with the bid-ask spread it was found to be 30%. Bekaert et al. (2006) note that the use of proportion of zero daily returns in emerging markets is predicated on the assumption that zero returns proxy for no-trading days in these relatively illiquid markets. For the U.S., proportion of no-trading days can actually be constructed. Bekaert et al. (2006) further correlate proportion of zero returns observed on no-trading days and find that in this setting, correlation of the measure with the Amihud liquidity measure is much higher, 91%. The authors note that the above distinction is important as zero returns in emerging markets are more likely to be associated with non-trading than in the U.S. where a significant number of trades are processed with no associated price movement.

Having performed the correlation analysis, Bekaert et al. (2006) conclude that the proportion of zero daily returns liquidity measure is able to capture liquidity in emerging equity markets and apply this measure in their study of the influence of liquidity on expected asset returns.

A recent study of Goyenko et al. (2009) performs a deep analysis of the ability of a wide selection of low-frequency liquidity measures for measuring liquidity of the U.S. stocks. For researchers that need a liquidity measure for their study, low-frequency measures are easier to compute and apply than the high frequency measures, though the latter are usually presumed to have a higher precision. The purpose of the study is to test the hypothesis that low-frequency measures of liquidity, measured monthly and annually, can usefully substitute high frequency measures and if so, which measures are the best. The study applies data for 400 randomly selected stocks listed on NYSE, AMEX, or Nasdaq over 1993-2005. The methodology applied in the study is time-series correlations, cross-sectional correlations, and prediction errors.

In the exploration of the best low-frequency measures of liquidity, the low frequency liquidity measures are compared to a range of sophisticated benchmarks calculated based on high-frequency data. The benchmarks include two spread benchmarks: the effective bid-ask spread and the realized bid-ask spread, and two price impact benchmarks: lambda and 5-minute price impact.

The study tested six low-frequency measures of liquidity that are spread proxies: (i) the effective tick, developed jointly by Goyenko et al. (2009) and Holden (2007); (ii) the Holden measure from Holden (2007); (iii) the Roll measure from Roll (1984); (iv) the Gibbs measure from Hasbrouck (2004); (v) the LOT measure, and (vi) the proportion of daily zero returns measure from Lesmond et al. (1999). Also, the study tested four low frequency measures of liquidity that are price impact proxies: (i) the Amihud measure from Amihud (2002); (ii) the extended Amihud measure developed in Goyenko et al. (2009); (iii) the Pastor and Stambaugh measure from Pastor and Stambaugh (2003); and (iv) the Amivest liquidity ratio.

Goyenko et al. (2009) find that both monthly and annual low-frequency measures usefully capture high-frequency measures of transactions costs, so the effort of using high frequency measures is not worth the cost. The answer to the question of which measure a researcher should use, was found to depend on what exactly the researcher wants to measure. To capture spread, without considering computational requirements, the Holden measure delivered the best performance overall. Considering ease of computation, effective tick was found the best measure to use. The proportion of daily zero returns was found inferior to all other measures designed to capture effective spread. Bekaert et al. (2006) come to the same conclusion regarding the proportion of daily zero returns when apply the U.S. data in a similar setting (without taking into account whether zero return took place on a no-trading day or not). To capture price impact, both the Amihud and the extended Amihud measures were found to do a good job. The Pastor and Stambaugh and the Amivest measures were found to have very little or nothing to do with the price impact benchmarks.

Not all liquidity measures respond to the trading pressure in the same way. As the study of Chordia et al. (2001) show, volume-based and cost-of-trading-based measures of liquidity are found to behave differently in the turbulent times in the market. Even though trading activity and trading costs are often assumed (and shown) to be related, they capture different aspects of secondary markets and do not need to behave similarly. In tranquil times and across securities, higher volume is associated with lower transaction costs. In other words, all liquidity proxies move in the same direction. But their behaviour changes in periods of financial turbulence, when shocks are of different nature. For example, a sudden increase in trading activity when investors rush to exit the market, might signal an increased trading demand for a given market depth, congesting the market and raising the costs of trading. While trading activity variables increase both in rising and falling markets, bid-ask spreads respond asymmetrically by increasing significantly in down markets and decreasing only marginally in up markets. Therefore it is important to perform correlation analysis between the volume-based and the trading cost-based liquidity measures during normal market conditions.

5.3. Methodology of the Liquidity Measures Computation

This section describes the methodology of computation of the liquidity measures applied in the chapter. Based on the data available, the list of liquidity measures that we are able to estimate includes the quoted bid-ask spread, turnover, Amihud's measure, proportion of zero daily returns, proportion of no-trading days, and volatility of return. Quoted bid-ask spread is estimated instead of a more accurate estimate of transaction cost, which is effective bid-ask spread, because there are not enough data for finding reliable estimates of the effective bid-ask spread for a wide cross-section of Ukrainian stocks applied in the chapter.

The dataset includes 56 Ukrainian stocks during the first half of 2006. More details on the data are presented in the next section.

i) Quoted bid-ask spread

The daily proportional quoted bid-ask spread is defined as:

$$QuotedSpread = \frac{P_A - P_B}{(P_A + P_B)/2} \tag{5.1}$$

Where P_A is the closing ask quote and P_B is the closing bid quote.

Lower value of the bid-ask spread is associated with higher liquidity of a stock.

ii) Turnover

The daily turnover liquidity measure is defined as in Lesmond (2005):

$$Turnover_i = (1/D_H)*\sum_{t=1}^{H} \frac{Volume_{it}}{SharesOutstanding_i} \tag{5.2}$$

Where D_H is the number of trading days in the period H; $Volume_{it}$ is the number of shares traded for the stock i in the day t; $SharesOutstanding_i$ is the number of outstanding shares for the stock i in the beginning of the period H;
Higher value of turnover is associated with a higher liquidity of a stock.

iii) Amihud's measure

The daily Amihud's measure is defined as:

$$Amihud's Measure_i = (1/D_H)\sum_{t=1}^{H} \frac{|R_{it}|}{Price_{it} * Volume_{it}} \qquad (5.3)$$

Where D_H is the number of trading days in the period H; R_{it} is the daily return on stock i: $R_{it} = \frac{Price_{it} - Price_{i,t-1}}{Price_{i,t-1}}$; $Price_{it}$ is the mid-quote of the closing bid-ask quote for the stock i in the day t; $Volume_{it}$ is the number of shares traded for the stock i in the day t.
The measure is then multiplied by 10^6 as it is done in Amihud (2002) to present the results in a comparable format to other studies.
Amihud's liquidity measure relates price impact (percentage change in price) to the volume of stock traded. Lower value of Amihud's measure is associated with higher liquidity of a stock.
If zero volume occurs on a day t, then the Amihud's measure cannot be computed for the day t and that day is excluded from the calculations.

iv) Proportion of zero daily returns

The proportion of zero daily returns is calculated as a ratio of days with zero daily returns to the total number of trading days over a period for a stock.

Daily return for a stock is calculated in the same way as for Amihud's liquidity measure.

Lower number of proportion of zero daily returns for a stock indicates a higher liquidity of the stock.

v) Proportion of no-trading days

The proportion of no-trading days is calculated as a ratio of the number of days with no trading to the total number of trading days over a period for each stock.

Lower number of no-trading days for a stock indicates higher liquidity of the stock.

vi) Volatility of return

Volatility of return is a standard deviation of daily return for a stock over a given period. Daily return for a stock is calculated in the same way as for Amihud's liquidity measure.

Lower volatility of a stock indicates higher liquidity of the stock.

5.4. Data and Methodology of Analysis

The Ukrainian stock market has been actively developing in the past several years and the volume of trading and liquidity of the market has been considerably growing. For example, the volume of trading in PFTS has grown by 211% in 2005 and by 81% in 2006. Estimation of liquidity of the Ukrainian stock market over an extended period of time can result in very high standard errors of our liquidity estimates. Therefore, we have decided to limit the period of observations for our liquidity study to the first half of 2006.

When choosing a data period for a liquidity study it is important to pay close attention to the market conditions. As mentioned above, in the crisis times, the volume of trading and the cost of trading change significantly (Yeyati et al. (2007)). Turnover is likely to increase during liquidity crunches such as occurred during the Tequila Crisis, the Asian Crisis, and the Brazilian Crisis (Summers, 2000), rather than decrease to reflect the decline in market liquidity (Froot et al., 2001).

During the first half of 2006 Ukrainian stock market did not experience any shocks or crises. It had a gradual growth during January-April (index PFTS has grown by 34.8%) and a graduate decline during May-June (index PFTS has decreased by 19.6%). A mixture of trends will allow us to find an estimate of the stock market liquidity attributed to an average market condition.

The main dataset for the thesis described in Chapter 3 excludes all the trades reported before the opening of the trading session (before 11 a.m.). Though for liquidity study, we find it appropriate to keep the trades in the dataset. Inclusion of the trades will allow us to estimate volume-related liquidity measures (turnover, the Amihud, and the proportion of no-trading days) more accurately, while it will not have any influence on the estimates of the quoted bid-ask spread, the proportion of zero daily returns, and volatility of return measures of liquidity (as these measures are estimated based on the closing bid-ask spread data).

It is important to mention that the trades reported before 11 a.m. were executed one or two trading days before the day on which they were reported. The actual day of execution of these trades is unknown to the market participants. They learn about the trades only after they are reported, which is one or two trading days after the execution day. Since the trades will influence the market only after they become known to the market, they can be considered as if they were executed on the day of their reporting. Of course, the prices for these trades are expected to be close to the prices prevalent on the actual day of execution of the trades rather than on the day of reporting. But since actual trade prices are not used in the estimations of any of the liquidity measures in the chapter, inclusion of the trades reported before 11 a.m. is seen as an appropriate step.

The dataset was not corrected for outliers in terms of trades with abnormally high returns (as it was done for the main dataset described in Chapter 3) because actual stock prices are not used in the estimation of any of the liquidity measures in this chapter. Instead, for estimations of stock returns, midquote of the closing bid-ask quote is used. Keeping all the executed trades in our dataset allows us to find more accurate estimates for the volume-related measures of the cost of trading.

The main characteristics of the Ukrainian stocks during the first half of 2006 are presented in Table 5.1. The dataset includes 56 stocks. The number of trades varies from 1 for YAMZ to 589 for UTEL. None of the stocks were traded on each of the trading days, the number of which accounted for 117 in the first half of 2006. The number of days traded varies from as low as 1 for YAMZ to 106 for UTEL. The total volume of stocks traded varies from 29.2 ths. shares for MSICH (average price USD 80.7) to 4,840,000 ths. shares for DNAZ (average price USD 0.005).

Similar to Lesmond (2005), Bekaert et al. (2006), and Goyenko et al. (2009), the methodology applied for studying the efficacy of the liquidity measures in measuring liquidity in the Ukrainian stock market is time-series, cross-sectional, and rank correlations.

Table 5.1. The main characteristics of Ukrainian stocks.

The table presents the main characteristics of Ukrainian stocks during the first half of 2006. The stocks are sorted by PFTS Code.

N	Company Name	PFTS Code	Stock details				
			Number of trades	Number of days traded	Average price, USD	Volume Traded, ths shares	Mcap, USD, mln.
1	Alchevsk Iron & Steel	ALMK	8	7	0.16	386.7	450.9
2	Avdiyivka Coke	AVDK	123	60	3.87	1,071.8	370.9
3	Azot Cherkasy	AZOT	12	9	1.90	1,041.8	171.5
4	Azovstal	AZST	330	84	0.46	13,600.0	1,033.9
5	Aval	BAVL	214	76	0.10	556,000.0	1,381.0
6	Centrenergo	CEEN	188	72	0.71	13,100.0	436.0
7	Donetskgirmash	DGRM	69	35	0.43	5,134.8	14.4
8	Donetsk Coke	DKOK	119	52	0.23	12,300.0	27.8
9	Donetsk Metal Rolling	DMPZ	30	23	0.05	8,467.4	15.3
10	Kominmet	DMZK	10	8	0.12	1,838.5	18.0
11	DniproAzot	DNAZ	71	33	0.01	4,840,000.0	135.8
12	Dniproenergo	DNEN	119	56	69.97	219.7	442.6
13	Dniprooblenergo	DNON	53	35	42.79	43.3	307.9
14	DniproSpetsStal	DNSS	133	63	171.36	38.3	189.8
15	Donbasenergo	DOEN	63	40	5.35	327.3	188.5
16	Donetsk Metal Plant	DOMZ	85	42	0.19	5,625.9	37.7
17	Druzhkivka Machine-Shop	DRMZ	66	40	0.32	3,285.0	59.0
18	Dnipropetrovsk Pipe	DTRZ	239	76	55.04	216.5	98.2
19	Forum	FORM	4	4	11.76	139.5	303.8
20	Galnaftogaz	GLNG	15	13	0.01	745,000.0	115.8
21	Galychyna Refinery	HANZ	86	42	0.33	27,900.0	238.4
22	Svitlo Shakhtarya	HMBZ	39	24	0.31	1,943.5	28.8
23	Khmelnitskoblenergo	HMON	8	7	0.40	3,216.5	49.3
24	Kievenergo	KIEN	111	46	1.57	7,594.9	161.0
25	AvtoKrAZ	KRAZ	30	20	0.12	6,941.6	86.1
26	Krymenergo	KREN	50	25	0.23	5,240.3	111.3
27	Mittal Steel Kryvyy Rig	KSTL	66	40	0.74	2,311.1	3,497.0
28	Luganskteplovoz	LTPL	336	91	0.46	43,700.0	85.5
29	Megabank	MEGA	26	12	1.61	16,100.0	44.9
30	Mariupol Illicha	MMKI	222	66	0.59	8,769.2	1,500.2
31	Motor Sich	MSICH	113	61	80.67	29.2	160.7
32	Maruipol Heavy Machinery	MZVM	213	74	12.28	613.0	138.9
33	Nikopol Ferroalloy	NFER	25	20	1.44	475.0	360.6
34	Nyzhnyodniprovsky Pipe	NITR	178	78	11.25	1,078.5	817.8

35	Novomoskovsk Pipe	NVTR	70	40	6.58	418.1	90.7
36	Poltavsky Iron Ore	PGOK	147	66	12.34	1,943.8	997.4
37	Pivdenny Iron Ore	PGZK	155	57	0.13	100,000.0	175.1
38	Rodovid Bank	RODB	22	7	763.38	37.2	80.2
39	Stakhanov Ferroalloy	SFER	18	16	0.00	6,698.5	53.7
40	Komsomolets Donbasa	SHKD	20	12	0.19	7,143.9	66.0
41	Imeni Frunze	SMASH	167	70	4.18	1,936.0	233.3
42	Stirol	STIR	145	56	22.80	402.3	384.0
43	Stakhanovsky Wagon	SVGZ	140	38	29.93	75.9	34.1
44	Turboatom	TATM	64	29	0.40	8,017.3	130.1
45	Ukrnafta	UNAF	352	96	56.69	951.7	3,215.8
46	Ukrsotsbank	USCB	301	40	0.42	26,200.0	1,294.5
47	Ukrtelecom	UTEL	589	106	0.19	87,600.0	3,142.6
48	Yasynuvata machinery plant	YAMZ	1	1	2.53	30.0	39.0
49	Yasinivsky Coke	YASK	95	49	0.41	20,300.0	42.1
50	ZaporizhCoke	ZACO	91	48	1.46	2,313.3	130.5
51	Zakhidenergo	ZAEN	194	65	27.46	406.6	551.7
52	Zaporizhzhya Aluminum	ZALK	75	42	0.17	7,930.5	83.2
53	Zaporizhiaoblenergo	ZAON	20	13	0.87	2,722.6	210.5
54	Zaporizhzhya Ferroalloy	ZFER	55	31	0.11	8,395.6	87.0
55	Zhytomyroblenergo	ZHEN	16	13	0.71	2,500.5	92.3
56	Zaporizhstal	ZPST	358	83	0.96	11,500.0	75.7
	Total		**6,641**	**-**	**16.55**	**6,631,324.0**	**24,288.4**

5.5. Results

This section discusses the results of studying efficacy of liquidity measures for measuring liquidity of the Ukrainian stock market. It also suggests a comparison of liquidity of the Ukrainian stock market with liquidity of other emerging markets based on the estimates of liquidity for emerging markets found in other literature.

The main methodology of studying the efficacy of liquidity measures is correlation analysis, in particular, time-series, cross-sectional, and rank correlations are applied. The bid-ask spread is considered by many researchers by far the most demonstrable measure of liquidity for any market since it directly measures the level of friction of trading a stock. Therefore the bid-ask spread is taken as a benchmark for studying efficacy of other liquidity measures. A similar approach was taken in Lesmond (2005) and Goyenko et al. (2009).

Among two possible benchmarks, which are the quoted bid-ask spread and the effective bid-ask spread, we have chosen to apply the quoted bid-ask spread. The data on closing bid-ask spreads is available daily for a wide range of Ukrainian stocks, not depending on the frequency of trading for these stocks. Though for finding reliable estimates of the effective bid-ask spread, frequent data on the prices of executed trades is needed, which is not available for many Ukrainian stocks due to low trading frequency in them.

Preliminary Findings

Before performing the correlation analysis, we first suggest a preliminary analysis of the interrelation between various liquidity measures and the quoted bid-ask spread.

The results of estimation of liquidity measures are presented in Table 5.2. For each liquidity measure, the table also reports the rank of each stock by liquidity. Rank 1 shows that a stock is the most liquid among other stocks. Rank 56 shows that a stock is the least liquid among other stocks.

By the main measure of liquidity, the quoted bid-ask spread, top ten liquid companies were large companies, with market capitalization from USD 86 mln. to USD 3,216 mln. These companies had the bid-ask spread of 1.7%-4.0%. Bottom ten companies by the quoted bid-ask spread were mostly small and medium-sized companies, with market capitalization from USD 15 mln. to USD 66 mln., with an exception of two large companies: USCB with market capitalization of USD 1,294 mln. and ALMK with market capitalization of USD 451 mln. The bid-ask spread for the least liquid companies ranged from 25.3% to 70.2%.

Table 5.2. The estimates of the liquidity measures for the Ukrainian stocks.

The table reports the estimates of liquidity measures for Ukrainian stocks during the first half of 2006. For each liquidity measure, the table also reports the rank of each stock by liquidity. Rank 1 refers to the highest liquidity, while rank 56 refers to the lowest liquidity.

		Liquidity measures											
N	PFTS Code	Quoted bid-ask spread	Rank	Turnover	Rank	Amihud (*10⁶)	Rank	Prop-n of days with Zero returns	Rank	Proportion of no-trading days	Rank	Volatility of Return	Rank
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**UTEL**	1.66%	1	0.00%	48	0.055	3	10.34%	1	9.40%	1	1.34%	5
2	**UNAF**	2.12%	2	0.02%	30	0.031	2	16.38%	4	17.95%	2	0.92%	1
3	**ZAEN**	2.58%	3	0.03%	20	0.136	15	21.55%	9	44.44%	14	1.43%	6
4	**NITR**	2.62%	4	0.02%	26	0.133	13	27.59%	19	33.33%	6	1.83%	20
5	**MMKI**	2.98%	5	0.00%	51	0.18	21	12.93%	3	43.59%	12	1.59%	10
6	**BAVL**	3.33%	6	0.03%	16	0.605	44	26.72%	18	35.04%	8	1.82%	18
7	**AZST**	3.73%	7	0.00%	49	0.311	31	24.14%	14	28.21%	4	1.96%	22
8	**DNON**	3.88%	8	0.01%	43	0.102	12	50.00%	39	70.09%	35	1.54%	9
9	**CEEN**	3.97%	9	0.03%	17	0.243	28	25.00%	15	38.46%	10	1.25%	3
10	**LTPL**	4.01%	10	0.17%	4	0.08	7	25.86%	16	22.22%	3	2.46%	29
11	**DNSS**	4.02%	11	0.03%	18	0.169	19	25.86%	17	46.15%	15	1.75%	17
12	**MZVM**	4.11%	12	0.03%	15	0.073	4	32.76%	24	36.75%	9	1.10%	2
13	**PGOK**	4.11%	13	0.01%	33	0.201	22	36.21%	27	43.59%	13	1.44%	7
14	**STIR**	4.11%	14	0.01%	35	0.556	42	31.03%	22	52.14%	20	2.37%	28

15	**KSTL**	4.24%	15	0.00%	52	0.206	24	43.10%	33	65.81%	29	1.63%	11
16	**DTRZ**	4.26%	16	0.18%	3	0.1	11	24.14%	13	35.04%	7	2.18%	25
17	**ZACO**	4.68%	17	0.02%	27	0.089	8	43.97%	34	58.97%	23	1.47%	8
18	**SMASH**	4.70%	18	0.02%	23	0.284	30	22.41%	10	40.17%	11	2.32%	27
19	**KIEN**	4.74%	19	0.06%	9	0.099	10	43.10%	32	60.68%	24	1.25%	4
20	**AVDK**	5.25%	20	0.01%	47	0.156	18	29.31%	21	48.72%	17	1.69%	13
21	**YASK**	5.31%	21	0.13%	5	0.281	29	32.76%	25	58.12%	22	2.81%	34
22	**DNEN**	5.39%	22	0.05%	12	0.154	17	19.83%	7	52.14%	19	1.70%	14
23	**NVTR**	5.40%	23	0.03%	19	0.211	25	54.31%	41	65.81%	32	1.82%	19
24	**MSICH**	5.41%	24	0.01%	39	0.51	41	27.59%	20	47.86%	16	2.73%	33
25	**ZPST**	5.53%	25	0.08%	8	0.144	16	23.28%	11	29.06%	5	2.13%	24
26	**DOEN**	5.61%	26	0.01%	40	0.314	32	20.69%	8	65.81%	28	1.74%	16
27	**DKOK**	6.18%	27	0.04%	13	0.485	40	39.66%	29	55.56%	21	2.02%	23
28	**GLNG**	6.41%	28	0.05%	11	0.467	38	84.48%	53	88.89%	47	6.27%	48
29	**DOMZ**	6.76%	29	0.01%	36	0.47	39	33.62%	26	64.10%	25	2.70%	32
30	**RODB**	7.70%	30	0.32%	2	0.074	5	24.14%	12	94.02%	52	1.71%	15
31	**DGRM**	8.13%	31	0.10%	7	1.03	47	18.97%	5	70.09%	34	4.04%	41
32	**ZALK**	9.28%	32	0.01%	41	0.328	33	44.83%	36	64.10%	27	2.28%	26
33	**ZFER**	9.75%	33	0.01%	44	0.663	46	54.31%	42	73.50%	37	3.76%	38
34	**MEGA**	10.36%	34	0.40%	1	0.135	14	41.38%	31	89.74%	49	6.56%	49
35	**FORM**	11.25%	35	0.00%	50	0.33	34	87.07%	55	96.58%	55	1.94%	21
36	**ZAON**	12.18%	36	0.01%	37	0.03	1	75.86%	51	88.89%	45	2.51%	31
37	**TATM**	12.23%	37	0.02%	29	0.356	37	31.90%	23	75.21%	38	3.04%	37
38	**PGZK**	12.96%	38	0.04%	14	0.205	23	38.79%	28	51.28%	18	4.04%	40
39	**KRAZ**	13.59%	39	0.01%	45	4.2	53	70.69%	50	82.91%	42	13.00%	54
40	**DRMZ**	14.50%	40	0.01%	34	1.16	49	47.41%	38	65.81%	31	4.67%	44

41	**DNAZ**	14.72%	41	0.12%	6	0.569	43	55.17%	43	71.79%	36	3.99%	39
42	**ZHEN**	15.17%	42	0.02%	28	0.079	6	77.59%	52	88.89%	46	2.47%	30
43	**KREN**	18.36%	43	0.03%	22	0.093	9	62.07%	45	78.63%	39	4.67%	45
44	**NFER**	18.54%	44	0.00%	53	0.237	27	87.07%	54	82.91%	43	1.63%	12
45	**HANZ**	18.73%	45	0.03%	21	0.222	26	43.97%	35	64.10%	26	2.90%	35
46	**AZOT**	22.29%	46	0.01%	42	0.336	35	62.93%	46	92.31%	50	2.97%	36
47	**SHKD**	25.34%	47	0.02%	25	1.46	50	10.34%	2	89.74%	48	4.64%	43
48	**DMPZ**	27.29%	48	0.01%	38	1.05	48	56.03%	44	80.34%	41	6.27%	47
49	**USCB**	28.17%	49	0.01%	46	0.353	36	46.55%	37	65.81%	30	4.17%	42
50	**YAMZ**	32.01%	50	0.00%	54	-	-	18.97%	6	99.15%	56	8.44%	51
51	**HMBZ**	34.42%	51	0.02%	31	1.76	51	39.66%	30	79.49%	40	11.01%	53
52	**SVGZ**	37.32%	52	0.06%	10	0.632	45	53.45%	40	67.52%	33	26.79%	55
53	**SFER**	38.37%	53	0.00%	55	9.44	54	68.10%	48	86.32%	44	7.87%	50
54	**DMZK**	43.34%	54	0.02%	32	0.169	20	69.83%	49	93.16%	51	8.91%	52
55	**HMON**	50.00%	55	0.02%	24	-	-	100.00%	56	94.02%	54	0.00%	-
56	**ALMK**	70.19%	56	0.00%	56	2.05	52	64.66%	47	94.02%	53	6.22%	46
Average		**7.38%**		**0.02%**		**0.28**		**31.27%**		**44.88%**		**2.03%**	

The results suggested by the turnover liquidity measure (Table 5.2, columns 5-6) vary considerably from those based on the quoted bid-ask spreads. Some companies from the top ten list by quoted bid-ask spreads appear to be in the bottom-ten list by turnover. For example, UTEL and AZST have quoted bid-ask spreads of 1.7% and 3.7% respectively but turnovers of only 0.004%. At the same time a company with one of the highest bid-ask spreads, SVGZ (bid-ask spread 37.3%) appears in the top-ten list by turnover with turnover of 0.056%. The result is possibly due to different levels of free float for many companies in the Ukrainian stock market. A lower free float for a company will result in lower turnover just because of a smaller proportion of stocks in the circulation and therefore lower potential for trading the stock in the stock market. In fact, the free floats of UTEL and AZST were 7.14% and 2.75% respectively, whereas the free float of SVGZ was 12.8%[22]. The results give the first indication that turnover has a low ability for measuring liquidity of stocks in Ukraine.

The estimation results show that Amihud's liquidity measure tends to assign liquidity in line with the quoted bid-ask spread. Amihud's measure is found to be low for many companies with a low bid-ask spread and high for many companies with a high bid-ask spread (Table 2, columns 7-8). For example, UTEL, UNAF, and LTPL have ranks 1, 2, and 10 respectively by the quoted bid-ask spread and 3, 2, and 7 respectively by the Amihud's liquidity measure. SFER, ALMK, and HMBZ have ranks 53, 56, and 51 respectively by the quoted bid-ask spread and 54, 52, and 51 respectively by the Amihud's liquidity measure.

Zero return days are fairly prevalent among the Ukrainian stocks. The proportion of zero daily returns vary from 10.3% to 100% (Table 2, columns 9-10). SHKD and UTEL had the smallest value of the measure, 10.3%. HMON had the largest value of

[22] Data from www.fundmarket.com.ua as of February 2009.

the measure, having had just 8 trades in the first half of 2006 and having experienced no quote change over the time (100% of zero daily returns).
Proportion of zero daily returns tends, on average, to be low for the companies from the top-ten liquidity group by quoted bid-ask spread (for example, UTEL (10.3%), MMKI (12.9%), and UNAF (16.4%)) and high for the companies from the bottom-ten liquidity group by quoted bid-ask spread (for example DMZK (69.8%), SFER (68.1%), and ALMK (64.7%)). The only two exceptions are SHKD and YAMZ that were assigned to the bottom-ten group by quoted bid-ask spread (bid-ask spreads of 25.3% and 32% respectively) but to the top-ten liquidity group by proportion of zero daily returns (proportion of zero daily returns of 10.3% and 19% respectively). This possibly indicates that the quotes posted by brokers for these companies changed in the days when no trading occurred. The reason of the change of the quotes can be inflow of new information about the stocks but the expected gain from this information in terms of stock return could not exceed the high cost of trading for these stocks. Therefore, no trading occurred. These findings give a first indication of that proportion of zero daily returns at certain times can inaccurately assign stocks' liquidity.

High interrelation between the quoted bid-ask spread and the proportion of no-trading days is found. The majority of the top-ten liquid companies by quoted bid-ask spread appear in the top list by proportion of no-trading days, which ranges for them from 10.3% to 21.6% (Table 2, columns 11-12). The only exception is DNON with 70.1% of no-trading days. All the bottom-ten stocks by the quoted bid-ask spread appear in the bottom of the list sorted by the proportion of no-trading days, which varies for them from 79.5% to 99.2%.

The volatility of return varies from 0% to 26.8% (Table 2, columns 13-14). For the top ten companies by the quoted bid-ask spread volatility ranged between 0.9% and 2.5%. For the bottom ten companies by the quoted bid-ask spread volatility ranged between 4.2% and 26.8%. Volatility of return seems to be associated with the quoted bid-ask spread.

A problem with this measure can appear if there was no price change for a stock over time. It is very probable that no change of a stock price is an indication of low liquidity of the stock. But the volatility of return will give an opposite indication. It will show 0% volatility for the stock and with this will attribute the highest liquidity to this stock, as it was in the case for HMON. An illiquid stock HMON (quoted bid-ask spread 50%, proportion of no-trading days 94%) had no price change during the first half of 2006, which has resulted in 0% volatility and the top liquidity rating by the volatility liquidity proxy.

Results of the Correlation Analysis

Three types of correlations are analysed, time-series correlations, cross-sectional correlations, and rank correlations.

Time-series correlations are computed for the daily bid-ask spread and the daily turnover liquidity measures and for the daily bid-ask spread and the daily Amihud's liquidity measures. For the other liquidity measures (proportion of zero daily returns, proportion of no-trading days, and the volatility of return), only cross-sectional correlations are estimated due to the nature of the construction of the measures as they can be computed only for a period.

It is expected that if on a day *t* turnover for a stock rises, the bid-ask spread will narrow for the stock on this day. In the same manner, it is expected that if on a day *t* price impact per unit of volume for a stock (Amihud's liquidity measure) rises, the bid-ask spread on this day for the stock will widen.

If a liquidity measure did not change from one day to another, the day of no change is not included in the computation since no variation in one of the two variables can lead to a biased estimate of the correlation coefficient. Due to this, the number of daily observations during the first half of 2006 for some stocks is as low as 0. The estimation results for the time-series correlations are presented in Table 5.3 and will be discussed below together with the results for cross-sectional correlations and rank correlations.

The cross-sectional correlations between the liquidity measures are computed based on the liquidity measures for each stock during the first half of 2006. For the quoted bid-ask spread, turnover, and Amihud's measure, simple averages of the daily values are taken during the first half of 2006. Proportion of zero daily returns, proportion of no-trading days, and volatility of return are computed for the period of the first half of 2006. The results are presented in Table 5.4. We conclude about the efficacy of liquidity measures in measuring liquidity based on the correlation of each measure with the quoted bid-ask spread. Though, for additional information, Table 5.4 also presents correlations of the liquidity measures with each other.

Correlations between the ranks of stocks by the quoted bid-ask spread and by alternative liquidity measures are presented in Table 5.5. All the estimates of the rank correlations are expected to have a positive sign since rank 1 represents the highest liquidity for any liquidity measure, and rank 56 represents the lowest liquidity for any liquidity measure.

The majority of the time-series correlation coefficients for the **quoted bid-ask spread and turnover** are negative, as expected, but insignificantly different from zero. Only for 6 out of 54 companies the correlations are negative and significantly different from zero at least at the 10% significance level (Table 5.3). The cross-sectional correlation between the quoted bid-ask spread and turnover is -0.16 and is not significantly different from zero (Table 5.4). The rank correlation is 0.1653 and is not significantly different from zero. The results support our preliminary findings and suggest that turnover has a low applicability for measuring liquidity of stocks in Ukraine.

Table 5.3. The bid-ask spread and alternative liquidity measure correlations

The time-series correlations are computed based on the daily data for each stock during the first half of 2006. Average is weighted by the number of observations.
*** indicates significance level at 1%, ** indicates significance level at 5%, * indicates significance level at 10%.

	PFTS Code	Correlation of the bid-ask spread and Turnover	P-value of t-stat.	Obs.	Correlation of the bid-ask spread and the Amihud *10^6	P-value of t-stat.	Obs.
1	**ALMK**	-0.7557**	0.049	7	-0.8980	0.290	3
2	**AVDK**	0.1635	0.212	60	0.0975	0.544	41
3	**AZOT**	-0.0556	0.887	9	-	-	2
4	**AZST**	-0.3419***	0.001	84	0.5575***	0.000	70
5	**BAVL**	-0.0930	0.424	76	0.0022	0.987	60
6	**CEEN**	-0.1316	0.271	72	0.3067**	0.020	57
7	**DGRM**	0.1302	0.456	35	0.6663***	0.000	27
8	**DKOK**	0.1678	0.234	52	0.0202	0.904	38
9	**DMPZ**	0.1169	0.595	23	0.4586	0.253	8
10	**DMZK**	0.2542	0.543	8	0.3291	0.671	4
11	**DNAZ**	-0.2813	0.113	33	-0.2929	0.210	20
12	**DNEN**	-0.2753**	0.040	56	0.2696*	0.056	51
13	**DNON**	-0.0238	0.892	35	0.4257**	0.048	22
14	**DNSS**	-0.0847	0.509	63	0.3008**	0.030	52
15	**DOEN**	0.0443	0.786	40	0.0846	0.629	35
16	**DOMZ**	0.1799	0.254	42	0.0117	0.950	31
17	**DRMZ**	-0.1464	0.367	40	0.3467	0.105	23
18	**DTRZ**	-0.0247	0.833	76	0.2385*	0.060	63
19	**FORM**	-0.7097	0.290	4	0.0382	0.976	3
20	**GLNG**	-0.2948	0.328	13	-	-	0
21	**HANZ**	-0.0343	0.829	42	0.2009	0.347	24
22	**HMBZ**	0.1709	0.425	24	-0.0039	0.988	18
23	**HMON**	-	-	7	-	-	0
24	**KIEN**	0.0336	0.824	46	0.1293	0.466	43
25	**KRAZ**	-0.2746	0.241	20	0.8937***	0.000	12
26	**KREN**	0.0403	0.848	25	-0.0270	0.937	11
27	**KSTL**	0.0124	0.939	40	0.3482*	0.075	27
28	**LTPL**	0.0317	0.766	91	0.2496**	0.033	73
29	**MEGA**	-0.3448	0.272	12	0.9994**	0.022	3
30	**MMKI**	-0.2129*	0.086	66	0.1483	0.254	61

31	**MSICH**	0.1177	0.366	61	0.3567**	0.014	47
32	**MZVM**	-0.0096	0.936	74	-0.2121	0.120	55
33	**NFER**	0.3966*	0.083	20	0.3776	0.622	4
34	**NITR**	-0.1364	0.234	78	0.3178**	0.013	60
35	**NVTR**	-0.3307**	0.037	40	0.0861	0.689	24
36	**PGOK**	0.1340	0.283	66	0.1454	0.324	48
37	**PGZK**	0.2545*	0.056	57	0.1409	0.362	44
38	**RODB**	-0.1075	0.839	7	-0.5219	0.367	5
39	**SFER**	-0.0413	0.879	16	-0.4571	0.302	7
40	**SHKD**	-0.3023	0.340	12	0.7588**	0.048	7
41	**SMASH**	0.1100	0.365	70	0.0562	0.678	57
42	**STIR**	-0.0801	0.557	56	-0.1461	0.327	47
43	**SVGZ**	-0.336**	0.039	38	0.4908***	0.009	27
44	**TATM**	0.1155	0.551	29	-0.0247	0.907	25
45	**UNAF**	0.1402	0.173	96	0.1594	0.158	80
46	**USCB**	0.3949**	0.012	40	0.1136	0.543	31
47	**UTEL**	-0.1585	0.105	106	0.3322***	0.001	99
48	**YAMZ**	-	-	1	-	-	0
49	**YASK**	0.0512	0.727	49	0.5243***	0.000	41
50	**ZACO**	-0.1987	0.176	48	0.4322**	0.015	31
51	**ZAEN**	-0.1576	0.210	65	0.0494	0.725	53
52	**ZALK**	-0.0329	0.836	42	0.0457	0.810	30
53	**ZAON**	-0.1332	0.664	13	-0.3807	0.527	5
54	**ZFER**	0.0951	0.611	31	-0.2515	0.314	18
55	**ZHEN**	-0.1921	0.529	13	0.5465	0.453	4
56	**ZPST**	-0.1235	0.266	83	0.3491***	0.003	70
	Average	**-0.0367**			**0.1994**		

Table 5.4. The cross-sectional correlations between the liquidity measures.

The cross-sectional correlations are computed based on the averages for each measure for 56 Ukrainian stocks during the first half of 2006.
The p-value of the t-statistics is reported in the parentheses. *** indicates significance level at 1%, ** indicates significance level at 5%, * indicates significance level at 10%.
Number of observations: 56

	Quoted bid-ask spread	Turnover	Amihud (*1,000,000)	Proportion of zero returns	Proportion of no-trading days	Return Volatility
Quoted bid-ask spread	**1** (-)					
Turnover	**-0.1624** (-0.232)	**1** (-)				
Amihud (*1,000,000)	**0.4428***** (-0.001)	**-0.1495** (0.281)	**1** (-)			
Proportion of zero returns	**0.4981***** (0.000)	**-0.1678** (0.216)	**0.2545*** (0.063)	**1** (-)		
Proportion of no-trading days	**0.6185***** (0.000)	**0.0407** (0.764)	**0.2899**** (0.033)	**0.6665***** (0.000)	**1** (-)	
Return Volatility	**0.5081***** (0.000)	**0.0268** (0.845)	**0.3562***** (0.008)	**0.2197** (0.104)	**0.3412***** (0.010)	**1** (-)

Table 5.5. Rank correlations between the liquidity measures.

The estimates are found by correlating the ranks of stocks by the quoted bid-ask spread with the rank s of stocks by alternative liquidity measures during the first half of 2006.
The p-value of the t-statistics is reported in the parentheses. *** indicates significance level at 1%, ** indicates significance level at 5%, * indicates significance level at 10%.
Number of observations: 56

	Turnover	Amihud *1,000,000	Proportion of zero returns	Proportion of no-trading days	Return Volatility
Quoted bid-ask spread	0.1653 (0.223)	0.5112*** (0.000)	0.5958*** (0.000)	0.8090*** (0.000)	0.8028*** (0.000)

The results are in line with the findings in Bekaert et al. (2006) and Lesmond (2005). Bekaert et al. (2006) found that for a cross-section of 9 emerging markets, correlation between the bid-ask spread and turnover was only -0.2. Lesmond (2005) found that turnover was negatively and significantly correlated with the bid-ask spread in only 9 of the 23 emerging markets studied; the cross-country estimate of the correlation coefficient was found very low, just -0.065. Lesmond (2005) concludes: "the most telling finding [of the paper's analysis] is the lack of correlation between turnover and the bid-ask spread… These results cast doubt on a wide range of studies employing turnover as a principal liquidity proxy."

The daily time-series correlations between the **quoted bid-ask spread and the Amihud's measure** for each stock show high level of interrelation between these two liquidity measures. For 18 out of 52 companies correlations are significant and quite high (from 23.9% to 99.9% at least at 10% significance level, Table 5.3). Cross-sectional correlation of the two liquidity measures is high, 44.3%, and significantly different from zero at 1% significance level (Table 5.4). The rank correlation is 51.1% and is also significantly different from zero at 1% significance level. The results suggest that Amihud's measure is applicable for liquidity measurement in the Ukrainian stock market. Similar conclusion was drawn for the emerging stock markets study of Lesmond (2005): "Amihud's measure is very highly (positively) correlated with the [quoted bid-ask] spread regardless of country". The study finds positive and significant (at 1% significance level) correlations that vary from 18.5% for Taiwan to 63.6% for Argentina. Lesmond (2005) adds: "the results for Amihud's measure perhaps are surprising given that the bid-ask spread is not often associated with price impact costs". Goyenko et al. (2009) find that for the U.S. stocks there are also quite high and significantly different from zero cross-sectional and time-series correlations of the Amihud liquidity measure with the effective bid-ask spread (57.1% and 53.9% respectively). The Amihud liquidity measure seems to work well in both emerging and developed markets.

The cross-sectional correlations of the **proportion of zero daily returns and the proportion of no-trading days with the quoted bid-ask spread** are 49.8% and 61.9% and respectively, and both are significant at 1% significance level (Table 5.4). The rank correlations are 59.6% and 80.9% respectively (Table 5.5). Therefore both measures are well applicable for measuring liquidity in the Ukrainian stock market. Higher correlation coefficient of the proportion of no-trading days suggest better applicability of this measure compared to the proportion of zero daily returns measure. The finding is in line with the assumption, on which the proportion of zero daily returns measure is based. Lesmond et al. (1999) and Bekaert et al. (2006) explain that the measure is applied as a proxy for the proportion of no-trading days based on the assumption that on no-trading days zero return will be observed. The assumption is not always true, therefore it is not surprising that the proportion of no-trading days performs better than its proxy.

Higher correlations of the two measures with the quoted bid-ask spread relative to Amihud's measure suggest higher ability of these two measures than Amihud's measure to measure liquidity in Ukraine. This result is possibly related to no dependence of the two measures to the volume, which is, as proved by the low significance of turnover, not a good proxy for liquidity.

Our results for the proportion of zero daily returns are in line with the findings in Bekaert et al. (2006) and Goyenko et al. (2009). Bekaert et al. (2006) also find that the proportion of zero daily returns measure is highly correlated, 48% on average, with the mean bid-ask spread across all 9 emerging markets for which the bid-ask spreads are available. Goyenko et al. (2009) documented that for a cross-section of 400 U.S. stocks, correlation between zero daily returns and effective bid-ask spread is quite high, 42.7% for monthly data frequency and 59.0% for annual data frequency.

The **volatility of return** has a high and significantly different from zero cross-sectional and rank correlations **with the quoted bid-ask spread**, 51% (Table 5.4) and

80% (Table 5.5) respectively, which suggest that this measure has power in measuring liquidity of stocks in the Ukrainian stock market.

To summarize, four measures out of the five applied (Amihud's measure, the proportion of no-trading days, the proportion of zero daily returns, and volatility) have shown quite high time-series (where applicable), cross-sectional, and rank correlations with the quoted bid-ask spread. Therefore they are concluded to have a high ability in measuring liquidity of stocks in the Ukrainian stock market. Out of them, the proportion of no-trading days has shown the highest (and significant) correlations (both cross-sectional and rank) with the quoted bid-ask spread and therefore is considered as a superior measure for measuring liquidity of stocks in Ukraine. It is followed by the proportion of zero daily returns, volatility of return, and, finally, Amihud's measure. Turnover has shown a very low association with the quoted bid-ask spread and is concluded to be inappropriate for measuring liquidity of stocks in the Ukrainian stock market.

Comparison of the Ukrainian Stock Market Liquidity to the Liquidity of Other Emerging Markets

To see the place of the Ukrainian stock market by liquidity among other emerging markets, liquidity measures estimated for Ukraine in this chapter are compared to the liquidity measures estimated for emerging markets in other literature. The comparison will also show how to use different liquidity measures and will present the interrelationships between different liquidity measures.

There are very few available academic studies on liquidity in the emerging stock markets. Lesmond (2005) and Bekaert et al. (2006) are some of the few papers in the area.

The liquidity measures for Ukraine estimated in this chapter are compared to the liquidity measures for other emerging markets estimated in Lesmond (2005) based on the quoted bid-ask spread, turnover, Amihud's measure, and the proportion of zero daily returns liquidity measures. Also, the proportion of zero daily returns in Ukraine is compared to the proportion of zero daily returns estimated in Bekaert et al. (2006) for other emerging markets. Lesmond (2005) and Bekaert et al. (2006) do not include Ukraine in their datasets.

Bekaert and Harvey (1995) argue that in the universe of emerging stock markets, the markets of Chile and Colombia are the least liquid and the markets of Korea and Taiwan are the most liquid. The estimates for the Ukrainian stock market are compared to those for Chile, Colombia, Korea, Taiwan, and to a number of Eastern European stock markets – Poland, Czech Republic, and Russia to also show the liquidity of the Ukrainian stock market relative to its neighbour markets.

Our dataset covers a greater part of the Ukrainian listed stocks (56 out of 262 listed) than the dataset in Lesmond (2005). Due to the limitations with the available data, the number of the companies for each country included in the dataset in Lesmond (2005) is quite limited. For example, only 30 companies are included for India (out of 4,763 listed in 2005[23]), 178 companies for Malaysia (out of 1,020), 4 companies for Argentina (out of 101), 5 companies for Czech Republic (out of 36), 25 companies for Poland (out of 248), 7 companies for Russia (out of 96)). The source of the data in Lesmond (2005) is Datastream, a database that provides data only for the most liquid companies in emerging markets. Therefore, the liquidity estimates found in Lesmond (2005) are to be attributed to the stocks with higher liquidity rather than to the markets as a whole. On average, 12% of the number of the listed stocks for each country was covered by the dataset in Lesmond (2005).

[23] The data on the number of listed companies for each of the markets is taken from the World Bank's World Development Indicators 2006.

To make the liquidity estimates found for Ukraine in this chapter comparable to the liquidity estimates in Lesmond (2005), we recalculate the liquidity measures for Ukraine and include only 12% of the all quoted stocks in Ukraine, which is roughly 30 stocks, in the computations of the liquidity measures. The liquidity estimates for emerging markets from Lesmond (2005) and our recalculated estimates are presented in Table 5.6.

Table 5.6. The liquidity estimates for a selection of countries from Lesmond (2005) and the adjusted liquidity estimates for Ukraine.

The estimates for all countries, except Ukraine, are the liquidity estimates from Lesmond (2005). The estimates are found based on data period from 1987 to 2000. The estimates for Ukraine are own calculations. The calculations for Ukraine are based on the data for only top 30 companies ranked by liquidity (measured by the quoted bid-ask spread). The companies represent 12% of the number of the quoted companies in the Ukrainian stock market (as of end of 2006). The estimates are equally weighted averages of the estimates for individual stocks. The sample is created to make the results for the Ukrainian stock market comparable to the results in Lesmond (2005). The Ukrainian estimates are found based on the data period of the first half of 2006.

Country	Quoted bid-ask spread, %	Rank by quoted bid-ask spread	Turnover*	Rank by Turnover	Amihud ($*10^6$)	Rank by Amihud	Prop-n of zero daily returns	Rank by prop-n of zero daily returns
Chile	-	-	0.28%	5	0.15%	4	42.27%	7
Colombia	4.52%	5	0.06%	7	0.00%	1	50.94%	8
Czech Republic	8.15%	6	1.25%	2	0.43%	5	32.28%	5
Korea	1.95%	2	1.58%	1	0.01%	2	15.33%	2
Poland	3.13%	3	0.33%	4	1.90%	6	19.37%	3
Russia	47.22%	7	0.22%	6	4.88%	7	41.55%	6
Taiwan	1.09%	1	1.21%	3	0.04%	3	11.57%	1
Ukraine	4.49%	4	0.02%	8	18.60%	8	25.48%	4

*Turnover is a ratio of shares traded to shares outstanding.

It is important to note that liquidity of the Ukrainian stock market in 2006 is compared to liquidity of other stock markets in 1990s. Comparison of Ukraine to the other stock markets in 2006 would give more accurate results, though liquidity estimates for emerging markets in 2006 are not available in literature.

The comparison of liquidity of Ukraine with other emerging markets shows that by volume-related measures of liquidity (turnover and Amihud's) Ukraine has the worst rating, 8, among all the emerging markets considered. The reason of this is probably the peculiar feature of the Ukrainian stock market – very low free float. Because of the low free float, turnover (the ratio of shares traded to shares outstanding) in Ukraine is extremely low. Also due to the low number of stocks in circulation in the stock market, an increase in daily volume traded causes considerable price impact in Ukraine, which is reflected in the high value of Amihud's measure relative to other countries.

The comparison of liquidity of Ukraine based on non-volume liquidity measures (the quoted bid-ask spread and the proportion of zero returns) with Korea, Taiwan, Chile, and Colombia shows that Ukrainian stock market is less liquid than the stock markets of Korea and Taiwan, though more liquid than the stock markets of Chile and Colombia. Lower proportion of zero daily returns for Ukraine than for Chile and Colombia shows that even though the free float in Ukraine is very low, the circulation of the free float in Ukraine is more active than in Chile and Colombia. Since volume-related liquidity measures are found in literature as less reliable for measuring liquidity in the emerging stock markets than non-volume-related, we give more credence to the comparison results based on the quoted bid-ask spread and the proportion of zero returns.

The comparison of liquidity of Ukraine based on non-volume related liquidity measures (the quoted bid-ask spread and the proportion of zero returns) with Czech Republic, Poland, and Russia shows that Ukrainian stock market in 2006 was less liquid than the stock market in Poland and more liquid than stock markets in Czech Republic and Russia in 1990s (Table 5.6). The results emphasize low development of the Ukrainian stock market as the stock market of Poland, a country comparable to Ukraine by the size of the economy, the level of industrialization, and the time of beginning of transition to the market economy, had a more liquid than in Ukraine stock market already a decade ago.

Bekaert et al. (2006) presents estimates of the proportion of zero daily returns for a number of emerging markets. The estimates are done based on the dataset from the Datastream research files, which covers the majority of the companies traded in a market, for example, 892 for India, 815 for Malaysia, and 83 for Argentina. Therefore the liquidity estimates in Bekaert et al. (2006) can be directly compared with those computed in this chapter. The estimates for Korea, Taiwan, Chile, and Colombia as well as our estimates for Ukraine are presented in Table 5.7. The ranks of the countries by the proportion of zero daily returns based on the results in Bekaert et al. (2006) are in line with those based on the results in Lesmond (2005): Ukraine is found more liquid than Chile and Colombia, though less liquid than Taiwan and Korea.

Table 5.7. The estimates of the proportion of zero daily returns for a selection of countries from Bekaert et al. (2006) and the proportion of zero daily returns for Ukraine.

The estimates for all countries, except Ukraine, are the liquidity estimates from Bekaert et al. (2006). The estimates are found based on the data period from 1987 to 2000. The estimates for Ukraine are own calculations. The Ukrainian estimates are found based on the data period of the first half of 2006.

Country	Proportion of zero daily returns	Rank
Korea	8.20%	2
Taiwan	6.60%	1
Chile	46.60%	4
Colombia	51.90%	5
Ukraine	44.90%	3

5.6. Conclusion

This chapter applies a number of liquidity measures for assessing firm-level liquidity in the Ukrainian stock market, studies their efficacy, and points out the place of Ukraine by liquidity among other emerging stock markets of the world. The liquidity measures applied in the chapter are the quoted bid-ask spread, turnover, Amihud’s measure (Amihud, 2002), the proportion of zero daily returns (Lesmond et al., 1999), the proportion of no-trading days (Lesmond, 1999), and the volatility of return.

The liquidity costs range widely across the Ukrainian stocks. For example, the bid-ask spread varies from 1.7% for UTEL to 70.2% for ALMK, which underlines importance of accurate liquidity measurement for investors and portfolio managers when making their investment decisions, as well as for researchers who employ stock liquidity in their studies.

The correlation analysis allows to assess efficacy of different liquidity measures in measuring liquidity of the Ukrainian stocks. Four measures out of the five applied (Amihud's measure, the proportion of no-trading days, the proportion of zero daily returns, and volatility) have shown high correlation with the quoted bid-ask spread. Therefore they are concluded to have a high ability in measuring liquidity of stocks in the Ukrainian stock market. Out of them, the proportion of no-trading days has shown the highest (and significant) correlations (both cross-sectional and rank) with the quoted bid-ask spread and therefore is considered as a superior measure out of the other measures applied. It is followed by the proportion of zero daily returns, volatility of return, and, finally, Amihud's measure.

High efficacy of the proportion of zero daily returns in measuring liquidity of emerging stock markets was also found in Lesmond (2005) and Bekaert et al. (2006). Though this measure does not seem to be effective for measuring liquidity in the developed stock market of the U.S. (Goyenko et al., 2009).

Amihud's measure was found quite effective for measuring stock liquidity in both emerging and developed markets (Lesmond (2005), Goyenko et al. (2009), and the results of our study).
Turnover has shown a very low association with the quoted bid-ask spread and is concluded to be inappropriate for measuring liquidity of stocks in the Ukrainian stock market. The result is in line with the findings for emerging stock markets in other literature (Lesmond (2005) and Bekaert et al. (2006)).

It is argued that in the universe of emerging stock markets, the markets of Korea and Taiwan are the most liquid and the markets of Chile and Colombia are the least liquid. Comparison of liquidity of the Ukrainian stock market to these four markets have shown that based on non-volume-related liquidity measures (quoted bid-ask spread and proportion of zero daily returns), Ukrainian stock market is less liquid than those of Korea and Taiwan and more liquid than those of Chile and Colombia. Based on the volume-related liquidity measures (turnover and Amihud's), Ukrainian stock market was found less liquid than all the four markets. Since non-volume related liquidity measures are found to be more reliable for measuring liquidity of emerging stock markets than volume-related liquidity measures (Lesmond (2005), Bekaert et al. (2006), own results in the chapter), we give more credence to the comparison of the markets' liquidity based on the quoted bid-ask spread and the proportion of zero daily returns.

Low liquidity of the Ukrainian stock market is seen as an important reason of the high cost of trading in this market.

Chapter 6

Estimation of the Components of the Bid-Ask Spread

6.1. Introduction

The bid-ask spread, or more correctly the effective bid-ask spread, is the major cost of equity trading. It is therefore an important economic phenomenon, which researchers have tried to understand.

The theory suggests that there are three main sources of the bid-ask spread: i) order processing cost, ii) inventory holding cost, and iii) information asymmetry, or adverse selection cost.

The *order processing cost* is the oldest identified in literature. It refers to different kinds of administrative costs related to order execution, like office rent, salaries to the employees, costs of finding counterparts for a trade, etc.

Some authors argue that market makers use spread to compensate for some unwanted *inventory* positions. Because of their role of liquidity suppliers, market makers are obliged to constantly post quotes and must be ready to play as counterparts for each trade; as a result, they falling an inventory risk due to positions away from their desired target level. The relationship between the spread and inventory costs has been studied, among others, by Stoll (1978), Ho & Stoll (1981) and Amihud & Mendelson (1980).

The existence of the *information asymmetry cost,* or adverse selection cost, grounds on the idea that a market maker always loses to informed traders, but recovers his losses with the gains he earns from transactions with uninformed traders. The relationship between information asymmetry and the bid-ask spread has been the object of numerous studies (Copeland & Galai (1983), Glosten & Milgrom (1985), Easley & O'Hara (1987), etc.).

Since the mid 1980s, many researchers have attempted to empirically estimate the components of the bid-ask spread. Their methods essentially vary in (i) the number of components into which the bid-ask spread is decomposed (some methods decompose the bid-ask spread into all the three components, while other can group some of the components together) and (ii) the way they try to identify the considered components (one class of methods is based on the serial covariance properties of price changes, while another estimates the spread components by running regressions using a variable that indicates the direction of each trade).

The spread decomposition models have been largely used in empirical studies for various purposes. The examples given hereunder are far from being exhaustive. By comparing the spread components between open outcry auction and automated order execution on the Sydney Futures Exchange, Wang (1999) showed that floor traders are better able to assess the presence of adverse information than screen traders. Saporta et al. (1999) found that a reduction in the delay of reporting on the London Stock Exchange in January 1996 did not have any impact on the relative components of the spread, thereby suggesting that this change did not affect market liquidity. Menyah and Paudyal (2000) studied how the spread components were affected by stock liquidity on the London Stock Exchange. Dennis and Weston (2001) analysed the relationship between the adverse selection component of the bid-ask spread and the ownership structure of firms and suggested that institutions and insiders were better informed than individual investors. Elder et al. (2004) considered the impact of tracking stocks on the adverse selection component of spreads posted by market makers.

Having shown in Chapter 4 of the thesis that the spreads are much wider in the Ukrainian stock market than in the developed and many other emerging markets, we are interested in estimation of the components of the bid-ask spread with an aim to explain the sources of the substantial width of the spreads.
The literature on the bid-ask spread decomposition for the Ukrainian stock market is very scarce. To our knowledge, only Ryzhkov (2007) studied the components of the bid-ask spread in the Ukrainian stock market. The study estimated the model of Huang and Stoll (1997) customized for the Prague stock exchange by Hanousek and Podpiera (2003).

The level of private information trading in the Ukrainian stock market is viewed as high (EBRD, 2008 [1]), transparency of public companies and the ownership structure disclosure are low (EBRD, 2008 [1], EBRD, 2008 [2], S&P/FIA, 2007). We suspect that an important reason of wide bid-ask spreads is a high level of information asymmetry in the Ukrainian stock market.

This chapter estimates the components of the bid-ask spread for the Ukrainian stocks by applying Stoll (1989), Huang and Stoll (1997), and Glosten and Harris (1988)) models of the bid-ask spread decomposition. Three different models are applied in order to check whether the estimates provided by alternative models are plausible and consistent with each other.

The chapter is organised as follows. Section 6.2 provides a review of literature, Section 6.3 presents the methodology of the bid-ask spread decomposition, Section 6.4 explains the estimation procedure, Section 6.5 discusses the estimation results, and Section 6.6 summarizes and concludes.

6.2. Review of Literature

This part of the chapter gives a general overview of the most frequently cited in literature spread decomposition models. A deeper discussion of the models with the derivation of the main equations will be presented in the Methodology part.

Early Models of the Bid-Ask Spread

For many decades the existence of the bid-ask spread was explained purely by the necessity to compensate brokers their order processing costs. A simple paper by **Bagehot (1971)** has given an origin to a new theory that posited an important role for information in determining the bid-ask spread. Bagehot (1971) developed his argument based on the fact that there are traders in the market that are better informed than the market-maker. They buy when they know that the stock price is too low and sell when it is too high. Moreover these informed traders have an option not to trade as opposed to the market-maker who always has to quote buy and sell prices. As a consequence, the market maker always loses when he trades with informed traders. In order to compensate for the losses, the market maker widens his bid-ask spread and recovers from the uninformed traders what he has lost to the informed traders. This insightful idea about the role of asymmetric information in determining assets' buy and sell prices provided a new and important direction in the market microstructure research.

The first attempt to formally analyse the concept of information asymmetry was done by **Copeland and Galai (1983).** Their analysis develops a one-period model of the market-maker's pricing problem under an assumption that a fraction of traders have superior information. The model also assumes that the order processing and inventory holding costs are zero and, consequently, the bid-ask spread is induced solely by the adverse information component. The market maker's profit function is set and its maximization problem is solved. The results suggest the bid and ask prices that an efficient market maker would set. The size of the spread differs with various market parameters, in particular the elasticities of traders' demand functions and the trading probabilities of informed and uninformed traders but as long as there is a positive probability that some of the traders are informed, spread is never zero.

While the model manages to formalize the influence of asymmetric information on the posted bid and ask price, it does so in a static one-period framework. Because the dealer's decision problem in this framework is simply to balance gains and losses, the problem is very similar to the inventory control problems widely discussed in earlier literature (Garman (1976), Stoll (1978), Amihud and Mendelson (1980), and Ho and Stoll (1981)). The similarity disappears when dynamic considerations are introduced. According to the asymmetric information hypothesis, the trade itself conveys information. The continued trading of the informed traders provides a potential for uninformed market makers to infer the underlying information and to adjust the quotes accordingly. What is missing in Copeland and Galai (1983) framework is the realization that the trades in themselves could reveal the underlying information and affect future prices. The concept that trades themselves are signals of information was developed by Glosten and Milgrom (1985) and Easley and O'Hara (1987). Their models have contributed not only to describing the process of price formation but also to the market efficiency theory. In previous research the exogeneity of order flow reduced the market maker's problem to setting such prices that would balance his gains and losses over time. Now, however, the ability to learn from the order flow meant that private information revealed through trading can be incorporated into the market prices, which means that the price path is not independent of the private information.

The modelling of the process of the brokers' price setting developed by Glosten and Milgrom (1985) and Easley and O'Hara (1987) has given an origin to the modern spread decomposition models such as Huang and Stoll (1997), Glosten and Harris (1988), and Madhavan, Richardson, and Roomans (1997).

The model by **Glosten and Milgrom (1985)** (further referred to as GM) assumes zero order processing and inventory holding costs and focuses on how information *per se* affects prices. Some traders have information about the true value of an asset while others do not. Similar to Copeland and Galai (1983), the specialist sets such prices so that his expected profit on any trade is zero. The main difference with Copeland and Galai (1983) though is that the direction of trade (a purchase or a sale) has a signal value and influences the price that the specialist sets. Following a trade, the specialist revises his beliefs about the stock value and sets a new trading price. The bid and ask prices set by a rational specialist are found by solving a Bayesian learning model. The model assumes that the specialist knows the probabilities of arrival of a good or a bad news about the stock and the probability of trading with an informed or an uninformed trader.

The model is solved by computing the probabilities of a purchase and a sale[24]. The probability functions depend on two variables: the probability of occurrence of an informed/uninformed trade and the probability of arrival of a good/bad news in the market.

One of the important results of GM is showing that the spread exists independent of existence of order processing costs or inventory holding risk. Similar to Copeland and Galai (1983), the spread arises due to the asymmetric information in the market. Because of the asymmetric information, a specialist aims at setting such bid and ask prices that will balance his losses to informed traders with his gains from uninformed traders. Though, different to Copeland and Galai (1983), the information is revealed dynamically, from the direction of the previous trade.

[24] Even though it is often assumed that buys and sells are equally likely, it is not necessarily true, especially when intraday data is considered. If there is a good news, the probability of a buy order is higher; if there is a bad news, the probability of a sell order is higher (O'Hara (1995)).

Easley and O'Hara (1987) develop the Glosten-Milgrom model by allowing traders to transact different trade sizes. A trader whose turn is to transact may either buy a small or a large quantity, sell a small or a large quantity, or simply not trade. Some informed traders would trade a large quantity only if uninformed traders want to trade the large quantity. If they did not, then a large trade could only be initiated by an informed trader, and market-maker's prices for large trades would then be the full information values. Allowing the informed traders to select among trade sizes implies that the equilibrium need not be that of the Copeland and Galai (1983) or Glosten and Milgrom (1985). In particular, the price will depend on the beliefs of the market-maker about the quantity that an informed trader can choose to trade.

Easley and O'Hara (1987) demonstrate that in such setting two types of equilibria are possible. The informed traders could choose to trade only large quantity and with that separate themselves from the small uninformed traders (this will occur if an informed trader is able to offset the better price by the ability to trade more shares, albeit at a worse price). Alternatively, informed traders could choose to submit both large and small orders and thus be pooled with the uninformed traders (in order to benefit from a better price due to hiding their identity). If the first case is true, then no spread would exist for the trades of small quantity but buy and sell prices for the large trades will be separated by a spread. In many active markets there are cases of very large blocks to be transacted, suggesting that in such markets a separating equilibrium might be expected to prevail (O'Hara (1998, p. 69)). If the second case is true, spread will exist for both small and large trades.

One of the important implications of the model is demonstration that information is revealed not only through the direction of an order but also through its size. Therefore, examining only small-trade spread cannot provide a comprehensive view on the level of the cost of trading in a stock market.

An Introduction to the Spread Decomposition Models

The modelling of the quotes that a rational market-maker would set based on the information received from the order flow gave an origin to a further question. If the bid-ask spread covers not only order processing costs but also asymmetric information costs, what portion of the spread does each of the costs constitute? Many models were developed in literature to answer the question though most of them can be attributed to one of the two classes: the covariance-based models and the trade indicator models. Trade indicator models have proved to be more promising and attracted more attention among the researchers.
Four most frequently cited in literature spread decomposition models are discussed below. They are the covariance-based model by Stoll (1989) and three trade indicator models by Glosten and Harris (1988), Huang and Stoll (1997), and Madhavan, Richardson and Roomans (1997).

Some of the spread decomposition models allow us to decompose the bid-ask spread into only two rather than three components. The models of Glosten and Harris (1997) and Madhavan, Richardson and Roomans (1997) decompose the bid-ask spread into asymmetric information component and the sum of the inventory holding and the order processing components. Whereas the model of Huang and Stoll (1997) (2-way decomposition) groups together the asymmetric information and the inventory holding components and estimates separately the order processing cost component. The models that allow spread decomposition into all the three components are Stoll (1989) and Huang and Stoll (1997) (3-way decomposition).

An important side-benefit of the spread decomposition models is their ability to estimate the effective bid-ask spread just from the trade price and trade direction data and with no need of the quoted bid-ask spread data, as opposed to the benchmark method (used for estimation of the effective bid-ask spread in Chapter 4). These models have also an advantage over the Roll model of the effective bid-ask spread as they take into account all three sources of the spread (order processing costs, inventory holding costs, and asymmetric information costs) whereas the Roll model assumes only order processing costs.

The Covariance-Based Spread Decomposition Models

The covariance-based models estimate the spread components based on the serial covariances of trade prices or bid-ask quotations.

One of the most frequently sited in literature covariance-based model is the model by Stoll (1989).

Stoll (1989) starts his analysis with studying the stock price development under alternative spread models. In case of the pure order processing cost model, and assuming no public information shocks, transactions will occur at the bid or ask prices, and these prices will not change in time (Roll (1984)). Stoll (1989) models the pure order processing cost model by assigning an expected value to two parameters, ∂ and π. ∂ is related to the size of a price reversal, which is given by $(1-\partial)S$, where S is the spread and $0 \leq \partial \leq 1$. The probability of a price reversal is given by π. Under the pure order processing view of the spread, prices simply move between the bid and the ask, and the price reversal is equal to the spread ($\partial=0$). In these models, it is usually assumed that the inflow of orders is such that the probability of a purchase equals the probability of a sale ($\pi=0.5$).

If the spread reflects inventory holding costs, dealers will change the position of the spread relative to the "true" price in order to induce public transactions that would balance the inventory position of the dealer: the bid and ask prices will be raised after a purchase in order to induce more sales, while the bid and ask prices will be lowered after a sale in order to induce more purchases (Stoll (1978) and Ho and Stoll (1981)). A similar adjustment of prices will be performed by dealers in case of presence of the asymmetric information costs, but for a different reason. After a purchase, bid and ask prices will be raised because the transaction conveys information that the expected equilibrium price of the security is higher. Similarly, a sale conveys information that causes the dealer to lower the quoted price (Copeland and Galai (1983) and Glosten and Milgrom (1985)). Stoll (1989) argues that the difference in the reason of price change in the two models will result in different values of π. In case of the inventory holding cost model, the adjustment of prices is intended to modify the probability of a transaction in one direction or the other and, as a result, the probability of the price reversal should exceed 0.5. In case of the asymmetric information cost model, the probability of price reversal should equal 0.5 since the dealers will set such bid and ask prices that will result in the probability of a purchase and probability of a sale to be equal.

Based on the values of the probable price changes after a purchase and after a sale, Stoll works out the values of the new bid and ask prices posted by the dealers and finds the covariances of price changes. For estimating the model, Stoll utilizes the relation between the bid-ask spread and the covariances of the consecutive price changes developed by Roll (1984). By regressing the bid-ask spread on the covariances, Stoll is able to estimate the parameters ∂ and π.

Further, based on the value of the realized spread (a concept in Stoll (1989) similar to the effective spread) and the estimated values of ∂ and π, Stoll decomposes the quoted bid-ask spread into its three components: order processing cost, inventory holding cost, and asymmetric information cost.

Stoll applies data on nearly 750 stocks traded on Nasdaq and estimates the model separately for each of the months of October, November, and December 1984. The theoretical model assumes application of intraday quotations and prices, though the limitations with the data constrain Stoll to applying data on the daily level of frequency.

Stoll finds that the average realized spread (the actual profit earned by the broker) is 57% of the quoted spread. The remaining 43% are lost due to the adverse stock price movement in response to the information learned from the direction of the previous trade. This part of the bid-ask spread is referred to as the asymmetric information component.

The realized spread is then decomposed into the inventory holding and the order processing costs. The decomposition is based on the assumption that market maker will adjust his quotes upwards (downwards) by half-value of the quoted spread following each buy (sell) trade in order to balance his inventory position. Stoll finds that the inventory holding cost is 10% of the quoted spread, and the remaining 47% of the quoted spread is the order processing cost.

Stoll runs additional tests to check whether the covariances of price changes and quote changes depend on some characteristics of the stocks other than the main determinant of the model, which is the quoted bid-ask spread. He includes such stock characteristics as average stock price during the month, average daily turnover, average daily volume of trading, and the average number of the market makers in a stock and finds that the additional stock characteristics do not play a significant role in explaining a stock price behaviour. The finding is predictable though, since most of the above mentioned variables are the determinants of the bid-ask spread (Harris, 2003, Ch. 14) and their inclusion in the regression, therefore, is not expected to increase the regression's explanatory power.

Stoll (1989) does not view the asymmetric information component as a part of realized spread but considers the asymmetric information component to be a difference between quoted and realized spread, while the inventory holding and the order processing cost components are the constituents of the realized spread. This differentiates the Stoll's (1989) approach from the approach of Glosten and Harris (1988), Huang and Stoll (1997), and Madhavan, Richardson, Roomans (1997) that consider the asymmetric information component, as well as the inventory holding and the order processing cost components, a part of the effective bid-ask spread.

The Findings of the Trade Indicator Models of Decomposition of the Bid-Ask Spread

One of the first trade indicator models was suggested by **Glosten and Harris (1988)** (further referred to as GH). The model allows decomposition of the bid-ask spread into the asymmetric information component and the transitory component (the sum of the order processing and the inventory holding costs of the brokers). The micro foundations of the decomposition lie in the earlier analysis by Copeland and Galai (1983), Glosten and Milgrom (1985), and Easley and O'Hara (1987) that investigated the information content of trades and showed that the order flow of trades for a stock can reveal to the market private information about the stock. GH start developing their spread decomposition model with defining the true, or fundamental, stock price. They suggest that the true stock price at period *t* equals the sum of the stock price at the previous period, the public information shock at period *t*, and a permanent change in price due the private information learned by brokers from the order flow (Glosten and Milgrom (1985)). Following Glosten and Milgrom (1985) and Easley and O'Hara (1987), GH assume that a broker does not know whether the incoming order is submitted by an informed or an uninformed trader and therefore adjusts his view of the fundamental price only by a certain amount, which is positive if the incoming order is a purchase, and negative if it is a sale. The value of the adjustment is the asymmetric information component of the bid-ask spread. Since the fundamental price is not observed and only purchase and sale prices are observed instead, GH add the bid-ask bounce to the fundamental price, which captures the order processing costs and the inventory holding costs of the brokers and is referred to as a transitory component of the bid-ask spread. The transitory component is incorporated through the trade indicator variable, which takes value 1 if a trade was a purchase and -1 if a trade was a sale.

The model takes into account the influence of trade size on the components of the spread. Similar to the previous theoretical papers of Easley and O'Hara (1987) and Glosten (1987), the model of GH assumes that the asymmetric information spread

component should increase with the quantity traded. An informed trader aims at maximizing his return on information that loses its value over time. The peculiarity of the GH approach is that it models the asymmetric information component as a linear function of the trade size.
Introduction of first differences in the stock price development model makes the model exactly identified and allows estimation of the asymmetric information and the transitory components.

To empirically test the model, GH apply the maximum likelihood estimation method and employ data on 20 NYSE common stocks chosen in the alphabetical order for the period of 1981-1983. For each stock they select about 700 successive price changes. These correspond to approximately three weeks of trading for the most actively traded stocks and ten months for the least actively traded ones.
GH find that the average round trip spread for a trade of 1,000 shares is $0.075 per share. A trade of 10,000 shares is more expensive, its round trip spread is $0.310 per share. The empirical results have shown no dependence of the transitory component on the trade size. The differences in the value of the spreads for smaller and larger trades are due solely to the asymmetric information costs and the direction of the relation between the asymmetric information component and the trade size was found positive, as it was expected. For a trade of 1,000 shares, the share of asymmetric information component is 35.5% of the effective spread, and for a trade of 10,000 shares it is 84.6% of the effective spread. If take into account that majority of the trades in a stock market are small and medium-sized trades, the estimate of the asymmetric information component of GH is, on average, close to that found in Stoll (1989).
GH note that their estimate of the asymmetric information component is identical to the estimates of the permanent price change following a large trade found in other literature (Kraus and Stoll (1972) and Holthausen, Leftwich and Mayers (1987)).

The model of **Huang and Stoll (1997)** (further referred to as HS) suggest another way of decomposing the bid-ask spread. The analysis of the model allows separating the sum of the asymmetric information and the inventory holding cost components of the bid-ask spread from the order processing cost. The approach of HS model is similar to that of GH model. The analysis starts with defining the fundamental unobserved stock price, which, as in Glosten and Harris (1988), equals the sum of the previous period stock price, the public information shock, and the private information learned from the order flow (the asymmetric information component). Though, as opposed to GH, HS model formally incorporates the inventory holding costs of the brokers. According to the inventory theories of the spread (Ho and Stoll (1981) and Stoll (1978)), brokers adjust their quote midpoint relative to the fundamental price by a certain proportion to induce trades that will balance their inventory position. Therefore, the HS model suggests that the midpoint of the bid-ask spread is the sum of the fundamental price of a stock and a portion of the half-spread attributable to the inventory holding costs. Then, by assuming that the bid-ask spread is constant, HS add bid-ask bounce to the midpoint (through the trade indicator variable, which takes a value of 1 if a trade was a purchase and -1 if a trade was a sale) and present a model of the stock price development.

HS also study the dependence of the spread components on the order size. Though, opposed to GH, the trade size indicators are not modelled through a linear relationship to the value of the spread but are applied in the form of dummy variables. This allows capturing the influence of the order size on the spread components without any assumptions about the mathematical form of the relationship.

To test the model, the data on 19 largest and most frequently traded stocks in NYSE during 1992 is applied. The number of observations across the stocks ranges from 165 to 715 trades per day.

The sum of the asymmetric information and the inventory holding costs components range across stocks from 1.9% to 22.3% of the effective (called "traded" in HS) spread. The remaining part of the traded spread, 98.1% and 77.7%, respectively, is the order processing cost. Given the presumption in numerous models that the asymmetric information is a large component of the spread, the relatively small estimates of the sum of the asymmetric information and the inventory holding cost components are surprising. Though the result seems to be reasonable if attention is paid to the dataset employed in HS. As the model by Easley et al. (1996) predicts, the risk of information-based trading is lower for active securities than for infrequently traded securities. Since the dataset in HS includes only liquid NYSE stocks, it is expected that relatively more uninformed traders are present for the stocks, which should reduce the probability for a market maker to trade with an informed trader and therefore reduce the asymmetric information component of the spread.

The estimates of the spread components relative to the size of trade are also smaller than those in GH. For small trades, asymmetric information and inventory holding components account, on average, for 3.3% of the traded spread. This increases to 21.7% for medium-sized trades and further doubles to almost 43% for large trades. The small coefficients found for the sum of asymmetric information and inventory holding components when the estimation was done without taking into account the trade size, suggest that the estimates are heavily influenced by small trades, which occur much more frequently. The considerable difference in the components estimates for different trade sizes highlights the importance of estimating the components of the bid-ask spread taking into account the size of trade.

HS also suggest a 3-way decomposition of the bid-ask spread, which allows to separate all the three spread components. The separate decomposition of the asymmetric information component and the inventory holding components is based on the fact that inventory effects induce negative serial correlation in trade prices. If there was a purchase (sale) at *t-1*, a market maker would make a downward (upward) revision in his posted bid and ask quotes in order to induce trades in the opposite direction and due to this to balance his inventory position. Therefore, the conditional probability that a trade at *t* is opposite in sign to a trade at *t-1*, is different from 0.5. The market is assumed to know the probability of a purchase (sale) at time *t* given the trade direction at *t-1* and to take it into account when building the expectations about the future stock prices. This allows to distinguish between the asymmetric information and the inventory holding cost components in the model.

Though the 3-way decomposition did not bring any plausible results. The asymmetric information component was found negative for all the stocks with the average value of -3.1%. A negative value of a spread component is not in line with the theory and does not have a meaningful interpretation.

The spread decomposition model suggested in **Madhavan, Richardson, Roomans (1997)** (further referred to as MRR) allows estimating the asymmetric information component of the bid-ask spread and the sum of the inventory holding and the order processing cost components. The model is similar to the models of Glosten and Harris (1988) and Huang and Stoll (1997). It starts with setting an equation that determines the expected value of a stock and gradually incorporates the influence of asymmetric information on the stock price formation. The model differs from those of GH and HS by taking on additional parameters such as the probability that a transaction takes place inside the spread, and the autocorrelation of the order flow.

The dataset includes 274 NYSE-listed stocks over 1990 with a high frequency intraday trading data, which allows MRR to study the development of the bid-ask spread and the information asymmetry during a trading day. MRR estimate the model for five intervals during a day[25] and find that the asymmetric information component of the effective bid-ask spread drops sharply after the opening half-hour interval and remains at its level until the final period where it increases slightly. A

[25] The intervals are the following: 9.30-10.00, 10.00-11.30, 11.30-14.00, 14.00-15.30, and 15.30-16.00.

decline in the bid-ask spread represents less reliance on the signal content of the order flow during the day. This can be explained either as a greater reliance of the market makers on prior beliefs (the beliefs established in the beginning of the day) or larger percentage of liquidity traders during the day. The asymmetric information component changes from 4.2 cents (54.7% of the effective bid-ask spread) in the beginning of the day to 2.9 cents (38.4% of the effective bid-ask spread) in the end of the day.

The estimate of the asymmetric information component is much higher than in Huang and Stoll (1997) and similar to the estimate of Glosten and Harris (1988) for the medium-sized trades.

The intraday patterns of the asymmetric information cost, and the dealer's overall trading cost rule the spread's behaviour. In the beginning of the day, information asymmetries are large, and, consequently, the spread is wide. During the day, asymmetries are resolved through price discovery, which narrows the spreads. Toward the end of the day, the asymmetric information component is small but the overall cost of trading is higher (possibly reflecting the risks of carrying inventory overnight).

The spread decomposition models discussed above were developed for the NYSE, an exchange with a "hybrid" trading system. A "hybrid" trading system combines consolidated electronic order books and obligatory quotes by designated market makers. The market makers are obliged to post quotes at which they must be prepared to trade. Some of the stock exchanges (like f.i. Paris Bourse and Tokyo Stock Exchange) have a pure electronic limit order book trading systems, a system with no designated market makers. In such systems the inventory holding component is not relevant any more and the spread decomposition models are often estimated under assumption that the inventory holding component equals to zero (Foucault (1999), Glosten (1994), Silva & Chavez (2002), Vandelanoite (2002), and Declerck (2002)).

The spread decomposition models have also been applied to decompose the bid-ask spread in the Eastern European emerging stock markets. Some of the peculiarities of these markets are low trading frequency, low level of information disclosure, and high level of informed trading, which urge the brokers to post wider bid-ask spreads. **Hanousek and Podpiera (2003)** decompose the bid-ask spread into three components using a modification of Huang and Stoll's (1997) model for the Czech stock market. They argue that Huang and Stoll's (1997) model in its original form holds only for a single-dealer market structure, like NYSE. For a multiple-dealer market structure (like Nasdaq or Prague stock exchange), market-makers behave differently due to the less demanding inventory rebalancing needs. In competitive dealer trading systems market makers may react significantly weaker to general trading pressure because general trading pressure falls not on a single specialist but is instead dispersed among a larger capital base of multiple competing dealers. But, as Hanousek and Podpiera (2003) notice, during the unusual periods of serious selling or buying pressure, inventory rebalancing trades between dealers increase sharply, which urges many dealers in the market to revise bid and ask quotes due to inventory reasons.
Hanousek and Podpiera (2003) find that asymmetric information component takes only 17% of the effective bid-ask spread. The low value of the component given the evidence of a high level of informed trading in the Prague stock exchange was found surprising. All the estimates of the asymmetric information component for individual stocks were statistically significant and varied between 13% and 22%.

To our best knowledge, the only study of the spread components available for the Ukrainian stock market is Ryzhkov (2007). Ryzhkov (2007) applies the Hanousek and Podpiera (2003) variation of the Huang and Stoll (1997) model for a cross-section of 10 most liquid Ukrainian stocks during 2005-2006. The study finds that the asymmetric information component ranges from 5.9% to 16.3% across the stocks, with an average value of 10%, and is significantly different from zero for five out of the ten stocks examined. The inventory holding cost component is insignificantly different from zero for the majority of the stocks. The remaining 90% of the bid-ask spread, on average, is attributed to the order processing cost. The low estimate of the asymmetric information spread component seems to be inadequate to the scope of informed trading in the Ukrainian stock market. Ryzhkov (2007) suggests that the result can be caused by the fact that a large portion of equity trades in Ukraine cannot be included in the study because they are not registered timely in the trading system. Due to this, the dataset may not include many of the really informed trades. When accounting for the trade size, Ryzhkov (2007) finds that the asymmetric information spread component falls with the trade size.

Relation Between the Asymmetric Information and the Inventory Holding Cost Components of the Bid-Ask Spread

Both inventory models and the asymmetric information models predict that prices move in the direction of order flow but the reasons of the movement are different, which results in a predicted temporary price change in case of inventory theory and a predicted permanent price change in case of asymmetric information theory.

Inventory theory (Stoll (1978) and Ho and Stoll (1981)) sees the market maker as a trader who is willing to change his desired proportion of stock holdings in order to fill the trading orders of other market participants. A diversion from the desired level of inventory creates a risk for the market-maker, for which he expects to be compensated. The costs of the risk are reflected in the bid-ask spreads that the market-maker posts. In inventory models, the market maker faces a complex problem of balancing his inventory aiming at mitigating considerable deviations from the desired inventory level resulting in random inflows and outflows of stocks. For this, a market maker increases (decreases) the midquote following a purchase (sale) in order to induce trades in the opposite direction. These deviations are, by assumption, unrelated to the future value of the stock, and therefore are irrelevant in the long-run. So, the market maker's effect on price is always temporary and prices move back to their "true" level if the inventory is balanced.

Asymmetric information theory suggests that under assumption of presence of both informed and uninformed traders in the market, purchases are seen by brokers as possible signals of positive information about a stock, while sales – as possible signals of negative information about a stock. As a result, following a purchase, brokers review their beliefs about the true stock value upwards, while following a sale, brokers review their beliefs about the true stock value downwards. Consequently, private information implied from the order flow results in permanent change in price.

Based on the property that the inventory effects are temporary while the asymmetric information effects are permanent, researchers separate the inventory holding and the asymmetric information components of the bid-ask spread (Hasbrouck (1991) and Huang and Stoll (1997)). Though for reliable differentiation of the inventory holding cost component, it is important to specify what the desired level of inventory is for a broker, what factors (if any) can change it, and how a dealer translates his optimal inventory strategy into prices, which is quite a complex problem that has not been closely addressed in the existing literature yet (O'Hara, 1998). If a dealer, for example, trades for speculative reasons, his desired level of inventory may vary not only in the short-run but also in the long-run. Madhavan and Smidt (1991) and Hasbrouck and Sofianos (1993) find that dealers are willing to depart from their preferred inventory positions over longer (several weeks) cycles, a behaviour that has not been predicted by the available spread decomposition models. Simplicity of current inventory models may result in difficulties in reliable differentiation between the asymmetric information and the inventory holding cost components.

Critique to the Spread Decomposition Models

Spread decomposition models are a well-developed and an established area in the microstructure research, nevertheless they have not escaped serious criticism. A number of papers call into question whether spread decomposition models actually measure what they claim to measure. For example, Van Ness et al. (2001) examine the performance of five spread decomposition models by comparing the asymmetric information component estimates to other measures of information asymmetry: volatility, analysts' forecast errors, dispersion of analysts' earnings forecasts, and others. They also compare the asymmetric information component estimates to two measures of informed trading: the number of analysts that follow the stock and the percentage of shares owned by institutions. They find that asymmetric information components appear unrelated to the measures of uncertainty, and conclude that the asymmetric information models measure the level of asymmetric information weakly at best.

Neal and Wheatley (1998) do not find any significant difference between the asymmetric information spread components estimated for closed-end funds and for a matched sample of common stocks. This result seems puzzling for the authors who predicted lower asymmetric information for closed-end funds, because they report their net asset values weekly, which eliminates uncertainty about their current liquidation value. According to Neal and Wheatley (1998), this suggests that the spread decomposition models can be misspecified.

Low estimated value of the asymmetric information component together with the widely discussed facts of high information content of trades in the Prague stock exchange and in the Ukrainian stock exchange (PFTS) (Hanousek and Podpiera (2000) and Ryzhkov (2007)) contribute to the view of low ability of asymmetric information spread component to measure the information asymmetry in the stock markets.

Despite abundant spread decomposition studies, current literature has not yet settled on the issue of the relative importance of each of the three spread components – the adverse selection, the inventory holding, and the order processing cost.

Spread Decomposition Models Applied in the Thesis

A wide selection of spread decomposition models were developed in literature. This requires from an empirical researcher a close consideration of what models to choose for an empirical study of a particular market. Among the most frequently cited and applied in empirical literature models are the original models by Stoll (1989), Glosten and Harris (1988), Huang and Stoll (1997), and Madhavan, Richardson, and Roomans (1997). With time spread decomposition literature grew with other researchers building up on or suggesting some modifications to the models. For example, George et al. (1991) argued that the spread estimates of the Stoll (1989) model were downward biased, because they did not take into account the time variation in expected returns and suggested a new approach that used a spread measure based on the serial covariance of the difference between transaction returns and returns using bid prices. Serednyakov (2005) criticized the Stoll (1989) and the Huang and Stoll (1997) (three-way decomposition version) models for giving, in many cases, results that cannot be reasonably interpreted as spread components. The models required the order flow to be negatively autocorrelated in order for the component estimates to make economic sense, though in practice, order flow can often be persistent as buy (sell) orders may tend to be followed by buy (sell) orders. Taking this into consideration, Serednyakov (2005) built up on the model of Stoll (1989) and suggested a new model of the three-way decomposition of the bid-ask spread. Hanousek and Podpiera (2003) created a variation of the Huang and Stoll (1997) model that was more suitable for the multiple-dealer market structure of the Prague Stock Exchange as opposed to the single-dealer market structure of NYSE, for which the original model was designed.

Despite trying to improve the original models, the "improved" versions of the original models had their own limitations. For example, George et al. (1991) model allowed to decompose the bid-ask spread in only two components, the order processing cost and the asymmetric information cost, while the model of Stoll (1989) allowed to decompose the bid-ask spread into all three components. In Serednyakov (2005) estimates of the spread components for some stocks still did not have economic sense because of their negative sign. The model of Hanousek and Podpiera (2003) is similar to the Huang and Stoll (1997) model under assumption of zero inventory holding cost.

In spite of the range of modifications to the models of Stoll (1989), Glosten and Harris (1988), and Huang and Stoll (1997), recent empirical literature seems to give preference to the original models (Clarke and Shastri (2000), Van Ness et al. (2001), Silva and Chavez (2002), Declerk (2002), De Winne and Majois (2003), and Henker and Martens (2003)).

Taking into account that the models of Stoll (1989), Glosten and Harris (1988), and Huang and Stoll (1997) suit to the Ukrainian stock market because of the similar stock market structure in Ukraine and in the U.S., in our research we also chose to apply these models. The models named above were developed for a dealership market structure of Nasdaq and hybrid market structure of NYSE, where specialists post quotes based on their beliefs about the true value of a stock and taking into account their inventory positions. Ukrainian stock market is a dealership markets and has a similar process of stock price formation. Brokers post quotes and are believed to revise them based on their believes about the true value of a stock and their inventory positions.

6.3. Methodology of the Bid-Ask Spread Decomposition

Stoll (1989) Model

Stoll (1989) aims at finding the realized spread based on which the quoted spread can be decomposed into its components. The realized bid-ask spread is the average difference between the price at which a dealer sells at one point in time and the price at which a dealer buys at an earlier point in time. Usually realized spread is smaller than quoted spread due to the adverse stock price movements following a trade.

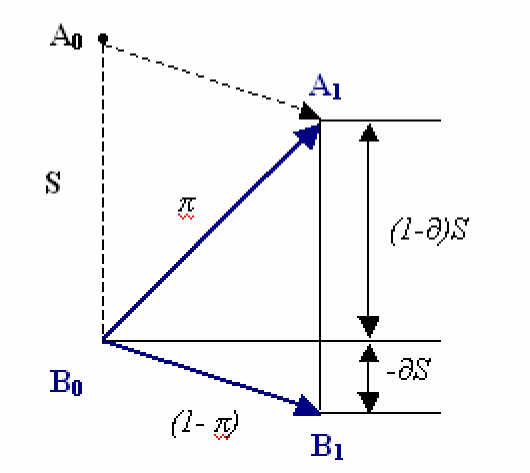
Let S denote the constant bid-ask spread set by a dealer for a stock. If A is the specialist's ask price and B is the bid price, then $S = A\text{-}B$. The model assumes that transactions can only occur at the dealer bid or ask. It is assumed that no new information arises in the market place, other than that conveyed by the transaction itself. If the spread reflects only order processing cost, A and B are set symmetrically relative to the "true" price and remain unchanged for each transaction. Sequences of purchases at the bid price are ultimately offset by sequences of sales at ask price. This is the model suggested by Roll (1984).

If the spread reflects the inventory holding cost, dealers tend to set bid and ask prices that are not symmetrical relative to the "true" price in order to induce public transactions that would balance the inventory position of the dealer. Bid and ask prices are lowered after a dealer purchase in order to induce dealer sales and raised after a dealer sale in order to induce dealer purchases. It is assumed that inventory costs are linear in inventory and symmetric with respect to purchases and sales. This implies that price changes are symmetric (not to confuse with the fact that bid and ask are asymmetric in respect to the "true" price). The bid and ask prices fall by $0.5S$ after a purchase and increase by $0.5S$ after a sale. This process implies that the dealer makes $0.5S$ if a trade is reversed. Over time, the dealer has a balanced inventory position because his price adjustments increase the probability of transactions that eliminate inventory the dealer has acquired.

If the spread reflects asymmetric information costs, after a purchase (sale) transaction bid and ask prices shift in the same manner as in the case of inventory adjustment but for a different reason. A purchase (sale) transaction conveys information that the expected equilibrium price of the security is higher (lower).
The inventory and the asymmetric information models imply that the realized spread earned by a dealer is less than the spread quoted by the dealer.

Suppose there is a transaction at B_0 (a sale) (see Figure 6.1). Following the transaction the specialist will adjust his bid and ask quotes downward to A_1 and B_1 by ∂S, $0 \leq \partial \leq 1$, where ∂ is a fraction of spread by which dealer adjusts the previous (at t_0) price in case of trade continuation. Dealers adjust their quotes due to two reasons. First, in order to induce inventory equilibrating trades, and second, in order to earn from the uninformed traders what they lose to the informed traders.

Figure 6.1. Possible sequences of transaction prices starting at the bid price.



A is ask price, B is bid price, π is probability of a price reversal, ∂ is amount of a price continuation as a fraction of the spread, S. The subscripts of 0 and 1 refer to the periods 0 and 1 respectively.

Let π denote the probability of trade reversal (the probability that a transaction at the ask (bid) is followed by a transaction at the bid (ask)). Then $1-\pi$ is the probability of trade continuation. Under the pure order processing view of the spread $\pi = 0.5$ and $\partial = 0$. Under the pure inventory holding cost view of the spread the specialist adjusts the quotes by half of the spread so that to induce inventory equilibrating trades ($\partial = 0.5$) and, therefore, the probability of a trade reversal is greater than 0.5 ($0.5<\pi<1$). In case of pure asymmetric information cost view of the spread, the spread is determined by the probability that informed traders will trade with the dealer. Because of the price adjustment mechanism aimed at balancing dealer's losses from informed traders with gains from uninformed traders (developed in Copeland and Galai (1983) and Glosten and Milgrom (1985)), the price reversal is half the magnitude of the spread and is equal to the price continuation ($\partial = 0.5$). On the basis of the information conveyed by the last trade, prices are such that the probability of a purchase equals the probability of a sale ($\pi = 0.5$).

Under the assumption of constant spread, the possible price changes after a sale are:

i) if the sale is followed by a buy, then price will change by

$$A_t - B_{t-1} = (1-\partial)S \text{ with probability } \pi \tag{6.1}$$

ii) if the sale is followed by a sale, then price will change by

$$B_t - B_{t-1} = -\partial S \text{ with probability } 1-\pi \tag{6.2}$$

Then the expected price change conditional on a sale transaction is:

$$E(\Delta P_t | B_{t-1}) = \pi(1-\partial)S + (1-\pi)(-\partial S) = (\pi-\partial)S \tag{6.3}$$

Under the assumption of symmetry, the expected price change conditional on a purchase transaction is:

$$E(\Delta P_t | A_{t-1}) = -(\pi-\partial)S \tag{6.4}$$

The difference between (3) and (4) gives the value of the realized spread:

$$RealizedSpread = 2(\pi - \partial)S \qquad (6.5)$$

The relationship for the realized spread is the corner stone of the Stoll model.
For an illustration of why the realized spread equals the difference of the conditional expected price changes, see Appendix 6.1.

Based on the information on the values of the quoted and realized spreads the asymmetric information spread component can be found. The realized spread, which is the expected profit per trade, covers only the order processing costs and inventory holding costs. If quoted spread was made up of asymmetric information cost alone, the expected gross profit per trade would be zero. The asymmetric information component of the quoted spread is thus the difference between the quoted spread *S* and the realized spread:

$$\text{Asymmetric information component} = S(1 - 2(\pi - \partial)) \qquad (6.5.1)$$

Further, the realized spread can be decomposed into the order processing costs and inventory holding costs. Under the inventory holding cost view of the spread $\partial = 0.5$. Using this value of ∂ and the estimated value of π, it is possible to compute the realized spread in the absence of the order processing costs, which is the inventory holding cost component:

$$Inventory\ holding\ cost\ component = 2(\pi - 0.5)S \qquad (6.5.2)$$

It is important to mention that the inventory holding cost component of the spread compensates the dealer for bearing the risk resulting from a loss of diversification and is not a compensation for a normal risk associated with holding a security. The latter is earned by holding the security.

The order processing cost component of the spread is the remainder of the realized spread after subtracting the inventory holding cost component:

$$Order\ \ processing\ \ cost\ \ component = (1-2\partial)S \qquad (6.5.3)$$

The transaction price and quote data allow estimating the parameters π and ∂. The estimation is done following the approach suggested by Roll (1984) by finding the covariances of price changes and covariances of quote changes:

$$cov_T \equiv cov(\Delta P_t, \Delta P_{t-1}) = S^2[\partial^2(1-2\pi) - \pi^2(1-2\partial)] \qquad (6.6)$$

$$cov_Q \equiv cov(\Delta Q_t, \Delta Q_{t-1}) = S^2\partial^2(1-2\pi)\text{ , } Q \text{ equals either } A \text{ or } B. \qquad (6.7)$$

Where P_t is the transaction price at time t, A_t and B_t are the quoted ask and bid prices at time t.

Under the assumption of a constant spread, cov_Q can be calculated either from bid price changes as $cov_B \equiv cov(\Delta B_t, \Delta B_{t-1})$, or from ask price changes, as $cov_A \equiv cov(\Delta A_t, \Delta A_{t-1})$.

To find the coefficients of the interest empirically, both covariances are regressed against a cross-section of the squared quoted spreads S in the following regression form:

$$cov_T = a_0 + a_1 S^2 + u \qquad (6.8)$$

$$cov_Q = b_0 + b_1 S^2 + v\text{ ,} \qquad Q \text{ equals either } A \text{ or } B. \qquad (6.9)$$

where u and v are random errors and

$$a_1 = \partial^2(1-2\pi) - \pi^2(1-2\partial) \qquad (6.10)$$

$$b_1 = \partial^2 (1 - 2\pi) \qquad (6.11)$$

Under the assumption of market efficiency, parameters a_0 and b_0 should be equal to zero. The estimates of a_1 and b_1 allow then to find the coefficients ∂ (magnitude of a price change expressed as a fraction of the spread), and π (the probability of price reversal).

Equations (6.8) and (6.9) are estimated by applying OLS method.

Since the estimation of the model is based on the principal assumption that the direction of previous trade causes a change in the quoted bid and ask prices issued following the trade, the estimation of the model implies application of intraday trade and quote data. The dataset available in Stoll (1989) contains data at a lower, daily frequency. Application of daily data can lead to distortions in the estimates of the spread components so as a big portion of information on the process of price formation and the influence of the previous trade on the next quote will be lost. Nevertheless, unavailability of data at a higher frequency forces Stoll (1989) to empirically test his model with the data at daily frequency.

There is some criticism to the Stoll (1989) model. George, Kaul, and Nimalendran (1991) argue that Stoll's estimates may be biased since they are nonlinear transformations of the linear parameters, which were obtained from regressing covariances of price changes and quote revisions on mean spreads.

Glosten and Harris (1988) Model

Glosten and Harris (1988) suggest a model that allows to estimate two spread components: the transitory component (the sum of the order processing cost and the inventory holding cost components) and the asymmetric information component.

An important contribution of the model is that it takes into account the influence of the order size on the components of the spread.

The "true", or fundamental, value of a stock develops through a process that is driven by the arrival of new public information and the information a broker learns from the direction of the incoming order:

$$F_t = F_{t-1} + Q_t Z_t + \varepsilon_t \qquad (6.12)$$

Where F_t is the unobserved true value of a stock, which reflects all the publicly available information immediately following a transaction at time t (this price includes any information revealed by that transaction); Q_t - unobserved trade indicator variable, it takes value 1 if the transaction t was initiated by a buyer and -1 if by a seller; Z_t – asymmetric information spread component; ε_t - unobserved innovation in the 'true' values between transactions at *t-1* and *t* due to the arrival of new public information about the stock. (Some notations in equation (6.12) are different from the original notations in Glosten and Harris (1988) in order to keep the model comparable to the other models discussed in this chapter. In the original model m_t is used instead of F_t).

Since a broker does not know whether the next order is submitted by informed or uninformed trader, he makes only a certain adjustment in his beliefs about the true value of the stock, which is positive if the incoming order is a purchase and negative if it is a sale. This adjustment is the asymmetric information spread component.

Since the broker incurs costs related to the processing of orders, he trades at such prices that would allow him to cover the costs:

$$P_t = F_t + Q_t C_t \qquad (6.13)$$

where P_t is the observed price and C_t is the transitory spread component.

Following Easley and O'Hara (1987), the model assumes that the asymmetric information spread component increases with the quantity traded. The asymmetric information and the transitory spread components are assumed to be linear functions of the trade size:

$$Z_t = z_0 + z_1 V_t \quad (6.14)$$

$$C_t = c_0 + c_1 V_t \quad (6.15)$$

where z_0 and c_0 are constants, z_1 and c_1 are the slope coefficients, and V_t is trade volume.

It is expected that the equation (6.14) has zero intercept and a positive slope. Since it is unlikely that a small trade is initiated by an informed trader, its execution should lead to little revision in expectations. Therefore, the intercept, z_0, is expected to be zero. Theoretical models by Easely and O'Hara (1987) and Glosten (1989) argue that the asymmetric information spread component should increase with the quantity traded because well-informed traders are interested in maximizing their return on information that looses value over time. Therefore, the slope, z_1, is expected to be positive.

Theoretical explanations concerning the expected coefficients for equation (6.15) are ambiguous. Overall, the transitory component has to be positive since brokers do incur inventory holding and order processing costs. Though the sign of the volume coefficient c_1 depends on whether per-share transitory costs have decreasing, constant, or increasing pattern in order size. If the pattern is constant, c_0 will be positive and c_1 will be zero. If it is increasing (when with larger trades a broker takes on a higher inventory risk, as the inventory models suggest), c_1 will be positive. If it is decreasing (when either variable costs of trading decrease with the trade size or there are substantial fixed costs), c_1 will be negative.

With the NYSE data, Glosten and Harris (1988) find that the model with $z_0=0$ and $c_1=0$ is the most appropriate specification. It thus suggests that the volume dependence of the bid-ask spread is purely due to the asymmetric information component.

By taking the first difference of equation (6.13) and combining it with the equations (6.12), (6.14), and (6.15) the main equation of the model is obtained:

$$\Delta P_t = c_0 \Delta Q_t + c_1 \Delta (Q_t V_t) + z_0 Q_t + z_1 Q_t V_t + \varepsilon_t \tag{6.16}$$

To better understand the development of the price process, let us consider an example. If a buy trade at time *t-1* is followed by another buy trade at time *t*, the ask price that a broker will set for the time *t* order will grow by:

$$\Delta P_t = c_1 \Delta V_t + z_0 + z_1 V_t + \varepsilon_t \tag{6.17}$$

The empirical results of GH showed that c_1 is not significantly different from zero (the transitory component does not depend on the trade size). This leaves the equation (6.17) with:

$$\Delta P_t = z_0 + z_1 V_t + \varepsilon_t \tag{6.18}$$

So, if the incoming trade is a buy, a broker will react to this information by increasing the stock price by the amount of the asymmetric information spread component plus the public information shock.

If a sale trade is followed by a buy trade, the price rise will equal the sum of the asymmetric information spread component and the public information shock plus the part that refers to the bid-ask bounce and equals the doubled transitory spread component:

$$\Delta P_t = 2c_0 + (z_0 + z_1 V_t) + \varepsilon_t \tag{6.18.1}$$

Defining $\overline{V}$ as the average transaction size, the effective bid-ask spread is found as:

$$S = 2(c_0 + c_1\overline{V}) + 2(z_0 + z_1\overline{V}) \qquad (6.19),$$

The adverse selection component expressed as a fraction of the spread, can be found as doubled equation (6.14) divided by the equation (6.19):

$$\alpha = \frac{2(z_0 + z_1\overline{V})}{2(c_0 + c_1\overline{V}) + 2(z_0 + z_1\overline{V})} \qquad (6.20)$$

The sum of the inventory holding and the order processing components as a fraction of the spread is doubled equation (6.15) divided by the equation (6.19) and equals one minus the adverse selection spread component:

$$\beta + \gamma = \frac{2(c_0 + c_1\overline{V})}{2(c_0 + c_1\overline{V}) + 2(z_0 + z_1\overline{V})} = 1 - \alpha \qquad (6.21)$$

By inserting the appropriate values of $\overline{V}$, the spread components can be estimated for different trade sizes.

Basic Huang and Stoll (1997) Model

Similar to Glosten and Harris (1988), the development of the Huang and Stoll (1997) model starts with establishing a relationship for the stock price development in time. Let S denote the traded (a concept identical to "effective") bid-ask spread, which is assumed not to vary in time. Then new information shifts the true value of a stock by a certain fixed value $\alpha\frac{S}{2}$ due to the information learned by a broker from the direction of previous trade and due to a serially uncorrelated public information shock ε_t:

$$F_t = F_{t-1} + \alpha \frac{S}{2} Q_{t-1} + \varepsilon_t \qquad (6.22)$$

Where F_t is the unobservable fundamental value of the stock in the absence of transaction costs; it is determined just prior to the posting of the bid and ask quotes at time t, S is the constant spread, α is the percentage of the half-spread attributable to adverse selection, Q_t is the buy-sell trade indicator variable for a transaction at time t . It equals 1 if a transaction is buyer initiated (occurs above the midquote), -1 if a transaction is seller initiated (occurs below the midquote), and 0 if the transaction occurs at the midquote, and ε_t is serially uncorrelated public information shock. (Some of the original notations used in Huang and Stoll (1997) are changed in order to keep the model comparable to other models discussed in this chapter. In the original model V_t is used instead of F_t).

Huang and Stoll (1997) pay close attention to the modelling of the inventory holding spread component. While F_t is a hypothetical construct, the midpoint of the bid-ask spread, M_t, is observable. According to the inventory theories of the spread, liquidity suppliers adjust the quote midpoint relative to the fundamental value on the basis of accumulated inventory in order to induce inventory equilibrating trades (Ho and Stoll (1981) and Stoll (1978)). The adjustment will depend on the direction of previous trades executed by the market maker. Assuming that past trades are of a normal size of one, the midpoint is related to the fundamental stock value in the following way:

$$M_t = F_t + \beta \frac{S}{2} \sum_{i=1}^{t-1} Q_i \qquad (6.23)$$

Where β is the proportion of the half-spread attributable to the inventory holding costs, $\sum_{i=1}^{t-1} Q_i$ is the cumulated inventory from the market open until time $t-1$, and Q_1 is the initial inventory for the day.

In the absence of any inventory holding costs, there would be a one-to-one mapping between F_t, and M_t. Equation (6.23) is valid for bid or ask quotes as well as for the midquote.

The first difference of equation (6.23) combined with the equation (6.22) implies that quotes are adjusted to reflect the information revealed by the previous trade and to balance the inventory position:

$$\Delta M_t = (\alpha + \beta)\frac{S}{2}Q_{t-1} + \varepsilon_t \qquad (6.24)$$

The constant spread assumption is specified by the following equation:

$$P_t = M_t + \frac{S}{2}Q_t + \eta_t \qquad (6.25)$$

Where the error term η_t captures the deviation of the observed half-spread, P_t - M_t, from the constant half-spread, S/2, and includes rounding errors associated with price discreteness.

By substitution of the expression for M_t (Equation (6.23)) into (6.25), the following expression is obtained:

$$P_t = F_t + \beta\frac{S}{2}\sum_{i=1}^{t-1}Q_i + \frac{S}{2}Q_t + \eta_t \qquad (6.25.1)$$

Expression (6.25.1) can be related to the equation (6.13) of the Glosten and Harris (1988) model. The two models have identical approaches to defining the ask (bid) stock price. The price equals the "true" value of the stock plus (minus) the sum of the inventory holding and the order processing costs. (Note: at this stage the model of Huang and Stoll already incorporates the public information shock while the model of Glosten and Harris yet does not). Though the models differ in the way of modelling the two costs. Huang and Stoll (1997) assume that the inventory holding cost depends on the direction of all previous trades during a day and that the order processing cost is a fixed portion of the traded spread. Whereas Glosten and Harris (1988) do not model inventory holding cost separately from the order processing cost and allow the costs vary with the order size (Equation (6.15)).

By taking the first difference of the Equation (6.25) and combining it with the Equation (6.24) the main equation of the Huang and Stoll (1997) model is obtained:

$$\Delta P_t = \frac{S}{2}\Delta Q_t + (\alpha + \beta)\frac{S}{2}Q_{t-1} + e_t \qquad (6.26)$$

Where $e_t = \varepsilon_t + \Delta\eta_t$.

The only explanatory variable in the model is the trade indicator variable. By estimating the model the traded half-spread, S/2, and the sum of the asymmetric information and the inventory holding cost components *(α+β)* can be found.
On the basis of Equation (6.26) alone the adverse selection *(α)* and the inventory holding *(β)* components cannot be separately identified. However the order processing component can be found as *(1-(α+β)).*

An interesting point to consider is the difference in the error terms in the Huang and Stoll (1997) and the Glosten and Harris (1988) models. Since the spread in the Huang and Stoll (1997) model is assumed to be constant, the error term, e_t, captures both the public information shock and the deviation of the observed spread from the constant spread. There is no need for the latter in the Glosten and Harris (1988) model since the spread is not assumed to be constant and its variation is captured by the order size variable. So, the error term ε_t in Glosten and Harris (1988) accounts only for the public information shock, whereas in Huang and Stoll (1997), additionally to capturing the public information shock, it also captures the deviation of the observed spread from the constant spread.

To better understand the development of the price process in the Huang and Stoll (1997) model, let us consider an example. If a trade at time *t-1* was a purchase and it was followed by another purchase at time *t*, the trade price at *t* will increase relative to the trade price at *t-1* by:

$$\Delta P_t = (\alpha + \beta)\frac{S}{2} + e_t \qquad (6.27)$$

So, the price will grow by the value of the combined asymmetric information and inventory holding spread components plus the error term e_t.

If a sale trade is followed by a buy trade, additionally to the factors showed in (6.27), the new price will also include a shift from a sale to a purchase, which equals to the value of the bid-ask spread:

$$\Delta P_t = S - (\alpha + \beta)\frac{S}{2} + e_t \qquad (6.28)$$

The example also shows an important difference in the assumptions about the way of learning the information from the trades in the Glosten and Harris (1988) and Huang and Stoll (1997) models. In Glosten and Harris (1988) a market maker learns from the incoming trade, while in Huang and Stoll (1997) he learns from the past trade. So, if there is a sequence sale-buy (buy-sell), asymmetric information trade component leads to a price rise (fall) in the Glosten and Harris (1988) model, and to a price fall (rise) in the Huang and Stoll (1997) model (equations (6.18.1) and (6.28)).

Huang and Stoll (1997) Model With Accounting for Trade Size

As an extension to the basic model, Huang and Stoll (1997) allow different estimates for the sum of the information and inventory holding cost components depending on the trade size. Three trade size categories are chosen and the equation (6.26) is rewritten as follows:

$$\Delta P_t = \frac{S^S}{2} D_t^S + (\lambda^S - 1)\frac{S^S}{2} D_{t-1}^S + \frac{S^m}{2} D_t^m + (\lambda^m - 1)\frac{S^m}{2} D_{t-1}^m + \frac{S^l}{2} D_t^l + (\lambda^l - 1)\frac{S^l}{2} D_{t-1}^l + e_t \quad (6.29)$$

Where

$D_t^S = Q_t$ if the trade t was of small size

$= 0$ otherwise;

$D_t^m = Q_t$ if the trade t was of medium size

$= 0$ otherwise;

$D_t^l = Q_t$ if the trade t was of large size

$= 0$ otherwise.

Superscripts *s, m, and l* define the size for small, medium, and large trades correspondently; *S* is the quoted bid-ask spread; λ is the sum of the asymmetric information and the inventory holding cost components, e_t is the error term.

In Huang and Stoll (1997) small trades are those of less than or equal to 1,000 shares; medium-sized trades are trades of more than 1,000 but less than 10,000 shares; and the trades of 10,000 shares or more are considered as large trades.

Unlike in the basic model of Huang and Stoll (1997), the parameter estimates do not depend on the sequence of all previous trades. The trade price at time *t* depends on the trade size and trade direction of transactions at time *t* and *t-1*.

Huang and Stoll (1997) Model: Three-Way Decomposition

To distinguish the adverse selection *(α)* and inventory *(β)* components of the traded spread, Huang and Stoll (1997) apply the fact that, under inventory models, changes in quotes influence the subsequent arrival rate of trades. After a public sale (purchase) at the bid (ask), the dealer will increase (decrease) the bid (ask) quote relative to the fundamental stock price in order to increase the probability of arrival of a public purchase (sale) (see, e.g., Ho and Stoll (1981)). The dealer will then be compensated for inventory risk because the expected midquote change is positive after a dealer sale and negative after a dealer purchase. Therefore, the probability of a purchase (sale) is greater than 0.5 just after a sale (purchase). Such behaviour of brokers, under the inventory model, will induce negative serial covariance in trades (Q_t). As trades reverse, quotes reverse. Consequently, under the inventory models negative serial correlation in quote changes (as well as in trades) is induced. This implication is used to identify the inventory component.

Equations (6.22)-(6.26) make no assumption about the probability of trades and therefore cannot distinguish inventory and adverse information effects. The model is modified to reflect the serial correlation in trade flows. The conditional expectation of the trade indicator at time *t-1* (Q_{t-1}), given the trade indicator at time t-2 (Q_{t-2}), can be shown to be:

$$E(Q_{t-1} | Q_{t-2}) = (1 - 2\pi) Q_{t-2} \qquad (6.30)$$

Where π is the probability that the trade at *t* is opposite in sign to the trade at *t-1*. Once π is allowed to differ from one-half, Equation (6.22) has to be modified to account for the predictable information contained in the trade at time *t-2*. On the assumption that the market knows the Equation (6.30), the change in the fundamental value will be given by:

$$\Delta F_t = \alpha \frac{S}{2} Q_{t-1} - \alpha \frac{S}{2} (1-2\pi) Q_{t-2} + \varepsilon_t \tag{6.31}$$

Where the second term on the right-hand side subtracts the information in the transaction *t-1* that is not a surprise. When $\pi = 0.5$, the sign of the trade is totally unpredictable and Equation (6.31) reduces to Equation (6.22).

Next, Equation (6.31) and the first difference of Equation (6.23) are combined:

$$\Delta M_t = (\alpha + \beta) \frac{S}{2} Q_{t-1} - \alpha \frac{S}{2} (1-2\pi) Q_{t-2} + \varepsilon_t \tag{6.32}$$

It is important to mention that to get Equation (6.32), Equation (6.23) is used directly without modification for the expected sign of the trade. There is inventory risk only when inventory is acquired (even if the inventory change was expected), and there is no inventory risk if inventory is not acquired (even if the lack of inventory change was unexpected). Consequently quote adjustments for inventory reasons depend on actual trades, not trade surprises. This distinction is what allows to estimate separately the inventory and adverse information components.

Combining equations (6.32) and (6.25) gives:

$$\Delta P_t = \frac{S}{2} Q_t + (\alpha + \beta - 1) \frac{S}{2} Q_{t-1} - \alpha \frac{S}{2} (1-2\pi) Q_{t-2} + \varepsilon_t \tag{6.33}$$

which is analogous to equation (6.26). The traded spread S, the three components of the spread α, β, and $(1-\alpha-\beta)$, and the probability of a trade reversal π can be found by estimating equations (6.30) and (6.33) simultaneously.

6.4. Estimation Procedure

The Stoll (1989) model is estimated using OLS procedure. The step by step estimation of the model is presented in the Results section of the chapter.

The models of Huang and Stoll (1997) and Glosten and Harris (1988) can be estimated by procedures that impose strong distributional assumptions on the error term such as maximum-likelihood (ML) or least squares (LS) methods. Though Huang and Stoll (1997) opts for a generalized method of moments (GMM). GMM is a robust estimator and, unlike maximum likelihood estimation, it does not require information of the exact distribution of the disturbances. This is especially important because the error term, e_t, includes rounding errors. The GMM procedure also accounts for the presence of conditional heteroscedasticity and/or autocorrelation of an unknown form, which are likely to be present in the time series of stock prices.

GMM estimation is based upon the assumption that the disturbances in the equations are uncorrelated with a set of instrumental variables. The GMM estimator selects parameter estimates so that the correlations between the instruments and disturbances are as close to zero as possible. By choosing the weighting matrix in the criterion function appropriately, GMM provides parameter estimates that are robust to heteroscedasticity and/or autocorrelation of unknown form.

Many standard estimators can be set up as special cases of GMM. For example, the ordinary least squares estimator can be viewed as a GMM estimator, if the explanatory variables in the model are uncorrelated with the residual.

Let $f(x_t, w)$ be a vector function such that for estimating the basic model (Equation (6.26) in case of Huang and Stoll (1997) model), it is

$$f(x_t, w) = \begin{bmatrix} e_t Q_t \\ e_t Q_{t-1} \end{bmatrix} \qquad (6.34)$$

where $w = (S\lambda)'$ is the vector of parameters of interest.

The basic model implies the orthogonality conditions $E[\, f(x_t, w)] = 0$. Under the GMM procedure, the parameter estimates chosen are those that minimize the criterion function:

$$J_T(w) = g_T(w)' S_T g_T(w) \qquad (6.35)$$

where $g_T(w)$ is the sample mean of $f(x_t, w)$, and S_T is a sample symmetric weighting matrix. Hansen (1982) proves that, under weak regularity conditions, the GMM estimator $\hat{w}_T$ is consistent and

$$\sqrt{T}(\hat{w}_T - w_0) \rightarrow N(0, \Omega) \qquad (6.36)$$

where

$$\Omega = (D_0' S_0^{-1} D_0)^{-1} \qquad (6.37)$$

$$D_0 = E\left[\frac{\partial f(x_t, w)}{\partial w}\right] \qquad (6.38)$$

$$S_0 = E[\, f(x_t, w) f(x_t, w)' \,] \qquad (6.39)$$

The basic model is exactly identified.
A similar approach is taken when estimating the Glosten and Harris (1988) model.

6.5. Results

Estimation Results of the Stoll (1989) Model

Stoll estimates the model based on a short time period (one month) but a wide cross-section of stocks. His sample includes stocks with at least 15 observations for a month and accounts for approximately 800 stocks. In our estimation we have a shorter cross-section of stocks (15) but will apply a longer time-series of observations for each of the stocks, the period of the first six months of 2006. To estimate the model of Stoll (1989), we apply a six-month period of 2006 rather than a two-year period of 2005-2006 in order to get more accurate estimates of the model. The model of Stoll assumes a fixed bid-ask spread, on the contrary to the Huang and Stoll (1997) and the Glosten and Harris (1988) models. During 2005-2006 the Ukrainian stock market was developing actively, liquidity of stocks grew considerably and, as a consequence, the bid-ask spreads were becoming smaller. An assumption of fixed bid-ask spread during 2005-2006 would be very unrealistic and could have resulted in biased estimates of the Stoll model.

Following Stoll, daily closing prices and quotations are applied for estimating the model.

In order to allow for comparisons across stocks, we follow Stoll (1989) and apply spreads and covariances in proportional terms rather than in the money terms. The use of relative terms means that in equations (6.6) and (6.7) the returns corresponding to ΔP_t, ΔB_t, and ΔA_t are applied.

To estimate the model we first compute the following variables: the covariance cov_T, the two versions of cov_Q, which are cov_B and cov_A, and the proportional quoted bid-ask spread S, which is the difference between best closing ask and bid quotations divided by the midpoint of the quotations. The quotations data is available daily but there were days during the first half of 2006 when no trades were recorded for some stocks. In order to keep consistency in the estimates of cov_T and

cov_Q, quotations data are used only for those days when at least one trade was recorded. The results of the computations are reported in Table 6.1.

All the serial covariances of the closing prices (cov_T) are negative. The sign was expected because of the presence of the bid-ask bounce in the daily closing prices (it is equally likely that a day can close with a purchase and that it can close with a sale). The magnitude of the serial relation can be easier assessed if the correlation coefficients are considered instead of the covariances. The correlation coefficients corresponding to the covariances vary from -13.9% for MZVM to -42.1% for UNAF with an average value of -30.2%. The numbers show a strong negative serial relation between the closing prices.

Table 6.1. The estimates of the covariances and the inside spread for the Stoll (1989) model.

The estimates are based on daily data for 15 most liquid Ukrainian stocks during the first half of 2006. In order to keep consistency in the estimates of covariances, quotations data are used only for those days when at least one trade was recorded.
cov_T is the serial covariance of daily closing transaction prices, cov_B is the serial covariance of daily closing inside bid quotes, cov_A is the serial covariance of daily closing inside ask quotes, S is the average closing bid-ask spread as a fraction of the midquote.

No	Company	cov_T *10,000	cov_B *10,000	cov_A *10,000	S	Number of observations
1	AZST	-85.28	-0.45	0.03	7.46%	84
2	BAVL	-5.82	0.02	-0.59	6.65%	76
3	CEEN	-3.48	-1.17	-0.08	7.94%	72
4	DTRZ	-9.96	-0.25	-0.31	8.51%	76
5	LTPL	-9.22	0.08	-0.05	8.02%	91
6	MMKI	-13.44	0.30	-0.15	5.95%	66
7	MZVM	-1.87	0.22	0.02	8.22%	74
8	NITR	-1.77	-0.18	-0.30	5.23%	78
9	PGOK	-368.30	0.32	0.37	8.22%	66
10	SMASH	-70.61	-0.80	1.74	9.40%	70
11	STIR	-27.52	0.61	-0.48	8.22%	56
12	UNAF	-75.62	0.00	0.01	4.24%	96
13	UTEL	-5.04	-0.01	-0.02	3.32%	106
14	ZAEN	-23.14	0.07	-0.11	5.16%	65
15	ZPST	-106.54	-0.02	0.10	11.05%	83

Serial covariances of bid (cov_B) and ask (cov_A) quotes have a variation in sign across the stocks. Since there is no bid-ask bounce in a sequence of bid (ask) prices, serial covariance of their changes depends solely on the information content of trades. If positive and negative news alternate over a period of time, serial covariance will tend to have a negative value. If one kind of news prevails over a period of time, serial covariance will tend to have a positive value. Again, to assess the strength of the serial relation, the correlations of the quotations are considered instead of covariances. The serial relation is very weak, the average correlation coefficient is -0.5% for the bid quotes and -0.6% for the ask quotes across the Ukrainian stocks. This gives the evidence that the previous day closing quote has a very low influence on the next day closing quote. It is very probable if the information content of the closing quote is absorbed by the next day opening quotes. A much weaker serial relation between quotations compared to the serial relation between trade prices is also found in Stoll (1989).

Then, the regressions (6.8) and (6.9) are estimated with the cross-sectional covariances and spreads data to find the coefficients a_1 and b_1.. The estimation results are presented in Table 6.2. All the estimates for the three regressions are not significantly different from zero at 10% significance level. Very low adjusted R-squared of the regressions (0.3%, -4.9%, and 6.2%) imply that the serial covariances across the stocks have low interrelation with the quoted bid-ask spread.

Stoll (1989) finds similar results for the regressions with the quotes (cov_B and cov_A). For both bid quote and ask quote regressions, the coefficients b_0 and b_1 are found insignificantly different from zero with the adjusted R-squared of 0.0039 and 0.0018 respectively. Though the cov_T regression in Stoll (1989) has a higher explanatory power with the coefficient a_1 significantly different from zero and the adjusted R-squared of 0.30.

Table 6.2. Results of estimation of regressions (6.8) and (6.9) of the Stoll (1989) model.

The table presents the estimates of Equations (6.8) and (6.9). The estimates are based on daily data for 15 most liquid Ukrainian stocks during the first half of 2006.
The parameters k_0 and k_1 are estimates of a_0 and a_1 in $cov_T = a_0 + a_1 S^2 + u$, and are estimates of b_0 and b_1 in $cov_Q = b_0 + b_1 S^2 + v$, *Q=A, B.*

Coefficient	**Regression for** cov_T	**Regression for** cov_B	**Regression for** cov_A
k_0	-0.0005	0.0000	0.0000
P-value of t-stat	*0.92*	*0.84*	*0.25*
k_1	-0.8763	-0.0025	0.0066
P-value of t-stat	*0.33*	*0.57*	*0.19*
Adjusted R^2	0.0031	-0.0491	0.0615

The estimates of a_1 and b_1 are substituted into the system of equations (6.10) and (6.11) to find ∂ and π. The Mathematica package is used to solve the system. There are 5 solutions to the system:

(∂ = -1.24195, π = 0.50081)
(∂ = -0.0569278, π = 0.88571)
(∂ = 0.000283702 -0.0295221i, π = 0.933817+0.0275599i)
(∂ = 0.000283702 +0.0295221i, π = -0.933817-0.0275599i)
(∂ = 0.0507091, π = 0.986114)

Two of the solution have negative values of ∂, another two give irrational values of the parameters, and only one solution suits the theoretical predictions of the Stoll model:

$$\partial = 0.0507$$

$$\pi = 0.9861$$

The estimates of ∂ and π allow to find the value of the realized spread and the values of each of the spread components. The average realized spread is found by substitution of ∂ and π into equation (6.5):

$$RealizedSpread = 2(0.99 - 0.05)S = 0.94S$$

The realized spread comprises 94% of the quoted spread.

The asymmetric information and inventory holding cost components of the spread are found by substitution of the estimated coefficients into equations (6.5.1) and (6.5.2) respectively. The value of the components are 0.06*S*, or 6% of the quoted spread and 0.49*S*, or 49% of the quoted spread respectively.

The order processing cost component is the remainder of the realized spread after subtracting the inventory holding cost component and has value of *0.45S,* or 45% of the quoted spread.

The critique of the Stoll (1989) model suggests that the estimates of the model may be biased, firstly, because the model assumes constant bid-ask spread, which is often not true, and secondly, because the estimates of the model are nonlinear transformations of the linear parameters obtained from regressing covariances of price changes and quote changes on mean spreads (George, Kaul, and Nimalendran (1991) and Huang and Stoll (1997)), namely, the linear estimates of the coefficients a_1 and b_1 are applied for solving a non-linear system of Equations (6.10) and (6.11).

In order to check the validity of the Stoll model estimates, the probability of trade reversal is calculated directly from the sequence of trades and then compared to the probability of trade reversal found by applying the Stoll model. The value of the parameter calculated directly from the sequence of trades is 0.3460, which is much lower than 0.9861 estimated from the Stoll model. Since the asymmetric information component and the inventory holding cost component in the Stoll model rely heavily on the probability of trade reversal, the components estimates can be biased.

The asymmetric information component is in inverse relation to the probability of trade reversal, therefore if the latter is overestimated, the former will be underestimated. The inventory holding component is proportional to the probability of trade reversal, therefore if the latter is overestimated, the former will be overestimated. As a result, the asymmetric information component in our estimation of the Stoll model is likely to be underestimated, while the inventory holding cost is likely to be overestimated. This bias is likely to be a consequence of nonlinear transformations of the linear parameters a_1 and b_1 in the Stoll model.

Table 6.3. Comparison of the estimates of the spread components from the Stoll (1989) model found for Ukraine with the estimates found in other literature.

Spread Component	Results of the Chapter[1]	Stoll (1989)[2]	De Winne and Majois (2004)[3]	Serednyakov (2005)[4]
Asymmetric Information Cost	6%	43%	From -9% to 92%, depending on a stock. Average: 43%	From -66% to 60%, depending on a stock. Average: 4%
Inventory Holding Cost	49%	10%	From 1% to 76%, depending on a stock. Average: 35%	From -12% to 81%, depending on a stock. Average: 38%
Order Processing Cost	45%	47%	From -15% to 48%, depending on a stock. Average: 22%	From 39% to 87%, depending on a stock. Average: 58%
Total	**100%**	**100%**	**100%**	**100%**

[1] In the chapter, data for 15 most traded Ukrainian stocks for January-June 2006 is applied.
[2] Stoll (1989) uses data on more than 700 NASDAQ stocks for October, November, and December 1984.
[3] De Winne and Majois (2004) use data on 19 most traded Belgian stocks from Bel20 index for October-December 2002.
[4] Serednyakov (2005) uses data on 20 NYSE stocks comprising the Major Market Index (MMI) for three years: 1996, 1999, and 2002.

The comparison of our estimates of the spread components with the estimates found in other literature are presented in Table 6.3. The empirical results show that the value of the components vary greatly across the markets and across the individual stocks. For example, the asymmetric information component is 4% for 20 stocks comprising the Major Market Index in NYSE, 43% for a large cross-section of Nasdaq stocks, and 43% for a sample of 19 most traded Belgian stocks. For the individual stocks some of the components have negative values, which is not in line with the theoretical predictions of the Stoll (1989) model.

Estimation Results of the Huang & Stoll (1997) Model

The Huang and Stoll (1997) model allows finding the traded half-spread, *S/2* and the sum of the asymmetric information and the inventory holding cost components of the bid-ask spread, λ. The model is estimated for the 15 most liquid Ukrainian stocks during 2005-2006.

The estimates of the Huang and Stoll (1997) trade indicator model (Equation (6.26)) are presented in Table 6.4. Following Huang and Stoll (1997), the model is estimated using the GMM method (Generalized Method of Moments). The method of estimation is chosen because it provides estimates robust to both heteroscedasticity and autocorrelation of unknown form. Eviews 5 package is used for estimation. The row "Total" in the Table 6.4 shows the coefficients found from estimating Equation (6.26)) based on pooled data for all the companies in the sample.

The adjusted R-squared of the regressions is quite high and ranges from 8.9% to 42.3%. The estimates in Table 6.4 are expressed in the absolute (monetary) terms. The values of the relative traded half-spread and the sum of the asymmetric information and inventory holding components as a percentage of the bid-ask spread, λ, are presented in Table 6.5. Relative traded spread is found as a ratio of Ukrainian hryvna traded half-spread *S/2* to the average price for a stock over the period under consideration. The coefficient λ is found as a ratio of the coefficient *(λ-1)S/2* to the coefficient *S*/2. The standard error of λ is calculated using the formula for the standard error of a ratio of two uncorrelated variables[26]:

$$SE\left\{\frac{f}{g}\right\}=\left[\left(\frac{f}{g}\right)\sqrt{\left(\frac{sd\{f\}^2}{f^2}\right)+\left(\frac{sd\{g\}^2}{g^2}\right)}\right]/\sqrt{N} \qquad (6.34)$$

where f and g are two variables, $sd\{f\}$ and $sd\{g\}$ are the standard deviations of f and g respectively, and N is the number of observations.

Table 6.4. Estimation results of the Huang and Stoll (1997) model.

The table presents results of estimating Equation (6.26). The model is estimated for 15 most liquid Ukrainian stocks during 2005-2006. The estimated Ukrainian hryvnya (UAH) traded half-spread (S/2) and the coefficient λ(S/2) are shown as well as the value of the adjusted R-squared. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	Company	Obs	Adjusted R-sq	Traded half-spread S/2, UAH				Coefficient λ (S/2), UAH			
				Coeff.	St. Error	t-stat	Prob.	Coeff.	St. Error	t-stat	Prob.
1	AZST	462	0.3680	0.0650***	0.0041	15.81	0.0000	0.0124**	0.0048	2.57	0.0104
2	BAVL	440	0.3168	0.0088***	0.0007	13.26	0.0000	0.0003	0.0007	0.36	0.7198
3	DNEN	188	0.3217	7.9398***	0.9393	8.45	0.0000	0.4626	1.1388	0.41	0.6850
4	DTRZ	273	0.2556	4.0307***	0.4506	8.95	0.0000	0.4135	0.5465	0.76	0.4499
5	LTPL	484	0.3907	0.0470***	0.0035	13.37	0.0000	0.0057*	0.0030	1.89	0.0592
6	MZVM	389	0.4168	1.1975***	0.0798	15.00	0.0000	0.1285	0.0990	1.30	0.1949
7	NITR	359	0.2662	0.7472***	0.0668	11.18	0.0000	0.1246	0.0766	1.63	0.1047
8	PGOK	252	0.4160	1.3913***	0.1257	11.07	0.0000	-0.0741	0.1578	-0.47	0.6392
9	SMASH	375	0.2484	0.3864***	0.0437	8.85	0.0000	-0.0364	0.0562	-0.65	0.5177
10	STIR	251	0.2569	2.4989***	0.2829	8.83	0.0000	0.2938	0.3232	0.91	0.3641
11	UNAF	564	0.1899	2.3751***	0.2132	11.14	0.0000	0.3203	0.2376	1.35	0.1782
12	USCB	222	0.0889	0.0833***	0.0190	4.38	0.0000	0.0035	0.0214	0.16	0.8704
13	UTEL	805	0.3658	0.0132***	0.0007	19.69	0.0000	0.0014*	0.0008	1.69	0.0920
14	ZAEN	320	0.3964	2.7315***	0.2121	12.88	0.0000	0.2485	0.2650	0.94	0.3491
15	ZPST	570	0.4230	0.1092***	0.0063	17.25	0.0000	0.0073	0.0084	0.88	0.3815
	Total	**5,975**	**0.0913**	**1.2794*** **	**0.4266**	**3.00**	**0.0027**	**0.2249***	**0.1341**	**1.68**	**0.0935**

[26] λ is a share of the bid-ask spread, which is assumed to be constant over a period of time.

Table 6.5. The estimates of the traded half-spread and the sum of the asymmetric information and the inventory holding cost components of the spread (Huang and Stoll (1997) model).

The results are based on the data for 15 most liquid Ukrainian stocks during 2005-2006. Relative traded half-spread is found as a ratio of the Ukrainian hryvnya traded half-spread (presented in the Table 6.4) to the average price for a stock over the period under consideration. λ is the share of the asymmetric information and inventory holding cost component in the traded spread. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	Company	Relative traded half-spread S/2[27]		λ, the sum of the asymmetric information and the inventory holding cost components	
		Coefficient	St. Error	Coefficient	St. Error
1	AZST	2.52%***	0.16%	19.07%***	7.52%
2	BAVL	1.97%***	0.15%	2.94%	8.18%
3	DNEN	2.08%***	0.25%	5.83%	14.36%
4	DTRZ	1.30%***	0.15%	10.26%	13.61%
5	LTPL	2.31%***	0.18%	12.08%*	6.45%
6	MZVM	2.24%***	0.15%	10.73%	8.30%
7	NITR	1.57%***	0.14%	16.67%	10.36%
8	PGOK	2.96%***	0.27%	-5.32%	11.36%
9	SMASH	2.28%***	0.26%	-9.42%	14.59%
10	STIR	2.42%***	0.28%	11.76%	13.00%
11	UNAF	0.91%***	0.08%	13.48%	10.08%
12	USCB	4.35%***	1.00%	4.19%	25.68%
13	UTEL	1.48%***	0.08%	10.26%*	6.10%
14	ZAEN	1.88%***	0.15%	9.10%	9.73%
15	ZPST	1.92%***	0.11%	6.70%	7.66%
	Total	**1.83%*** **	**0.21%**	**17.58%*** **	**5.83%**

The value of the relative traded half-spread varies between 0.91% for UNAF and 4.35% for USCB. All the estimates are significantly different from zero at 1% significance level. The traded half-spread for the cross-section of all stocks is 1.83% and is close to the estimate of the effective half-spread found using the benchmark method (2.17%) in Chapter 4.

[27] Relative traded half-spread is a ratio of the absolute traded half-spread to the spread midquote.

The value of λ, the sum of the asymmetric information and the inventory holding cost components, varies between -9.4% for SMASH and 19.1% for AZST. Most of the estimates are not significantly different from zero at 10% significance level. For the overall sample of stocks, λ is 17.6% and is significantly different from zero at 1% significance level. The estimate for the overall sample of stocks is significant probably due to the higher number of observations compared to the number of observations for individual stocks. The remaining part of the traded spread, 82.4%, is the order processing cost component.

The sum of the asymmetric information and the inventory holding cost components found by applying the Stoll (1989) model, 55%, is much higher than the estimate found by applying the Huang & Stoll (1997) model. Taking into account the criticism in literature to the Stoll (1989) model, we tend to give less credence to the results from the Stoll (1989) model than to the results from the Huang & Stoll (1997) model.

Hanousek and Podpiera (2003) argue that the inventory holding cost component in the markets with multiple dealers (like Ukrainian stock market) is zero because trading pressure does not fall on a single specialist but is instead dispersed among a larger capital base of multiple competing dealers. The value of the inventory holding cost component, which is close to zero, implies that the value of lambda of 17.6% found from estimation of the Huang & Stoll (1997) model can be attributed solely to the asymmetric information component of the bid-ask spread. A similar value of the asymmetric information component was found in Hanousek and Podpiera (2003) for the Prague Stock Exchange (17%) and in Ryzhkov (2007) for the Ukrainian stock market (10%). Hanousek and Podpiera (2003) consider such a low value of the asymmetric information component surprising given the evidence of a high level of informed trading in the Prague Stock Exchange (Hanousek and Podpiera (2002)). As insider trading is considered a serious risk in Ukraine with the practices of investigation and prosecution being limited (EBRD (2008 [1]), the estimate of the asymmetric information component of just 17.6% seems to be too low.

Estimation Results of the Huang & Stoll (1997) Model With Accounting for Trade Size

Since the average trade size differs considerably across Ukrainian stocks, rather than applying absolute trade size, as it is done in Huang & Stoll (1997), relative trade size is applied. Relative trade size for each trade is calculated as a ratio of the trade size to the normal market size (NMS) for the stock (for more details on determination of trade size, see Chapter 3).

The estimates of the Huang and Stoll (1997) trade indicator model with accounting for trade size (Equation (6.29)) are presented in Table 6.6. The explanatory power of the regressions is quite high with adjusted R-squared between 9.2% and 42.4%.

Table 6.7 reports the inferred values of the relative traded half-spread and λ. The relative traded half-spread is found as a ratio of the Ukrainian hryvnya traded half-spread $S/2$ to the average price for a stock over the period under consideration. λ is a ratio of coefficient $(\lambda\text{-}1)S/2$ to the coefficient $S/2$. Its standard error is calculated using formula (6.34).

The relative traded half-spread has the same pattern for small, medium and large trades as the effective half-spread estimated using the benchmark method (Chapter 4). The estimated values of the half-spread in Huang and Stoll (1997) model are very close, though slightly smaller than those of the benchmark method. Traded half-spread is the smallest for the medium-sized trades (1.3%). They are followed by large trades (1.5%), and then small trades (1.7%). The estimates of the effective half-spread using benchmark method were 1.9%, 2.1%, and 2.3% for medium-sized, large, and small trades respectively (Chapter 4). The comparison of the results shows that the Huang and Stoll (1997) model provides reliable estimates of the effective bid-ask spread.

For the overall sample, the estimate of λ, the sum of the asymmetric information and the inventory holding cost components of the bid-ask spread, is positive and significantly different from zero only for small trades, 15.7%. For individual stocks, the estimates of λ for small trades are mostly insignificantly different from zero. Only for the stocks with larger number of observations (such as AZST, UTEL, and ZPST) lambdas tend to be significantly different from zero.

For medium and large trades, lambdas are negative and not significantly different from zero both for the overall sample and for individual stocks. Huang and Stoll

Table 6.6. Estimation results of the Huang and Stoll (1997) model with accounting for trade size.

The table presents results of estimating Equation (6.29). The model is estimated for 15 most liquid Ukrainian stocks during 2005-2006. The estimated Ukrainian hryvnya (UAH) traded half-spread (S/2) and the coefficient (λ-1)(S/2) are shown for the trades of small, medium, and large size, as well as the value of the adjusted R-squared. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	Company	Obs	Adjusted R-sq	Traded half-spread S/2, UAH											
				SMALL trades				MEDIUM trades				LARGE trades			
				Coeff.	St. Error	t-stat	Prob.	Coeff.	St. Error	t-stat	Prob.	Coeff.	St. Error	t-stat	Prob.
1	AZST	462	0.3817	0.0723***	0.0047	15.45	0.0000	0.0458***	0.0090	5.08	0.0000	0.0314**	0.0157	1.99	0.0467
2	BAVL	440	0.3133	0.0088***	0.0008	10.76	0.0000	0.0089***	0.0015	5.88	0.0000	0.0089***	0.0015	5.89	0.0000
3	DNEN	188	0.3254	9.3210***	1.1691	7.97	0.0000	5.9097***	2.0679	2.86	0.0047	4.0771	2.4745	1.65	0.1009
4	DTRZ	273	0.2473	4.0113***	0.5521	7.26	0.0000	4.0891***	0.8916	4.59	0.0000	3.9895**	1.5516	2.57	0.0106
5	LTPL	507	0.3561	0.0483***	0.0040	12.14	0.0000	0.0529***	0.0078	6.82	0.0000	0.0309***	0.0106	2.92	0.0037
6	MZVM	389	0.4162	1.2066***	0.0953	12.67	0.0000	1.0259***	0.1717	5.97	0.0000	1.5454***	0.2554	6.05	0.0000
7	NITR	359	0.2654	0.8066***	0.0815	9.90	0.0000	0.5896***	0.1423	4.14	0.0000	0.6698***	0.1759	3.81	0.0002
8	PGOK	252	0.4216	1.6114***	0.1533	10.51	0.0000	0.8554***	0.2919	2.93	0.0037	1.0197***	0.3427	2.98	0.0032
9	SMASH	375	0.2440	0.3921***	0.0520	7.54	0.0000	0.3770***	0.1033	3.65	0.0003	0.3414**	0.1384	2.47	0.0140
10	STIR	251	0.2729	2.8775***	0.3525	8.16	0.0000	1.2727**	0.5992	2.12	0.0345	2.9802***	0.7060	4.22	0.0000
11	UNAF	564	0.1865	2.4918***	0.2488	10.01	0.0000	1.9369***	0.5813	3.33	0.0009	2.1516***	0.5173	4.16	0.0000
12	USCB	222	0.1341	0.1213***	0.0082	14.85	0.0000	0.0980***	0.0151	6.47	0.0000	0.1198***	0.0240	5.00	0.0000
13	UTEL	805	0.3694	0.0144***	0.0008	18.53	0.0000	0.0108***	0.0014	7.53	0.0000	0.0077***	0.0027	2.86	0.0043
14	ZAEN	320	0.3936	2.9084***	0.2491	11.68	0.0000	2.3896***	0.5457	4.38	0.0000	2.1274***	0.6140	3.46	0.0006
15	ZPST	570	0.4237	0.1177***	0.0077	15.38	0.0000	0.0861***	0.0131	6.57	0.0000	0.1041***	0.0213	4.88	0.0000
	Total	**5,976**	**0.0919**	**1.2323*** **	**0.0625**	**19.73**	**0.0000**	**0.9515*** **	**0.1167**	**8.15**	**0.0000**	**1.0988*** **	**0.1545**	**7.11**	**0.0000**

Table 6.6, cont. Estimation results of the Huang and Stoll (1997) model with accounting for trade size.

	Company	Coefficient, (λ-1)S/2, UAH											
		SMALL trade				MEDIUM trade				LARGE trade			
		Coeff.	St. Error	t-stat	Prob.	Coeff.	St. Error	t-stat	Prob.	Coeff.	St. Error	t-stat	Prob.
1	AZST	-0.0554***	0.0047	-11.79	0.0000	-0.0356***	0.0090	-3.96	0.0001	-0.0703***	0.0159	-4.41	0.0000
2	BAVL	-0.0084***	0.0008	-10.24	0.0000	-0.0078***	0.0015	-5.19	0.0000	-0.0101***	0.0015	-6.67	0.0000
3	DNEN	-7.5957***	1.1565	-6.57	0.0000	-8.0056***	2.0889	-3.83	0.0002	-7.0702***	2.4996	-2.83	0.0051
4	DTRZ	-3.3786***	0.5463	-6.18	0.0000	-4.1260***	0.8968	-4.60	0.0000	-3.9068**	1.5879	-2.46	0.0144
5	LTPL	-0.0418***	0.0040	-10.50	0.0000	-0.0570***	0.0078	-7.35	0.0000	-0.0448***	0.0106	-4.23	0.0000
6	MZVM	-1.1006***	0.0961	-11.45	0.0000	-0.9393***	0.1714	-5.48	0.0000	-1.1777***	0.2511	-4.69	0.0000
7	NITR	-0.5760***	0.0831	-6.93	0.0000	-0.6294***	0.1397	-4.51	0.0000	-0.7836***	0.1757	-4.46	0.0000
8	PGOK	-1.5176***	0.1501	-10.11	0.0000	-1.5140***	0.3002	-5.04	0.0000	-1.1899***	0.3394	-3.51	0.0005
9	SMASH	-0.4000***	0.0525	-7.62	0.0000	-0.5279***	0.1021	-5.17	0.0000	-0.3940***	0.1380	-2.85	0.0045
10	STIR	-2.5268***	0.3541	-7.14	0.0000	-0.9995*	0.5969	-1.67	0.0951	-3.0426***	0.7050	-4.32	0.0000
11	UNAF	-2.0664***	0.2492	-8.29	0.0000	-1.8274***	0.5818	-3.14	0.0018	-2.1750***	0.5158	-4.22	0.0000
12	USCB	-0.1021***	0.0082	-12.48	0.0000	-0.1222***	0.0152	-8.0333	0.0000	-0.1023***	0.0239	-4.28	0.0000
13	UTEL	-0.0119***	0.0008	-15.40	0.0000	-0.0118***	0.0014	-8.23	0.0000	-0.0112***	0.0027	-4.15	0.0000
14	ZAEN	-2.4605***	0.2484	-9.90	0.0000	-2.7533***	0.5481	-5.02	0.0000	-2.3449***	0.6129	-3.83	0.0002
15	ZPST	-0.1003***	0.0077	-13.06	0.0000	-0.1061***	0.0131	-8.08	0.0000	-0.0897***	0.0213	-4.22	0.0000
	Total	**-1.0385*** **	**0.0626**	**-16.58**	**0.0000**	**-1.0115*** **	**0.1164**	**-8.6872**	**0.0000**	**-1.2161*** **	**0.1546**	**-7.87**	**0.0000**

Table 6.7. Estimation results of the relative traded half-spreads and lambdas (the sum of the asymmetric information and the inventory holding cost components) with accounting for trade size (Huang and Stoll (1997) model).

The results are based on the data for 15 most liquid Ukrainian stocks during 2005-2006. Relative traded half-spread is found as a ratio of the Ukrainian hryvnya traded half-spread S/2 (presented in Table 6.6) to the average price for a stock over the period under consideration. λ is the share of the asymmetric information and inventory holding cost component in the traded spread. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	Company	Relative traded half-spread S/2						**λ, the sum of the asymmetric information and the inventory holding cost components of the bid-ask spread**					
		Small		**Medium**		**Large**		**Small**		**Medium**		**Large**	
		Coeff.	**St.Err.**	**Coeff.**	**St.Err.**	**Coeff.**	**St.Err.**	**Coeff.**	**St.Err.**	**Coeff.**	**St.Err.**	**Coeff.**	**St.Err.**
1	AZST	2.81%***	0.18%	1.78%***	0.35%	1.22%***	0.61%	23.36%***	8.18%	22.23%	24.89%	-124.18%	123.43%
2	BAVL	1.96%***	0.18%	1.97%***	0.34%	1.98%***	0.34%	5.13%	12.79%	11.69%	22.68%	-13.42%	25.70%
3	DNEN	2.44%***	0.31%	1.55%***	0.54%	1.07%***	0.65%	18.51%	16.08%	-35.47%	59.13%	-73.41%	121.80%
4	DTRZ	1.29%***	0.18%	1.32%***	0.29%	1.29%***	0.50%	15.77%	17.89%	-0.90%	31.06%	2.07%	55.09%
5	LTPL	2.43%***	0.20%	2.66%***	0.39%	1.55%***	0.53%	13.60%	10.88%	-7.77%	21.56%	-45.04%	60.39%
6	MZVM	2.26%***	0.18%	1.92%***	0.32%	2.89%***	0.48%	8.79%	10.74%	8.44%	22.67%	23.80%	20.56%
7	NITR	1.70%***	0.17%	1.24%***	0.30%	1.41%***	0.37%	28.59%**	12.57%	-6.76%	35.01%	-16.99%	40.41%
8	PGOK	3.42%***	0.33%	1.82%***	0.62%	2.17%***	0.73%	5.82%	12.93%	-77.00%	69.85%	-16.68%	51.43%
9	SMASH	2.32%***	0.31%	2.23%***	0.61%	2.02%***	0.82%	-2.01%	19.04%	-40.01%	46.95%	-15.38%	61.82%
10	STIR	2.78%***	0.34%	1.23%***	0.58%	2.88%***	0.68%	12.19%	16.34%	21.46%	59.72%	-2.09%	33.83%
11	UNAF	0.95%***	0.10%	0.74%***	0.22%	0.82%***	0.20%	17.07%	12.98%	5.66%	41.28%	-1.09%	34.14%
12	USCB	6.33%***	0.47%	5.12%***	0.81%	6.25%***	1.27%	15.81%*	8.81%	-24.62%	24.72%	14.58%	26.27%
13	UTEL	1.60%***	0.09%	1.20%***	0.16%	0.86%***	0.30%	16.86%**	7.02%	-9.33%	19.68%	-45.09%	61.65%
14	ZAEN	2.00%***	0.17%	1.64%***	0.38%	1.46%***	0.42%	15.40%	11.20%	-15.22%	34.91%	-10.22%	42.92%
15	ZPST	2.07%***	0.13%	1.51%***	0.23%	1.83%***	0.37%	14.77%*	8.56%	-23.20%	24.18%	13.83%	26.99%
	Total	**1.67%*** **	**0.09%**	**1.29%*** **	**0.16%**	**1.49%*** **	**0.21%**	**15.73%** **	**6.64%**	**-6.31%**	**17.88%**	**-10.67%**	**20.98%**

(1997) expect that the asymmetric information and inventory holding costs should grow in trade size as large trades are expected to be more informative and to involve higher inventory holding risk. The expected result was found in Huang and Stoll (1997) for NYSE data: λ was estimated at 3.3% for small trades, 21.7% for medium trades, and 42.9% for large trades. We presume that negative and insignificantly different from zero lambdas for medium and large trades found for Ukrainian stocks are not a consequence of low information content of larger trades but rather a result of low power of the regression due to the low number of observations. While there were 4,794 small trades, the number of medium trades was lower by more than three times (1,333 observations), and the number of large trades was lower by more than six times (755 observations). A longer time-series data is necessary for finding reliable estimates of lambda for different trade sizes.
Also, it is important to mention that the estimate of lambda for the overall sample is heavily dominated by the lambda for small trades due to the predominance of the number small trades in the sample. A similar result was found in Huang and Stoll (1997).

Estimation Results of the Huang & Stoll (1997) Model: Three-Way Decomposition of the Bid-Ask Spread

Table 6.8 reports the results of estimation of Equations (6.30) and (6.33), while Table 6.9 reports the estimates of alpha, beta, and gamma inferred from the regression coefficients with their standard errors found by applying Formula (6.34).

Most of the estimates of the asymmetric information component, alpha, are negative and not significantly different from zero. Negative coefficients do not have a rational explanation since alpha is a share of the bid-ask spread and therefore

Table 6.8. Estimation results of the Huang and Stoll (1997) model of the three-way decomposition of the bid-ask spread.

The table presents results of estimating Equations (6.30) and (6.33). The results are based on the data for 15 most liquid Ukrainian stocks during 2005-2006. The estimated Ukrainian hryvna (UAH) traded half-spread (S/2) and the coefficient (Alpha+Beta-1)S/2 and -AlphaS/2(1-2Pi) are shown as well as the value of the adjusted R-squared. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	PFTS Code	Obs	Adj. R-sq	Traded half-spread S/2, UAH				(Alpha+Beta-1) S/2, UAH				-Alpha S/2 (1-2Pi)			
				Coeff.	**St. Error**	**t-stat**	**Prob.**	**Coeff.**	**St. Error**	**t-stat**	**Prob.**	**Coeff.**	**St. Error**	**t-stat**	**Prob.**
1	AZST	461	0.3682	0.0658***	0.0042	15.69	0.0000	-0.0514***	0.0043	-12.07	0.0000	-0.0044	0.0042	-1.05	0.2964
2	BAVL	439	0.3175	0.0087***	0.0007	12.99	0.0000	-0.0088***	0.0007	-12.43	0.0000	0.0006	0.0007	0.85	0.3957
3	DNEN	187	0.3216	7.8927***	0.9509	8.30	0.0000	-7.6420***	0.9727	-7.86	0.0000	0.8458	0.9509	0.89	0.3747
4	DTRZ	272	0.2613	4.0829***	0.4533	9.01	0.0000	-3.7239***	0.4646	-8.01	0.0000	0.1690	0.4525	0.37	0.7091
5	LTPL	506	0.1385	-0.0382***	0.0039	-9.83	0.0000	0.0097**	0.0039	2.49	0.0131	0.0042	0.0039	1.09	0.2756
6	MZVM	388	0.4167	1.1900***	0.0809	14.72	0.0000	-1.0813***	0.0818	-13.22	0.0000	0.0685	0.0809	0.85	0.3981
7	NITR	358	0.2717	0.7297***	0.0671	10.87	0.0000	-0.6655***	0.0699	-9.52	0.0000	0.1278*	0.0673	1.90	0.0582
8	PGOK	251	0.4193	1.4061***	0.1265	11.11	0.0000	-1.4811***	0.1287	-11.50	0.0000	0.0036	0.1263	0.03	0.9773
9	SMASH	374	0.2546	0.3746***	0.0440	8.52	0.0000	-0.4379***	0.0442	-9.92	0.0000	0.1011**	0.0439	2.30	0.0218
10	STIR	250	0.2558	2.5360***	0.2930	8.66	0.0000	-2.1617***	0.2954	-7.32	0.0000	-0.1967	0.2938	-0.67	0.5038
11	UNAF	564	0.1910	2.3635***	0.2138	11.05	0.0000	-2.1604***	0.2272	-9.51	0.0000	0.2923	0.2138	1.37	0.1721
12	USCB	221	0.0971	0.0807***	0.0191	4.22	0.0000	-0.0918***	0.0202	-4.55	0.0000	0.0351*	0.0192	1.83	0.0684
13	UTEL	804	0.3653	0.0133***	0.0007	19.54	0.0000	-0.0118***	0.0007	-17.03	0.0000	-0.0003	0.0007	-0.44	0.6593
14	ZAEN	319	0.3986	2.6984***	0.2128	12.68	0.0000	-2.5527***	0.2168	-11.77	0.0000	0.2695	0.2131	1.26	0.2068
15	ZPST	569	0.4243	0.1080***	0.0064	16.92	0.0000	-0.1029***	0.0064	-16.14	0.0000	0.0102	0.0064	1.60	0.1092
	Total	**5,962**	**0.0909**	**1.0944*** **	**0.1240**	**8.83**	**0.0000**	**-0.9985*** **	**0.1173**	**-8.52**	**0.0000**	**0.0491**	**0.0479**	**1.03**	**0.3047**

Table 6.9. Estimation results for the relative traded half-spread and the three components of the spread (the Huang and Stoll (1997) model of the three-way decomposition of the bid-ask spread).

The results are based on the data for 15 most liquid Ukrainian stocks during 2005-2006. The estimates are referred from the estimation results presented in Table 6.8. Standard errors are found by applying formula (6.34). Pi is the probability of trade reversal, alpha is asymmetric information component, beta is inventory holding cost component, and gamma is order processing cost component. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	Company	Pi	Alpha		Beta		Gamma	
			Coeff.	St.Err.	Coeff.	St.Err.	Coeff.	St.Err.
1	AZST	0.3481	21.95%	21.05%	-0.03%	12.89%	78.08%**	33.94%
2	BAVL	0.3021	-16.52%	19.48%	15.59%*	8.25%	100.93%***	27.73%
3	DNEN	0.3665	-40.14%	45.39%	43.32%	28.42%	96.82%	73.80%
4	DTRZ	0.3727	-16.25%	43.56%	25.04%	28.32%	91.21%	71.88%
5	LTPL	0.4094	61.25%	56.48%	13.23%	45.90%	25.52%	102.38%
6	MZVM	0.3865	-25.34%	30.01%	34.47%*	20.77%	90.87%*	50.77%
7	NITR	0.3318	-52.04%*	27.81%	60.85%***	15.08%	91.19%**	42.89%
8	PGOK	0.3953	-1.22%	42.89%	-4.11%	29.72%	105.33%	72.61%
9	SMASH	0.4150	-158.77%**	71.45%	141.87%***	53.36%	116.90%	124.81%
10	STIR	0.3322	23.11%	34.63%	-8.35%	19.37%	85.24%	54.00%
11	UNAF	0.3133	-33.11%	24.40%	41.70%***	11.72%	91.41%***	36.13%
12	USCB	0.3218	-122.07%*	72.71%	108.26%***	35.94%	113.81%	108.64%
13	UTEL	0.3574	7.90%	17.93%	3.05%	10.99%	89.05%***	28.92%
14	ZAEN	0.3936	-46.94%	37.31%	52.34%**	26.34%	94.60%	63.64%
15	ZPST	0.4358	-73.84%	46.24%	78.53%**	38.08%	95.31%	84.33%
	Total	**0.3664**	**-16.80%**	**16.48%**	**25.57%*****	**1.59%**	**91.23%*****	**18.07%**

cannot be negative. A similar result of the majority of the alphas being negative was also found in Huang and Stoll (1997) who admit that their three-way decomposition methodology does not seem to be able to correctly decompose the bid-ask spread into its three components. Huang and Stoll (1997) explain that the result is due to the estimates of π (probability of trade reversal) that turn out to be less than 0.5. When π is less than 0.5, changes in ΔV_t are attenuated, which becomes clear from examining Equation (6.31). When the change in the stock's underlying value in reaction to a trade is reduced (because the sign of the trade is anticipated), the change in the stock's quote midpoint ascribed to inventory effects is increased. Consequently the net effect is in reduction of a (up to a negative value) and increase of β.

Both the results of our estimation and the results in Huang and Stoll (1997) point at that the model of the three-way decomposition of the bid-ask spread is not able to correctly decompose the bid-ask spread into its three components.

Estimation Results of the Glosten and Harris (1988) Model

The model of Glosten and Harris (1988) is estimated for 15 most liquid Ukrainian stocks during 2005-2006. Table 6.10 presents the GMM estimates of the Glosten and Harris (1988) trade indicator model (equation (6.16)) for individual stocks and for the pooled sample of all stocks (presented in the row "Total" in the table). The regressions have quite high explanatory power with R-squared varying from 9.4% to 43.3%.

The estimates of the constant part of the transitory component, c_0, and of the asymmetric information component, z_0, for the overall sample are positive and significantly different from zero at 1% significance level. Though the trade-size-related constituents of the both spread components, c_1 and z_1, are insignificantly different from zero for the overall sample. This implies that the values of the transitory component and the asymmetric information component do not depend on the trade size. The results do not conform with the predictions of the Huang and Stoll (1997) model, where the bid-ask spread is expected to depend on the trade size. A possible reason of the problem can be a very high weight that large trades are allowed to exert on the coefficients in the GH model. Glosten and Harris (1988) point out that many of the very large trades are arranged off the floor and do not necessarily reflect all the information available at the time, when the trade was crossed. Therefore GH suggest to truncate all the large trades at their lower bound

Table 6.10. Estimation Results of the Glosten & Harris (1988) model, basic specification.

The table presents results of estimating Equation (6.16). The results are based on the data for 15 most liquid Ukrainian stocks during 2005-2006. The estimated Ukrainian hryvna (UAH) constituents of the order processing spread component (*c0* and *c1*) and of the asymmetric information spread component (*z0* and *z1*) are shown as well as the value of the adjusted R-squared. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	PFTS Code	Obs	Adj. R-sq.	c0, UAH				$c1 \cdot 10^6$, UAH				z0, UAH				$z1 \cdot 10^6$, UAH			
				Coeff.	St. Error	t-stat	Prob.	Coeff.	St. Error	t-stat	Prob.	Coeff.	St. Error	t-stat	Prob.	Coeff.	St. Error	t-stat	Prob.
1	AZST	462	0.375	0.0499***	0.0046	10.83	0.000	0.0738	0.0503	1.47	0.143	0.0189***	0.0054	3.53	0.000	-0.1890***	0.0697	-2.71	0.007
2	BAVL	440	0.316	0.0083***	0.0007	11.78	0.000	0.0002	0.0002	0.99	0.321	0.0005	0.0008	0.65	0.517	-0.0002	0.0002	-0.88	0.378
3	DNEN	188	0.327	7.8725***	1.0163	7.75	0.000	-245.00	345.00	-0.71	0.478	0.7823	1.2302	0.64	0.526	-340.00	517.00	-0.66	0.511
4	DTRZ	273	0.251	3.5813***	0.5076	7.06	0.000	41.60	317.00	0.13	0.896	0.3725	0.6042	0.62	0.538	58.90	441.00	0.13	0.894
5	LTPL	507	0.356	0.0484***	0.0033	14.48	0.000	-0.0099	0.0096	-1.03	0.302	0.0052	0.0044	1.18	0.237	-0.0077	0.0140	-0.55	0.583
6	MZVM	389	0.415	1.0890***	0.0847	12.86	0.000	-4.1600	6.9800	-0.60	0.552	0.0978	0.1072	0.91	0.362	6.7700	8.6700	0.78	0.436
7	NITR	359	0.264	0.6083***	0.0737	8.25	0.000	2.3600	4.4900	0.53	0.600	0.1521*	0.0860	1.77	0.078	-4.1700	5.8700	-0.71	0.477
8	PGOK	252	0.412	1.4520***	0.1352	10.74	0.000	1.5300	5.5300	0.28	0.783	-0.0662	0.1689	-0.39	0.695	-1.0600	7.5300	-0.14	0.888
9	SMASH	375	0.246	0.4289***	0.0473	9.06	0.000	-0.4670	1.9400	-0.24	0.810	-0.0274	0.0605	-0.45	0.651	-1.2000	2.4400	-0.49	0.622
10	STIR	251	0.253	2.1468***	0.2996	7.17	0.000	29.80	46.90	0.63	0.526	0.3119	0.3505	0.89	0.374	-6.8400	59.8000	-0.11	0.909
11	UNAF	564	0.188	2.0537***	0.2181	9.42	0.000	-1.83	19.20	-0.10	0.924	0.2996	0.2445	1.23	0.221	10.90	26.60	0.41	0.683
12	USCB	222	0.089	0.0876***	0.0204	4.31	0.000	-0.0319	0.0523	-0.61	0.543	0.0052	0.0229	0.23	0.819	-0.0398	0.0697	-0.57	0.568
13	UTEL	805	0.367	0.0118***	0.0007	15.87	0.000	0.0008	0.0027	0.30	0.767	0.0021**	0.0009	2.29	0.022	-0.0065*	0.0039	-1.66	0.097
14	ZAEN	320	0.394	2.4467***	0.2295	10.66	0.000	25.50	62.00	0.41	0.681	0.3131	0.2857	1.10	0.274	-51.50	82.10	-0.63	0.531
15	ZPST	570	0.434	0.0899***	0.0072	12.44	0.000	0.5140***	0.1510	3.41	0.001	0.0118	0.0096	1.23	0.220	-0.2430	0.2100	-1.16	0.247
	Total	**5,975**	**0.094**	**1.1255********	**0.1279**	**8.80**	**0.000**	**-0.1250**	**0.0836**	**-1.50**	**0.134**	**0.1787********	**0.0566**	**3.16**	**0.002**	**0.0144**	**0.0792**	**0.18**	**0.856**

of 10,000 shares. That is, if a trade with size of 30,000 shares was executed, the truncated figure of 10,000 is to be used instead of 30,000.

Since Ukrainian trades are quite large and 10,000 shares is often a normal trade size for many trades in Ukrainian stocks, we apply a different truncation rule. We truncate our data at 6 NMS, which is a lower bound for a large trade in our sample (more details on NMS can be found in Chapter 3). That is, if a trade is larger than 6 NMS, the trade size corresponding to 6 NMS for the stock is applied instead of the actual size of the trade.

The results of estimating the GH model with truncation are presented in Table 6.11. The values and significance of c_0 and z_0 coefficients stayed approximately the same as in the model without truncation (c_0 had estimated value of 1.13 without truncation and 1.15 with truncation, while z_0 had estimated value of 0.18 both without and with truncation). Though the coefficient c_1 (the size-related constituent of the transitory spread component) was found significantly different from zero at 1% significance level. The coefficient z_1 (the size-related constituent of the asymmetric information spread component) stayed insignificantly different from zero. The finding suggest that per-share transitory costs are decreasing in the trade size, while the asymmetric information spread component does not depend on the trade size.

Table 6.12 shows the effective half-spreads and the components of the spread inferred from the estimates of the GH model with truncation. The relative effective half-spread is found as a ratio of Equation (6.19) to the mean stock price divided by two. The coefficient α is found by substitution of the estimated coefficients into Equation (6.20); the coefficient $(\beta+\gamma)$ is found as $(1-\alpha)$.

The asymmetric information component α is 14.1% and is significantly different from zero at 5% significance level. For the individual stocks α varies between -9.6% and 29.3% and is not significantly different from zero. The statistical significance of

Table 6.11. Estimation Results of the Glosten & Harris (1988) model with truncation.

The results are based on the data for 15 most liquid Ukrainian stocks during 2005-2006. In order to avoid giving too much weight in the estimation to the block trades, the trade volume is truncated at 6NMS (normal market size). That is if a trade size is more than 6 NMS, the truncated figure that corresponds to 6NMS for a stock is used instead of actual trade size. The table presents results of estimating Equation (6.16). The estimated Ukrainian hryvnya (UAH) constituents of the order processing spread component (*c0* and *c1*) and of the asymmetric information spread component (*z0* and *z1*) are shown as well as the value of the adjusted R-squared. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	PFTS Code	Obs	Adj. R-sq	c0, UAH				$c1 \cdot 10^6$, UAH				z0, UAH				$z1 \cdot 10^6$, UAH			
				Coeff.	**St. Error**	**t-stat**	**Prob.**	**Coeff.**	**St. Error**	**t-stat**	**Prob.**	**Coeff.**	**St. Error**	**t-stat**	**Prob.**	**Coeff.**	**St. Error**	**t-stat**	**Prob.**
1	AZST	462	0.381	0.0530***	0.006	9.50	0.000	0.0003	0.120	0.00	0.998	0.0252***	0.007	3.84	0.000	-0.432***	0.158	-2.74	0.006
2	BAVL	440	0.318	0.0080***	0.001	10.55	0.000	0.0012*	0.000	1.77	0.078	0.0006	0.001	0.77	0.440	-0.0010	0.001	-1.06	0.292
3	DNEN	188	0.346	8.2327***	1.286	6.40	0.000	-1337.00	2146	-0.62	0.534	2.5793	1.591	1.62	0.107	-5493.0*	2902	-1.89	0.060
4	DTRZ	273	0.256	3.1849***	0.621	5.13	0.000	914.00	879.0	1.04	0.299	0.3745	0.787	0.48	0.634	17.30	1204	0.01	0.989
5	LTPL	507	0.237	0.0826***	0.028	2.96	0.003	-0.0401	0.050	-0.80	0.425	0.0289	0.022	1.30	0.194	0.0995	0.089	1.12	0.263
6	MZVM	389	0.415	1.0846***	0.111	9.81	0.000	-5.8700	42.8	-0.14	0.891	0.0514	0.144	0.36	0.721	41.00	56.0	0.73	0.465
7	NITR	359	0.268	0.5796***	0.084	6.88	0.000	10.6000	13.3	0.80	0.424	0.2368**	0.101	2.34	0.020	-28.10*	16.5	-1.70	0.089
8	PGOK	252	0.432	1.6496***	0.173	9.54	0.000	-43.80*	26.2	-1.67	0.095	0.0965	0.224	0.43	0.666	-34.20	34.2	-1.00	0.317
9	SMASH	375	0.246	0.4234***	0.062	6.80	0.000	-0.0197	7.950	0.00	0.998	-0.0034	0.079	-0.04	0.966	-6.0600	10.0	-0.60	0.549
10	STIR	251	0.254	2.1341***	0.394	5.42	0.000	88.9000	276.0	0.32	0.748	0.5351	0.443	1.21	0.228	-269.00	335.0	-0.80	0.422
11	UNAF	564	0.189	2.1145***	0.264	8.01	0.000	-65.80	169.0	-0.39	0.697	0.3994	0.299	1.34	0.181	-85.60	195.0	-0.44	0.661
12	USCB	222	0.132	0.1456***	0.027	5.46	0.000	-1.070***	0.340	-3.11	0.002	-0.0023	0.029	-0.08	0.938	0.0576	0.432	0.13	0.894
13	UTEL	805	0.372	0.0118***	0.001	12.56	0.000	0.0010	0.010	0.13	0.894	0.0036***	0.001	3.04	0.003	-0.0251**	0.010	-2.57	0.010
14	ZAEN	320	0.394	2.4007***	0.286	8.38	0.000	128.00	294.0	0.44	0.662	0.4470	0.352	1.27	0.204	-317.00	368.0	-0.86	0.390
15	ZPST	570	0.424	0.0937***	0.009	10.24	0.000	0.4090	0.350	1.16	0.248	0.0231*	0.013	1.84	0.066	-0.817*	0.483	-1.69	0.091
	Total	**5,975**	**0.096**	**1.1508*** **	**0.129**	**8.93**	**0.000**	**-0.627*** **	**0.130**	**-4.69**	**0.000**	**0.1823*** **	**0.058**	**3.12**	**0.002**	**0.0108**	**0.418**	**0.03**	**0.979**

Table 6.12. Estimates of the components of the bid-ask spread and the effective bid-ask spread based on the Glosten and Harris (1988) model with truncation.

The effective half-spreads and the components of the spread presented in the table are found based on the GH model estimation results (Table 6.11). The results are based on the data for 15 most liquid Ukrainian stocks during 2005-2006. The relative effective half-spread is found as a ratio of Equation (6.19) to the mean stock price divided by two. The coefficient α is found by substitution of the estimated coefficients into Equation (6.20); the coefficient $(\beta+\gamma)$ is found as $(1-\alpha)$. *** indicates significance level at 1%, ** indicates significance level at 5%, * indicates significance level at 10%.

	PFTS Code	Mean volume per trade, shares	Effective half-spread, as a percentage of the midquote		Asymmetric information component, α		Order processing and inventory holding cost component, (γ+β)	
			Coeff.	St.Err.	Coeff.	St.Err.	Coeff.	St.Err.
1	AZST	31,080	2.52%***	0.81%	18.22%	18.66%	81.78%***	29.91%
2	BAVL	463,064	1.93%***	0.51%	2.07%	14.05%	97.93%***	28.50%
3	DNEN	407	2.10%	1.29%	4.30%	34.60%	95.70%	64.59%
4	DTRZ	473	1.29%*	0.77%	9.57%	34.37%	90.43%	59.96%
5	LTPL	45,764	5.74%**	2.84%	29.26%	27.14%	70.74%	43.81%
6	MZVM	1,814	2.24%**	0.81%	10.48%	20.78%	89.52%**	35.94%
7	NITR	3,887	1.57%**	0.63%	17.04%	23.13%	82.96%**	38.01%
8	PGOK	4,660	2.94%**	1.44%	-4.54%	27.79%	104.54%*	55.53%
9	SMASH	5,586	2.28%	1.43%	-9.64%	35.54%	109.64%	74.05%
10	STIR	949	2.42%	1.37%	11.20%	31.11%	88.80%	56.80%
11	UNAF	908	0.91%***	0.34%	13.54%	20.65%	86.46%**	36.93%
12	USCB	51,944	4.74%	5.01%	0.79%	56.67%	99.21%	115.84%
13	UTEL	90,964	1.47%***	0.41%	10.00%	15.94%	90.00%***	27.89%
14	ZAEN	641	1.88%***	0.73%	8.95%	21.82%	91.05%**	39.51%
15	ZPST	18,799	1.92%***	0.66%	7.11%	19.96%	92.89%***	34.99%
	Total	**57,447**	**1.76%*** **	**0.30%**	**14.10%** **	**6.78%**	**85.90%*** **	**17.91%**

the result for the overall sample is possibly driven by a larger sample size. The value of the component is much smaller than in Glosten and Harris (1988) and in Madhavan, Richardson and Roomans (1997) for the NYSE (on average, 47.4% and 46.6%, respectively), and similar to the result of Hanousek and Podpiera (2003) for the Prague Stock Exchange (17%) and Ryzhkov (2007) for the Ukrainian stock market (10%). Taking into account that the level of informed trading in the Prague Stock Exchange and in the Ukrainian stock market is considered much higher than in NYSE, it is surprising that the asymmetric information component for these two markets was found much lower than for NYSE.

Both studies of Hanousek and Podpiera (2003) and Ryzhkov (2007) assume that the inventory holding cost component in a market with multiple brokers is zero since there is no pressure on a particular broker to trade in order to support liquidity unlike in NYSE, where there is a pressure on market makers. Taking into account that the sum of the asymmetric information and the inventory holding cost components found by applying Huang and Stoll (1997) model for the Ukrainian stock market was 17.6% and the asymmetric information component found by applying Glosten and Harris (1988) model was 14.1%, it is very likely that the inventory holding cost component in the Ukrainian stock market is actually close to zero. In this case, the value of 17.6% found by estimating Huang and Stoll (1997) model, can be attributed solely to the asymmetric information component. The remaining part of the spread can attributed to the order processing cost component (82.4% in case of the Huang and Stoll (1997) model and 85.9% in case of the Glosten and Harris (1988) model.

Quite low estimate of the asymmetric information component found for the Prague Stock Exchange and for the Ukrainian stock market can be viewed as complementary evidence in support of the evidence-based critique of the spread decomposition models. Van Ness et al. (2001) examined the performance of five spread decomposition models by comparing the asymmetric information component estimates to other measures of information asymmetry (for more details on the study, see Section 7.2 "Review of Literature"). The study found that asymmetric information components appear unrelated to measures of uncertainty, and concluded that the asymmetric information models measure the level of asymmetric information weakly at best. Neal and Wheatley (1998) did not find any significant difference between the asymmetric information spread components estimated for closed-end funds and for a matched sample of common stocks. This result seemed puzzling to the authors who predicted lower asymmetric information for closed-end funds, because they report their net asset values weekly, which eliminates uncertainty about their current liquidation value. According to Neal and Wheatley (1998), this suggested that the spread decomposition models can be misspecified. Though, to our best knowledge, literature does not suggest solid critique of the methodology of the trade indicator spread decomposition models (such as Huang and Stoll (1997) and Glosten and Harris (1988) models) and the models are widely applied in various settings for measuring informational content of trades.

Estimation Results of the Glosten and Harris (1988) Model for Different Trade Sizes

By substitution of the mean volume of shares per trade for different trade sizes in the equations (6.19) and (6.20) the estimates of the effective spread and the components of spread can be found. The estimates of the coefficients c_0, c_1, z_0, and z_1 that are substituted in the equations are those presented in Table 6.11.

As in the estimation of the Huang and Stoll (1997) model with accounting for trade size, all the trades are divided into three groups: small, medium, and large based on the relative trade size for each stock (more details on division of stocks into size groups can be found in Chapter 3). Within each size group, mean volume of shares per trade is found individually for each stock.

The effective half-spreads and the spread components for different trade sizes are presented in Table 6.13.

Effective half spread for small, medium and large trades is 1.80%, 1.76%, and 1.34% respectively. Similar to the results from Huang and Stoll (1997) model and the estimation of the effective half-spread by applying the benchmark method (Chapter 4), small trades are found the most expensive to execute. Though the results from Huang and Stoll (1997) model and the benchmark method have shown that medium

Table 6.13. Estimates of the effective bid-ask spread and the components of the bid-ask spread relative to the trade size based on the Glosten and Harris (1988) model with truncation.

All the trades are divided into three groups by trade size: small, medium, and large based on the relative trade size for each stock. For each stock and each group the mean volume of shares per trade is found and substituted in the equations (6.19) and (6.20) together with the estimates of the corresponding coefficients (from Table 6.11). The results are based on the data for 15 most liquid Ukrainian stocks during 2005-2006. *** indicates significance level at 1%, ** indicates significance level at 5%, and * indicates significance level at 10%.

	PFTS Code	Mean volume per trade, shares			Effective half-spread						Asymmetric Information Spread Component, α					
					Small		Medium		Large		Small		Medium		Large	
		Small	Medium	Large	Coeff.	St.Err.	Coeff.	St.Err.	Coeff.	St.Err.	Coeff.	St.Err.	Coeff.	St.Err.	Coeff.	St.Err.
1	AZST	13,189	69,413	240,400	0.0282***	0.006	0.0188	0.012	-0.0099	0.031	0.2693**	0.133	-0.0982	0.369	3.0813	9.699
2	BAVL	59,031	393,223	5,875,016	0.0191***	0.004	0.0193***	0.005	0.0221	0.024	0.0657	0.100	0.0284	0.134	-0.4998	0.818
3	DNEN	9,623	40,726	253,622	-0.1438	-0.135	-0.7001	0.546	-4.5078	3.360	0.9156	1.012	0.8271	0.785	0.8078	0.739
4	DTRZ	285	979	3,961	0.0123*	0.007	0.0144	0.011	0.0234	0.031	0.0992	0.300	0.0875	0.445	0.0611	0.771
5	LTPL	20,285	171,633	918,195	0.0567**	0.027	0.0612	0.037	0.0835	0.089	0.274	0.249	0.3775	0.384	0.7241	0.995
6	MZVM	9,080	31,105	157,602	0.0272	0.022	0.0417	0.062	0.1248	0.296	0.2912	0.504	0.5953	1.227	0.9761	2.677
7	NITR	881	4,089	29,661	0.0169***	0.005	0.0157**	0.007	0.0063	0.023	0.2647	0.161	0.1636	0.236	-1.3823	4.588
8	PGOK	1,628	13,196	57,364	0.0344***	0.011	0.0152	0.025	-0.058	0.082	0.0252	0.173	-0.4949	1.251	0.6837	1.256
9	SMASH	1,529	12,743	67,926	0.0243**	0.010	0.0202	0.022	0.0004	0.081	-0.0307	0.230	-0.2352	0.657	-1.2236	4.757
10	STIR	3,535	15,065	80,018	0.0197	0.029	-0.0004	0.097	-0.1136	0.481	-0.2046	0.856	0.7002	1.504	1.7876	7.918
11	UNAF	260	1,541	14,235	0.0094***	0.003	0.0087**	0.004	0.0014	0.022	0.1524	0.147	0.1173	0.269	-1.8555	4.283
12	USCB	375	3,035	26,009	0.0746***	0.029	0.0732**	0.030	0.0611	0.040	-0.0158	0.204	-0.015	0.216	-0.0066	0.344
13	UTEL	17,695	56,482	327,000	0.0167***	0.003	0.0156***	0.003	0.0084	0.009	0.2109**	0.097	0.1557	0.128	-0.6122	0.857
14	ZAEN	285	1,352	11,677	0.0192***	0.006	0.0178*	0.011	0.0044	0.058	0.1276	0.168	0.0071	0.328	-1.7622	4.783
15	ZPST	15,416	88,249	293,462	0.0194***	0.006	0.0142	0.017	-0.0005	0.047	0.0952	0.183	-0.606	0.990	1.5321	5.231
	Total	**10,207**	**60,189**	**557,076**	**0.0180*** **	**0.003**	**0.0176*** **	**0.003**	**0.0134** **	**0.007**	**0.1375*** **	**0.051**	**0.1412** **	**0.069**	**0.1903**	**0.309**

trades are the cheapest to execute, while in the Glosten and Harris (1988) model large trades are found the cheapest. The reason of the difference lies in the different approaches to modelling of the effective spread relative to the trade size. Glosten and Harris (1988) assume linear relationship between the two parameters, while Huang and Stoll (1997) do not assume any functional form of relationship between the two parameters. As the results of applying the Huang and Stoll (1997) model and the benchmark method show, the relationship between the effective spread and the trade size in Ukraine is not linear, and, therefore, the Glosten and Harris (1988) model is not able to correctly capture it.

The estimation results of the Glosten and Harris (1988) model suggest that the effective bid-ask spread depends on the trade size not because of the variable part of the asymmetric information component (z_1 is not significantly different from zero), but because of the variable part of the transitory component (c_1 is significantly different from zero). If our assumption about the equality of the inventory holding cost component to zero is correct, the result means that the order processing cost component in Ukraine depends on the trade size, in particular, it falls with the trade size and, as a consequence, effective spread falls with the trade size. Glosten and Harris (1988) expected that the order processing cost component should not depend on the trade size and their empirical results supported the expectation. In case of Ukraine, dependence of the order processing cost component on the trade size is unexpected too. Negative value of the coefficient c_1 can mean that per unit cost of trading is higher for small orders than for the larger orders and can be due to two reasons: either decreasing per share cost of supplying liquidity services or substantial fixed costs of filling an order. From our knowledge of the trading process in the Ukrainian stock market, we do not have grounds to consider either of the reasons plausible. On the contrary, we think that the reason of the negative and significantly different from zero value of the coefficient c_1 is in that the coefficient captures the impact of another factor. As explained in Chapter 4, larger trades in the Ukrainian stock market tend to be negotiated and receive price improvement, while smaller trades are executed at a price, which is close to the bid/ask quote. As a result, larger trades have smaller effective spread than smaller trades and the reason of the difference in spreads is not a higher information content or larger order processing cost of small trades but a necessity of brokers to give price improvement to the clients that they value. The model of Glosten and Harris (1988) does not take price concessions into account and, as a result, the transitory component of the model captures it. So, we tend to conclude that negative dependence of the transitory component on the trade size is not the consequence of larger per share cost of execution of small trades but the consequence of price improvement suggested by brokers for larger trades. This conclusion adds to previously expressed concern (related to the linear modelling of the spread components) about inappropriateness of the Glosten and Harris (1988) model for decomposition of the bid-ask spread in the Ukrainian stock market.

The asymmetric information component, α, is found not to depend on the trade size as its variable component, z_1, is not significantly different from zero. This suggests that larger trades in the Ukrainian stock market are not more informative than small trades, which does not seem to be realistic. Possible reason of this result can again lie in the linear modelling of the dependence of the component on the trade size, which does not have to be necessarily true. The model of Huang and Stoll (1997) does not assume any functional form for the relationship and therefore seems to be more appropriate for the Ukrainian stock market. Though we were not able to find statistically significant estimates of the asymmetric information component for different trade sizes by applying Huang and Stoll (1997) model due to too low number of observations.

Spread decomposition models are widely applied in literature for measuring information contents of trades. Researchers that apply the models are often content with the results and, to our best knowledge, no solid critique was suggested to the methodology of the spread decomposition for the trade indicator models (apart from the evidence-based critique). At the same time, the true value of the spread components is unknown because the components are not observable. Different models suggest different results. For example, George et al. (1991) find that the asymmetric information cost component represents between 8 and 13% of the spread (the study is based on the NYSE/AMEX and Nasdaq data for 1969-1987). Huang et Stoll (1997) conclude that the sum of the asymmetric information and the inventory holding cost components ranges across stocks from 1.9% to 22.3% of the spread (the study is based on the data for 19 NYSE firms during 1992). Lin et al. (1995) find that the information asymmetry component is larger, 39.2% of the spread (the study is based on the data for 150 NYSE firms during 1998), while Madhavan, Richardson, and Roomans (1997) observe a gradual decrease in the asymmetric information cost during the trading day, from 54.7% of the spread in the beginning of the day to 38.4% of the spread in the end of the day (the study is based on the data for 274 NYSE firms during 1990). Since within the same market there is no benchmark for the asymmetric information spread component, it is difficult to judge whether different spread decomposition models correctly estimate the component. But the knowledge that information trading has a higher risk in emerging markets than in developed markets gives us grounds to expect the asymmetric information component in emerging markets to be higher than in developed markets. Since the estimation results for the Ukrainian stock market and for the Prague Stock Exchange did not support the expectation, it was reasonably concluded the spread decomposition models applied could not correctly estimate the asymmetric information component of the bid-ask spread in the markets.

In this chapter, we applied the most frequently applied in literature spread decomposition models, though they do not seem to be appropriate for decomposition of the bid-ask spread in Ukraine. Whether it is due to inapplicability of the models to Ukrainian data or due to the fundamental inability of the models to correctly decompose the bid-ask spread, stays an open question.

6.6. Summary and Conclusions

Three bid-ask spread decomposition models are applied for estimation of the spread components for 15 most liquid Ukrainian stocks.

Summary results of estimating the models of Stoll (1989), Huang and Stoll (1997), and Glosten and Harris (1988) are presented in Table 6.14.

Table 6.14. Summary of results of estimating the models of Stoll (1989), Huang and Stoll (1997), and Glosten and Harris (1988).

	Asymmetric information component	Inventory holding cost component	Order processing cost component
Stoll (1989)	6%	49%	45%
Huang and Stoll (1997)	17.6%***		82.4%
Glosten and Harris (1988)	14.1%**	85.9%	

According to the model of Stoll (1989), the asymmetric information component takes 6% of the bid-ask spread, the inventory holding cost component takes 49% of the bid-ask spread, and the order processing cost component takes 45% of the bid-ask spread. The estimation results of the Stoll model differ considerably from the results of the other two models estimated in the chapter. Taking into account the George, Kaul, and Nimalendran (1991) and Huang and Stoll (1997) critique of the Stoll (1989) model and the substantial differences in the estimates of the model found in literature, we tend to give little credence to the estimates of the spread components based on the model of Stoll (1989).

The results of estimation the Huang and Stoll (1997) model suggest that the sum of the asymmetric information component and the inventory holding cost component is 17.6%. As the inventory holding cost component is usually assumed in literature to be zero in the multiple dealer markets (as Ukrainian stock market PFTS), the value of 17.6% is attributed solely to the asymmetric information component. The estimation results of the Glosten and Harris (1988) model give a very close estimate, 14.1%. Similar result for the asymmetric information component for the Ukrainian stock market was found in Ryzhkov (2007), 10%, and for the Prague Stock Exchange in Hanousek and Podpiera (2003), 17%. It is surprising that the value of the asymmetric information component was found that low for these markets given that insider trading is considered a serious risk in Ukraine and the Czech Republic and practices of investigation and prosecution are limited (EBRD (2008 [1]), Hanousek and Podpiera (2002)). The low estimates seem to be even more surprising when taking into account that the asymmetric information component was found much higher in NYSE (47.4%, on average, in Glosten and Harris (1988) and 46.6%, on average, in Madhavan, Richardson and Roomans (1997)), where the information trading is not as widespread as in the emerging markets.

A low estimate of the asymmetric information component found for the Prague Stock Exchange and for the Ukrainian stock market, can be viewed as evidence in support of the general criticism of the spread decomposition models that accuses the models in that they do not measure what they claim to measure (Neal and Wheatley (1998) and Van Ness et al. (2001)).

The value of the asymmetric information component relative to the trade size could not have been reliably estimated for the Ukrainian stock market. The specification of the Glosten and Harris (1988) model assumes linear relationship between the component and trade size, which is not true for Ukraine (the benchmark method (Chapter 4) has shown that the medium-sized trades are the cheapest to execute in Ukraine). Huang and Stoll (1997) model does not assume any specific functional form of the relationship between the effective spread and the trade size but a too low number of observations do not allow to find reliable estimates for Ukraine.

Despite the critique of the spread decomposition models related to their ability of estimating the components of the bid-ask spread, Huang and Stoll (1997) model has shown high ability in estimation of the effective bid-ask spread, both overall and relative to the trade size. The pattern of the effective bid-ask relative to the trade size was found the same and the values were found very close to the estimates of the effective bid-ask spread based on the benchmark method (Chapter 4). Glosten and Harris (1988) model was found able to estimate the overall effective bid-ask spread but did not do well in estimating the effective bid-ask spread relative to the trade size due to the assumption of the model of linear relationship between effective spread and trade size, which is not true for Ukraine.

Chapter 7

Impact of the Cost of Trading on Portfolio Returns

7.1. Introduction

A study of transaction costs would not be complete if it did not include the analysis of how transaction costs influence returns of portfolios of stocks.

To show the impact of trading costs on portfolio returns we perform a study of a simple trading strategy and estimate returns that the strategy generates with and without accounting for the cost of trading. There is a wide selection of trading strategies that are considered as those that can help an asset manager to constantly outperform the market, for example, momentum strategies, value strategies, and growth strategies. Based on our data availability we have chosen to test a momentum strategy as analysing momentum strategies requires data only on the past stock returns.

The aim of our study is to demonstrate the importance of inclusion of the cost of trading when analysing a portfolio performance rather than prove or refute profitability of a momentum strategy in the Ukrainian stock market.

Momentum, or relative strength strategy is a strategy of maintaining a long position in past strong performers and a short position in past weak performers. There is a substantial evidence that momentum strategies earn abnormal returns over a three to twelve month horizon (Givoly and Lakonishok (1979), Bernard and Thomas (1989), Chan, Jegadeesh, and Lakonishok (1999)). This evidence is at odds with classical theory of market efficiency. Different explanations to this phenomenon are found in literature. Some of them are attributed to a certain inertia in investor behaviour, which creates persistent arbitrage opportunities, for example, expectation extrapolation (DeLong et al. (1990), conservatism in expectations updating (Barberis et al. (1998)), biased self-attribution (Daniel et al. (1998)), and selective information conditioning (Hong and Stein (1999)). The opponents of the strategy argue that the abnormal returns found in literature cannot be attained in practice due to the frictions in the real market. Chasing momentum can generate high turnover, which may result in dissipation of potential profit because of transaction costs (Chan, Jegadeesh, and Lakonishok (1999)).

Many studies that analyse returns of momentum strategies do not take into account the cost of trading and conclude that momentum strategies bring abnormal returns (Givoly and Lakonishok (1979), Bernard and Thomas (1989), Chan, Jegadeesh, and Lakonishok (1999)). Though a number of studies does test the profitability of momentum strategies taking into account transaction costs. Jegadeesh and Titman (1993) find that momentum strategies bring returns that exceed trading costs. On the contrary, Lesmond, Schill, and Zhow (2004) argue that the estimates of the trading costs in Jegadeesh and Titman (1993) are unrealistically low. They suggest a more accurate estimate of the cost of trading and show that returns associated with momentum strategies are lower than the cost of trading. The conclusion is reinforced by the fact that the composition of the momentum strategy portfolios is heavily weighted toward trading stocks with particularly high transaction costs.

Momentum strategy assumes a possibility of short selling as underperformers in the past period have to be short sold in order to follow the strategy. Even though short selling is not allowed in the Ukrainian stock market, in order to make the results of our study comparable to other literature, we assume that short selling is allowed in Ukraine. This assumption is not contradictory with the aim of our study, which is to show the influence of the costs of trading on portfolio returns rather than to prove or refute whether investors can earn abnormal returns by following a momentum strategy in the Ukrainian stock market.

The chapter is organized as follows: section 2 explains the approach to portfolios construction, section 3 describes the way of estimating the cost of trading, section 4 analyses the characteristics of momentum portfolios, section 5 discusses the profitability of momentum strategies, and section 6 concludes.

7.2. Approach to Portfolios Construction

We examine conventional momentum strategies over a period from February 2005 to November 2006. Our portfolios construction procedure follows Jegadeesh and Titman (1993) and Hong, Lim, and Stein (2000).

We define poor performers and strong performers in two different ways: i) top 10% and bottom 10% (Jegadeesh and Titman (1993), Chan, Jegadeesh, and Lakonishok (1999)) and ii) top 30% and bottom 30% (Hong, Lim, and Stein (2000)).

Stocks are grouped into one of the three portfolios (poor performers, moderate performers, or strong performers) based on their mean monthly return over a half-year period preceding the date of portfolio construction.

On the portfolio construction day, which is the last day of a month, all stocks are sorted based on their mean monthly return during the previous half-year (for example, on 31 July 2005 all stocks are sorted based on their mean monthly return during February-July 2005). Two different strategies of portfolio construction are applied. For 10-80-10 strategy, bottom 10% of all stocks sorted by mean monthly return are attributed to the poor performers portfolio (P1), top 10% of all stocks sorted by mean monthly return are attributed to the strong performers portfolio (P3), the rest of the stocks are attributed to the moderate performers portfolio (P2).

A similar approach is taken for the 30-40-30 strategy of portfolio construction but instead of bottom 10% and top 10%, bottom 30% and top 30% of all stocks are attributed to the P1 and P3 portfolios respectively.

Momentum strategy assumes maintaining a long position in the best performers and a short position in the worst performers. For example, on 31 July 2005, an investor opens a long position with the stocks attributed to portfolio P3 and opens a short position with the stocks attributed to portfolio P1. (The stocks were attributed to the P3 and P1 portfolios based on their mean monthly returns during February-July 2005). After 6 months, on 31 January 2006, the positions are closed and new positions are opened based on the mean monthly returns of all stocks in the market during August 2005 – January 2006. To follow the strategy requires paying full bid-ask spread on each of the two positions as long position is opened in the beginning of the holding period and closed in the end of the holding period as well as the short position. Even though short selling is not permitted in Ukraine, we assume that it is allowed, to make the results of our study comparable with the results in other literature.

In order, on the one hand, to increase the number of observed periods and, on the other hand, not to allow specific market conditions in one of the periods to shift our average estimates, rolling periods are considered. It means that portfolios are constructed in the end of each month starting 31 July 2005, according to the rules described above. Rolling average returns for portfolios P1, P2, and P3 over the period of observation are then computed.

Summary statistics for individual stocks are presented in Table 7.1. Mean monthly return for a stock over a period is computed as geometric average of monthly returns for the stock over the period. Monthly return for a stock is computed as percentage difference between the midquote for the stock on the last day of a month and the midquote for the stock on the last day of the previous month. Midquote is the average between closing bid and ask prices.

Mean monthly return varies from -15.1% for ALMK in 2006 to 22.4% for AVDK in 2005. Market capitalization of stocks varies from USD 37.3 mln. for DMZK in 2005 to

USD 17,660 mln. for KSTL in 2006. The stock price was the lowest for DNAZ in 2005, USD 0.005, and the highest for RODV in 2006, USD 794.

Table 7.1. Descriptive statistics for Ukrainian stocks in 2005 and 2006.
(Sorted by mean monthly return)

The table reports mean monthly return, market capitalization and mean price for a sample of Ukrainian stocks in 2005 and 2006. Mean monthly return is computed as geometric average of monthly returns over the period. Monthly return is found based on the midquote of the best closing quote for a stock in the end of the month. Market capitalization is estimated based on the stock price and shares outstanding at the beginning of each year.

2005

PFTS Code	Mean monthly return	St Error	Mcap, USD, mln.	Mean price, USD
AVDK	22.43%	2.32%	4,114.0	3.63
PGOK	16.10%	4.17%	6,474.0	9.30
YASK	15.21%	2.36%	317.8	0.33
HANZ	11.23%	5.64%	1,306.0	0.32
USCB	11.11%	8.48%	15,500.0	0.37
MZVM	10.59%	2.63%	827.1	10.86
ZHEN	10.49%	1.35%	367.2	0.51
BAVL	9.21%	1.05%	5,760.0	0.07
STIR	8.75%	1.20%	3,825.0	26.03
ZACO	7.55%	5.81%	773.1	1.27
NITR	6.86%	0.77%	2,419.0	7.62
LTPL	6.26%	3.10%	269.6	0.23
HMON	5.41%	1.55%	269.2	0.30
DKOK	4.90%	0.06%	311.4	0.25
NFER	3.94%	1.97%	2,352.0	1.54
DNON	3.47%	0.76%	1,183.0	36.41
UNAF	3.32%	0.64%	11,130.0	37.82
SMASH	2.41%	2.05%	1,217.0	3.19
ZFER	1.59%	0.64%	793.0	0.14
ALMK	0.95%	3.04%	11,750.0	0.32
ZALK	0.63%	2.14%	529.3	0.17
DOMZ	0.13%	2.73%	429.2	0.26
KIEN	-0.28%	0.51%	823.8	1.51
MSICH	-0.61%	0.89%	969.9	99.28
GLNG	-0.65%	1.40%	681.0	0.01
ZPST	-0.66%	0.55%	605.7	1.10
NVTR	-0.84%	0.37%	363.0	6.22

2006

PFTS Code	Mean monthly return	St Error	Mcap, USD, mln.	Mean price, USD
SVGZ	15.16%	6.31%	172.3	26.41
HMBZ	12.58%	7.50%	145.3	0.28
DTRZ	9.65%	2.04%	495.7	71.84
KREN	7.49%	1.97%	562.3	0.34
LTPL	7.04%	2.36%	431.8	0.47
DMZK	6.27%	2.02%	90.7	0.15
NITR	5.12%	0.96%	4,130.0	12.43
ZAON	4.69%	1.02%	1,063.0	1.11
DOEN	4.62%	0.61%	951.7	6.17
UNAF	4.51%	1.09%	16,240.0	59.28
DNEN	3.37%	0.61%	2,235.0	79.56
HMON	3.35%	1.23%	249.0	0.41
CEEN	3.32%	1.16%	2,202.0	0.84
ZHEN	2.84%	1.06%	466.3	0.70
DNON	2.83%	0.44%	1,555.0	46.36
BAVL	2.56%	1.52%	6,974.0	0.10
ZAEN	2.56%	0.66%	2,786.0	30.61
UTEL	2.55%	1.31%	15,870.0	0.19
TATM	1.22%	1.64%	657.0	0.37
AZOT	1.20%	1.05%	866.0	1.82
RODB	0.99%	0.63%	405.0	793.80
DNSS	0.94%	0.41%	958.4	175.49
USCB	0.91%	3.63%	6,537.0	0.35
SMASH	0.89%	1.48%	1,178.0	3.87
KSTL	0.75%	0.63%	17,660.0	0.78
NVTR	0.67%	0.46%	457.8	6.65
GLNG	0.65%	1.14%	585.0	0.01

TATM	-1.15%	0.59%	592.6	0.29
DOEN	-1.20%	1.10%	516.7	4.12
AZST	-1.69%	0.85%	7,522.0	0.58
ZAEN	-1.81%	0.49%	1,688.0	24.92
UTEL	-1.92%	0.70%	12,970.0	0.14
DNEN	-2.40%	0.67%	1,126.0	60.35
MMKI	-3.10%	1.16%	8,296.0	0.56
CEEN	-5.50%	0.14%	1,053.0	0.67
SVGZ	-5.80%	3.91%	121.2	20.77
SFER	-5.88%	2.49%	451.1	0.01
DMZK	-6.34%	0.62%	37.3	0.07
DNAZ	-7.61%	3.17%	914.2	0.005
KREN	-7.97%	2.24%	164.4	0.20

PGOK	0.42%	1.83%	5,037.0	11.02
MZVM	0.38%	1.22%	701.3	11.10
KIEN	-0.43%	0.54%	813.0	1.49
HANZ	-0.60%	1.09%	1,204.0	0.31
YASK	-0.71%	2.35%	212.4	0.35
ZALK	-0.95%	0.75%	420.3	0.16
MMKI	-1.09%	0.87%	7,576.0	0.55
DRMZ	-1.15%	0.85%	297.8	0.27
NFER	-1.46%	0.50%	1,821.0	1.37
ZACO	-2.25%	1.47%	659.1	1.24
MSICH	-2.78%	0.73%	811.5	77.25
MEGA	-2.80%	1.99%	226.5	1.28
AVDK	-2.90%	1.61%	1,873.0	3.20
ZPST	-3.11%	1.38%	382.3	0.93
DGRM	-3.27%	1.07%	72.7	0.35
DKOK	-4.24%	1.48%	140.4	0.19
DNAZ	-4.34%	0.60%	685.6	0.01
ZFER	-4.45%	0.64%	439.2	0.10
STIR	-4.53%	1.13%	1,939.0	18.87
AZST	-4.65%	0.61%	5,221.0	0.41
KRAZ	-4.98%	0.82%	434.8	0.09
SFER	-5.34%	2.49%	271.3	0.03
DMPZ	-6.41%	1.33%	77.2	0.03
DOMZ	-6.44%	1.14%	190.2	0.15
PGZK	-6.58%	1.67%	884.4	0.08
FORM	-6.91%	1.18%	1,534.0	7.52
ALMK	-15.07%	1.88%	2,277.0	0.10

Table 7.2 reports monthly returns of each of the portfolios constructed following 10-80-10 strategy and the cost of trading for each portfolio in terms of the quoted bid-ask spread. The cost of trading will be discussed in Section Stocks in each portfolio are equally weighted. Average monthly return for P1 portfolio is -0.80%, for P2 portfolio it is 0.24%, and for P3 portfolio it is 0.56%. Since portfolios are held for 6 months, average semi-annual return is also presented. It is found using the continuous compounding formula:

$$R^{semi-annual} = (1 + R^{monthly})^6 - 1 \qquad (7.1)$$

Where $R^{semi-annual}$ is semi-annual portfolio return and $R^{monthly}$ is monthly portfolio return.

Average semi-annual returns for P1, P2, and P3 portfolios are -4.68%, 1.44%, and 3.44% respectively. Portfolio P1 underperforms portfolio P2, while portfolio P3 overperforms portfolio P2, which supports momentum phenomenon.

Table 7.2. Monthly returns and the cost of trading for portfolios following 10-80-10 strategy.

The table reports buy-and-hold returns (%) for the six-month holding periods and trading cost estimates (%) associated with portfolio P1 (weak performers), portfolio P2, and portfolio P3 (strong performers) for 10-80-10 momentum strategy.
The sample is composed of 59 Ukrainian stocks during February 2005-November 2006. Relative strength portfolios are constructed by sorting stocks by the return performance over the previous 6 months. Firms are classified into three portfolios based on the respective break point percentiles of past performance.

Date of portfolio construction	Monthly returns for 10-80-10 strategy			Quoted spread		
	P1	P2	P3	P1	P2	P3
31-Jul-05	2.19%	3.73%	6.50%	11.08%	23.41%	20.20%
31-Aug-05	1.37%	1.95%	7.44%	42.34%	20.31%	8.89%
30-Sep-05	1.03%	1.45%	4.10%	47.44%	19.88%	8.30%
31-Oct-05	-0.84%	2.05%	2.41%	34.17%	20.01%	7.74%
30-Nov-05	6.58%	-0.40%	-3.11%	35.95%	19.78%	26.88%
31-Dec-05	8.21%	-0.36%	-8.49%	48.34%	21.03%	21.29%
31-Jan-06	-4.53%	-0.75%	3.03%	62.32%	18.99%	31.40%
28-Feb-06	-5.74%	-1.29%	0.98%	54.13%	19.18%	30.04%
31-Mar-06	-9.08%	-1.61%	-3.38%	53.99%	21.64%	18.59%
30-Apr-06	-5.74%	-1.61%	-4.23%	50.83%	17.50%	45.41%
31-May-06	-0.78%	-0.38%	2.17%	41.34%	19.87%	38.47%
Geometric Average	**-0.80%**	**0.24%**	**0.56%**	**43.17%**	**20.14%**	**22.82%**
Average semi-annual return	**-4.68%**	**1.44%**	**3.44%**			

Table 7.3 reports monthly returns of each of the portfolios constructed following 30-40-30 strategy. Stocks in each portfolio are equally weighted. In the same way as for 10-80-10 strategy, it is found that for 30-40-30 strategy average semi-annual returns

for P1, P2, and P3 portfolios are -3.64%, -0.60%, and 8.11% respectively. Portfolio P1 underperforms portfolio P2, while portfolio P3 overperforms portfolio P2, which supports momentum phenomenon.

Table 7.3. Monthly returns and the cost of trading for portfolios following 30-40-30 strategy.

The table reports buy-and-hold returns (%) for the six-month holding periods and trading cost estimates (%) associated with portfolio P1 (weak performers), portfolio P2, and portfolio P3 (strong performers) for 10-80-10 momentum strategy.
The sample is composed of 59 Ukrainian stocks during February 2005-November 2006. Relative strength portfolios are constructed by sorting stocks by the return performance over the previous 6 months. Firms are classified into three portfolios based on the respective break point percentiles of past performance.

Date of portfolio construction	Monthly returns for 30-40-30 strategy			Quoted spread		
	P1	P2	P3	P1	P2	P3
31-Jul-05	0.80%	3.03%	7.87%	14.19%	19.65%	32.48%
31-Aug-05	2.82%	-0.16%	5.30%	24.71%	13.70%	27.68%
30-Sep-05	2.26%	1.41%	1.51%	23.56%	21.28%	20.37%
31-Oct-05	2.15%	0.43%	3.23%	18.12%	23.78%	17.44%
30-Nov-05	1.64%	-2.00%	0.98%	22.70%	20.29%	23.99%
31-Dec-05	1.78%	-1.65%	-0.64%	33.59%	16.27%	24.01%
31-Jan-06	-2.65%	0.35%	-0.30%	34.97%	12.70%	29.97%
28-Feb-06	-2.89%	-0.96%	-0.88%	29.89%	19.31%	23.54%
31-Mar-06	-5.68%	-0.21%	-2.20%	30.33%	17.39%	27.54%
30-Apr-06	-3.75%	-1.96%	-1.45%	31.42%	14.20%	29.45%
31-May-06	-2.78%	0.75%	1.43%	29.81%	20.59%	23.38%
Geometric Average	**-0.62%**	**-0.10%**	**1.31%**	**26.51%**	**18.06%**	**25.37%**
Average semi-annual return	**-3.64%**	**-0.60%**	**8.11%**			

7.3. The Cost of Trading Estimate

We study net profitability of momentum strategies by comparing gross returns from short position in portfolio P1 and long position in portfolio P2 to the respective transaction costs related to maintaining the positions.

We apply two different estimates of transaction costs: quoted bid-ask spread and effective bid-ask spread.

Lesmond, Schill, and Zhow (2004) use transaction cost estimate from the period that precedes the portfolio holding period. We give a preference to the transaction cost estimate from the same period as the portfolio holding period since the relative strength stocks are actually bought and sold in the beginning and at the end of the holding period. As returns from relative strength strategies are equally weighted, the trading costs for a portfolio are also equally weighted. Our trading cost estimates represent the average round trip cost of trading the stocks within the respective portfolios.

The cost of trading for each portfolio is estimated in the following way. First, monthly estimates of the bid-ask spreads are found for each stock as the closing quoted bid-ask spread for the stock on the last day of the month. Second, the monthly estimates for each stock are averaged (by using geometric average) over half-year periods that correspond to the holding periods for portfolios. Finally, the cost of trading for each portfolio is found as equally-weighted average of the mean semi-annual bid-ask spreads for all stocks in the portfolio.
For example, if a portfolio was constructed on 31 July 2005 and consisted of 10 certain stocks, the cost of trading for this portfolio will be estimated as follows. First, for each of the ten stocks monthly closing bid-ask spreads will be found for the period of August 2005-January 2006. Then the monthly numbers for each stock will be averaged (by using geometric average) to find one semi-annual estimate of the

bid-ask spread for each stock. After this, semi-annual estimates across the ten stocks will be averaged (by using equal weights since the stocks in the portfolio are equally weighted) to find the cost of trading for the portfolio. Later, the cost of trading for the portfolio will be subtracted from the portfolio return to find net portfolio return.

The estimates of the quoted spreads for 10-80-10 strategy are presented in Table 7.2 and for 30-40-30 strategy – in Table 7.3. Quoted spreads for P1 and P2 portfolios are higher than quoted spread for P2 portfolio. For 10-80-10 strategy, to trade P1 and P3 portfolios stocks cost 43.17% and 22.82% respectively, while the cost of trading for portfolio P2 is 20.14% (Table 7.2). For 30-40-30 strategy, to trade P1 and P3 portfolios stocks cost 26.51% and 25.37% respectively, while the cost of trading for portfolio P2 is 18.06% (Table 7.3). The results are in line with Lesmond, Schill, and Zhow (2004) who also find that relative strength portfolios are more costly to trade than the portfolio of stocks with medium returns.

Literature generally considers effective spread as one of the most reliable estimates of the cost of trading, while quoted bid-ask spread is viewed as an overstated estimate of the cost of trading because trades are often executed within the quoted bid-ask spread (for more details see Chapter 4). So, our cost of trading estimate based on the quoted bid-ask spread may appear large to some traders. Unfortunately, due to low trading frequency, it is not possible to find reliable *monthly* estimates of the effective bid-ask spread for many of the Ukrainian stocks by applying any of the standard methodologies of effective spread estimation. Though from Chapter 4 we know the estimates of the effective spreads for each stock over a two-year period of 2005-2006. From the estimates of the quoted and effective bid-ask spreads over 2005-2006, we will find a coefficient, by which, on average, effective spread is less than quoted spread. Then we will divide the estimate of quoted spread for a portfolio by this coefficient to find effective spread for the portfolio. The data for computation of the coefficient are presented in Table 7.4. For Ukrainian stocks, quoted bid-ask spread is larger than effective bid-ask

Table 7.4. Quoted and effective bid-ask spreads for Ukrainian stocks during 2005-2006.

The table reports average values for quoted and effective spreads for Ukrainian stocks during 2005-2006. The values are taken from Table 4.3 of Chapter 4. The detailed explanation of the way of computation of the estimates can be found in Chapter 4.

Company	Quoted bid-ask spread	Effective bid-ask spread	Ratio of quoted to effective spread	Company	Quoted bid-ask spread	Effective bid-ask spread	Ratio of quoted to effective spread
ALKZ	123.95%	36.34%	3.41	MEGA	53.28%	29.58%	1.8
ALMK	62.02%	25.18%	2.46	MMKI	8.53%	5.32%	1.6
AVDK	37.28%	8.05%	4.63	MSICH	11.58%	5.74%	2.02
AZOT	57.30%	16.06%	3.57	MZVM	8.79%	5.10%	1.72
AZST	9.19%	5.01%	1.83	NFER	39.63%	18.45%	2.15
BAVL	14.74%	4.32%	3.41	NITR	7.66%	3.79%	2.02
CEEN	10.70%	4.63%	2.31	NVTR	13.59%	7.47%	1.82
DGRM	19.21%	8.35%	2.3	PGOK	23.22%	8.42%	2.76
DKOK	31.00%	13.09%	2.37	PGZK	25.27%	12.71%	1.99
DMPZ	66.47%	40.44%	1.64	RODB	17.48%	8.82%	1.98
DMZK	104.39%	25.47%	4.1	SFER	78.69%	33.42%	2.35
DNAZ	46.66%	25.51%	1.83	SHKD	24.29%	12.19%	1.99
DNEN	14.50%	4.66%	3.11	SMASH	14.14%	6.13%	2.31
DNON	13.11%	5.22%	2.51	STIR	9.07%	5.13%	1.77
DNSS	8.82%	5.37%	1.64	SVGZ	104.34%	48.94%	2.13
DOEN	12.22%	5.50%	2.22	TATM	34.50%	14.21%	2.43
DOMZ	14.33%	9.11%	1.57	TOEN	120.83%	81.68%	1.48
DRMZ	31.43%	8.88%	3.54	UNAF	5.56%	2.20%	2.53
DTRZ	10.40%	3.89%	2.67	USCB	67.97%	14.16%	4.8
FORM	36.18%	13.29%	2.72	UTEL	4.88%	3.16%	1.54
GLNG	22.04%	17.18%	1.28	YAMZ	40.24%	11.72%	3.43
HANZ	41.80%	25.25%	1.66	YASK	24.21%	8.66%	2.8
HMBZ	86.45%	23.36%	3.7	ZACO	18.95%	10.06%	1.88
HMON	104.28%	53.49%	1.95	ZAEN	7.54%	3.23%	2.33
HRTR	129.50%	55.51%	2.33	ZALK	28.70%	13.79%	2.08
KIEN	14.37%	7.62%	1.89	ZAON	25.56%	11.14%	2.29
KRAZ	35.97%	17.47%	2.06	ZFER	20.57%	11.87%	1.73
KREN	87.37%	23.22%	3.76	ZHEN	84.29%	19.27%	4.37
KSTL	8.63%	3.86%	2.24	ZPST	8.33%	3.66%	2.28
LTPL	15.53%	6.14%	2.53	**Average**			**2.43**

spread by 2.43, on average. By dividing the estimate of quoted spread for each of the portfolios by 2.43, we find that for 10-80-10 strategy, effective bid-ask spreads for P1, P2, and P3 portfolios are 17.77%, 8.29%, and 9.39% respectively. For 30-40-30 strategy, they are 10.91%, 7.43%, and 10.44% respectively.

7.4. Characteristics of the Relative Strength Portfolios

The portfolio characteristics of momentum strategies are presented in Table 7.5. For the 10-80-10 strategy, mean semi-annual returns for the portfolios P1, P2, and P3 are -4.68%, 1.44%, and 3.44% respectively. A trading strategy that maintains a long position in the best performers and a short position in the worst performers (P3 minus P1) brings semi-annual gross profit of 8.12%.

For the 30-40-30 strategy, mean monthly returns for the portfolios P1, P2, and P3 are -3.64%, -0.60%, and 8.11%. A trading strategy that maintains a long position in the best performers and a short position in the worst performers (P3 minus P1) brings monthly gross profit of 11.75%, which is higher than for 10-80-10 strategy.

Return on portfolio P2 represents benchmark performance and can be viewed as market performance. Higher absolute returns of P1 and P3 portfolios compared to return of P2 portfolio show that the momentum strategies do bring gross abnormal returns in the Ukrainian stock market. The result is in line with the findings in other literature (Givoly and Lakonishok (1979), Bernard and Thomas (1989), and Chan, Jegadeesh, and Lakonishok (1999)).

We test whether the returns of extreme performers (P1 and P3) are significantly different from those of portfolio P2. For the 10-80-10 strategy we reject the equality of returns of portfolios P1 and P2 at 5% significance level and equality of returns of portfolios P2 and P3 at 10% significance level. Though for 30-40-30 strategy we cannot reject the equality of returns of portfolios P1 and P2, and of portfolios P2 and P3.

Table 7.5. Portfolio characteristics of the momentum strategies.

The sample is composed of 59 Ukrainian stocks during February 2005-November 2006. Relative strength portfolios are constructed by sorting stocks by the return performance over the previous 6 months. Firms are classified into three portfolios based on the respective break point percentiles of past performance. Market capitalization is estimated based on the stock price and shares outstanding at the beginning of each year.

		10-80-10 strategy				30-40-30 strategy			
		P1	**P2**	**P3**		**P1**	**P2**	**P3**	
					P3-P1				**P3-P1**
Mean semi-annual portfolio return		-4.68%	1.44%	3.44%	8.12%	-3.64%	-0.60%	8.11%	11.75%
Share price (USD)	Mean	2.57	12.32	7.5		7.8	14.68	8.99	
	Median	0.15	0.99	1.59		0.34	1.62	1.08	
Market Capitalization (USD, millions)	Mean	389	561.6	510.2		497.4	486.1	639.6	
	Median	147.4	194.7	398		185.7	189.3	335.8	
					P3+P1				**P3+P1**
Mean quoted bid-ask spread		43.17%	20.14%	22.82%	65.99%	26.51%	18.06%	25.37%	51.88%
Mean effective bid-ask spread*		17.77%	8.29%	9.39%	27.16%	10.91%	7.43%	10.44%	21.35%
Proportion of no-trading days		72.10%	56.40%	53.40%		60.30%	57.70%	55.00%	

* Found by division of the mean quoted spread by 2.43, which is the proportion by which quoted spread exceeds, on average, the effective spread for Ukrainian stocks (See Table 7.4).

The mean share price of stocks within portfolios P1 and P3 is lower than that of stocks within portfolio P2: USD 2.57, USD 7.50 compared to USD 12.32 respectively for the 10-80-10 strategy and USD 7.80, USD 8.99 compared to USD 14.68 respectively for the 30-40-30 strategy. A lower mean price for the portfolio of winning stocks than for the non-traded portfolio was also documented in Lesmond, Schill, and Zhou (2004). A lower mean price is often associated with riskier stocks, which, in turn, have higher cost of trading and are expected to bring higher returns. Market capitalization of P2 stocks is higher than that of P1 and P3 stocks for the 10-80-10 strategy, which gives the evidence that extreme performing stocks are those of smaller size. The same finding was also documented in Lesmond, Schill, and Zhou (2004). Though for the 30-40-30 strategy the pattern is different, portfolio P2 has the lowest market capitalization. This suggests that 20% of best performing stocks in Ukraine that follow top 10% performing stocks are the stocks with quite large market capitalization. The same holds for 20% of worst performing stocks that follow bottom 10% performing stocks.

When executing the relative strength strategy, the trader does not trade stocks within portfolio P2 but trades stocks within portfolios P1 and P3. To execute the relative strength strategy, the trader in the beginning of a half-year period has to open long position in the best performers, P3, and to open a short position in the worst performers, P1. In the end of the half-year period, the trader has to close the long and the short positions. Execution of the full strategy requires paying full bid-ask spread on both portfolios, P1 and P3. Table 7.5 shows that the cost of trading for 10-80-10 strategy is 65.99%, while the cost of trading for 30-40-30 strategy is 51.88%.

The estimation results show that the costs of trading the two extreme portfolios are larger than the costs of trading portfolio P2 for both 10-80-10 and 30-40-30 strategies. For 10-80-10 strategy, the quoted spreads for portfolios P1 and P3 are 43.17% and 22.82% respectively, whereas the quoted spreads for P2 portfolio is 20.14%. The differences in trading costs between portfolios P1 and P2 and P3 and P2 are significant at 10% significance level. For 30-40-30 strategy, the quoted spreads for portfolios P1 and P3 are 26.51% and 25.37% respectively, whereas the quoted spreads for P2 portfolio is 18.06%. The differences in trading costs between portfolios P1 and P2 and P3 and P2 are significant at 5% significance level. The consistency with which P1 and P3 costs exceed the costs of P2 portfolio is striking, since even the benchmark portfolio P2 is comprised of illiquid stocks to a large extent (this will be shown below when considering the proportion of no-trading days liquidity measure for each of the portfolios). The results lead us to a conclusion that the relative strength portfolios are comprised of stocks with disproportionally large trading costs. A similar result was found in Lesmond, Schill, and Zhou (2004). For 10-80-10 strategy the costs of trading P1, P2, and P3 portfolios were 5.05%, 2.98%, and 4.32% respectively. For 30-40-30 strategy they were 6.10%, 4.16%, and 5.05% respectively.

The same pattern as for the quoted bid-ask spread holds for the effective bid-ask spread.

The fact that P1 and P3 stocks have higher cost of trading than P2 stocks suggests that P1 and P3 stocks are less liquid than P2 stocks (the bid-ask spread is considered in literature as one of the most reliable measures of liquidity, see Chapter 5 for more details). In order to further investigate whether the P1 and P3 stocks are actually less liquid, proportion of no-trading days is studied for each of the portfolios. Proportion of no-trading days liquidity measure is chosen because it proved to be one of the most representative liquidity measures for the Ukrainian stock market (see Chapter 5). The liquidity assigned to P1, P2, and P3 stocks by the quoted bid-ask spread slightly differs from that assigned by the proportion of no-trading days.

While the losing portfolios (P1) have lower liquidity (higher proportion of no-trading days) than portfolios P2, the winning portfolios (P3) have higher liquidity (lower proportion of no-trading days) than portfolios P2. This holds for both strategies. So, we can surely conclude that the worst performing stocks are low liquidity stocks, though it is not clear whether the top-performing stocks are more or less liquid than the stocks in the non-traded portfolio P2.

To summarize, the relative strength portfolios are comprised of stocks that can be characterized as lower price, smaller size, and more expensive to trade.

7.5. The Profitability of Standard Strategies

Table 7.6 shows the results of examining the before- and after transaction costs returns of the momentum strategies. For the 10-80-10 strategy, the long position in P3 together with the short position in P1 produces gross semi-annual return of 8.12%.

Table 7.6. Estimates of the profits of the momentum strategies

The table reports mean six-month buy-and-hold returns (%) associated with a short position in portfolio P1 (weak performers) and a long position in portfolio P3 (strong performers) from February 2005 to November 2006.

	10-80-10 strategy	**30-40-30 strategy**
Mean semi-annual P3-P1 portfolio return before trading costs	**8.12%**	**11.75%**
Total cost of trading for the strategy (quoted spreads)	65.99%	51.88%
Total cost of trading for the strategy (effective spreads)	27.16%	21.35%
Mean return (based on the quoted spread estimate of the transaction costs)	**-57.87%**	**-40.13%**
Mean return (based on the effective spread estimate of the transaction costs)	**-19.04%**	**-9.60%**

To realize the P3-P1 returns, investor has to open a short position in the worst performers (P1) in the beginning of the holding period and to close the short position in the end of the holding period. Similarly, investor also has to open a long position in the best performers (P3) in the beginning of the holding period and to close the long position in the end of the holding period. Therefore the strategy requires paying the full spread on both the long and short positions. For the 10-80-10 strategy, opening and closing short position in P1 is associated with the cost of trading of 43.17% (in quoted bid-ask spreads), while opening and closing long position in P3 is associated with the cost of trading of 22.82% (in quoted bid-ask spreads). The combined trading cost that a momentum investor faces is the sum 65.99%. Subtracting the estimated trading costs from the raw P3-P1 returns brings net semi-annual return of -57.9%. If the effective bid-ask spread is used as a measure of the cost of trading instead of the quoted bid-ask spread, then the 10-80-10 strategy would bring -19.04%. The respective net returns on the benchmark portfolio P2 are higher: -18.70% and -6.85% (found based on the estimates in Table 7.5). This suggests that when the cost of trading is taken into account, the 10-80-10 momentum strategy cannot outperform the market any more. The same conclusion was made in Lesmond, Schill, and Zhou (2004) for the 10-80-10 momentum strategy.

For the 30-40-30 strategy, if quoted bid-ask spread is used as a measure of the cost of trading, net return will be -40.13%. If effective bid-ask spread is used as a measure of the cost of trading, the strategy will bring net return of -9.60%. The respective net returns on the benchmark portfolio P2 are higher: -18.66% and -8.03% (found based on the estimates in Table 7.5). This suggests that when the cost of trading is taken into account, the 30-40-30 momentum strategy, as well as the 10-80-10 momentum strategy, cannot outperform the market any more. Results in Lesmond, Schill, and Zhou (2004) for the 30-40-30 momentum strategy suggest the same conclusion.

The realization of the momentum strategies requires trading of very costly stocks, whose cost of trading highly exceeds the gross returns of the strategies resulting in very high negative net returns.

Case of Actual Turnover

The standard momentum strategy assumes that at the end of the holding period, old long and short positions are closed, which means 100% turnover of stocks. Though if an investor follows a momentum strategy for a few periods, actually some of the securities in portfolios P1 and P3 can remain in his portfolio from one period to another, in case they stay among the top or bottom performers from one period to another. Therefore, the investor does not have to close the entire position. Investor will keep the stocks from one holding period to the next one and will not incur any costs of trading for these stocks.

The mean proportions of P1 and P3 stocks that remain in the same portfolio in the subsequent period are reported in Table 7.7. The proportions are found very high. For the 10-80-10 strategy they are 53.2% for the portfolio P1 and 64.7% for the portfolio P3. For the 30-40-30 strategy they are even higher, 71.9% and 74.4% respectively. The numbers show that there is a high persistence in stock returns from period to period in the Ukrainian stock market. For example, the proportions for the US stocks are much smaller, 22.7% and 15% respectively for the 10-80-10 strategy and 37.8% and 33.2% respectively for the 30-40-30 strategy (Lesmond, Schill, and Zhou (2004)). To better reflect the real returns from following the momentum strategy, we adjust the estimate of the cost of trading by the actual turnover of stocks in the portfolios. The cost of trading P3-P1 strategy based on actual turnover equals the sum of two products: the product of the mean bid-ask spread for portfolio P3 and the ratio of stocks that are turned over in portfolio P3 and the product of the mean bid-ask spread for the portfolio P1 and the ratio of stocks that are turned over in the portfolio P1. The adjusted total cost of realizing 10-80-10 strategy drops dramatically from 65.99% to 28.28% (in terms of quoted bid-ask spread). Though the estimated net return for the strategy is still negative, -20.16%. The respective net return on the benchmark portfolio P2 is still higher, -18.70%.
If the effective bid-ask spread is used as a measure of the cost of trading instead of the quoted bid-ask spread, then the 10-80-10 strategy would bring net return of -3.52%. The respective net return on the benchmark portfolio P2 is smaller, -6.85%, suggesting that the strategy does outperform the market.

For the 30-40-30 strategy, if quoted bid-ask spread is used as a measure of the cost of trading, net return will be -2.19%. If effective bid-ask spread is used as a measure of the cost of trading, the strategy will bring net return of 4.35%. The respective net returns on the benchmark portfolio P2 are smaller, 18.66% and -8.03% respectively, suggesting that the strategy does outperform the market.

Table 7.7. Estimates of the profits of the momentum strategies based on actual turnover.

The table reports the mean six-month buy-and-hold returns (%) associated with a short position in portfolio P1 (weak performers) and a long position in P3 (strong performers) from February 2005 to November 2006.
The positions retained proportion is the mean ratio of stocks that remain in the respective portfolio in the following period and therefore do not have to be traded. Investor therefore does not incur any transaction costs for the stocks, when he rebalances his portfolio.

	10-80-10 strategy	**30-40-30 strategy**
Mean semi-annual P3-P1 portfolio return before trading costs	**8.12%**	**11.75%**
Total cost of trading for the strategy based on 100% turnover (quoted spreads)	65.99%	51.88%
Total cost of trading for the strategy based on 100% turnover (effective spreads)	27.16%	21.35%
Portfolio positions retained, % of P1	**53.17%**	**71.88%**
Portfolio positions retained, % of P3	**64.67%**	**74.44%**
Total cost of trading for the strategy based on actual turnover (quoted spreads)	28.28%	13.94%
Total cost of trading for the strategy based on actual turnover (effective spreads)	11.64%	7.40%
Semi-annual P3-P1 portfolio return after trading costs based on actual turnover:		
Mean return (based on the quoted spread estimate of the transaction costs)	**-20.16%**	**-2.19%**
Mean return (based on the effective spread estimate of the transaction costs)	**-3.52%**	**4.35%**

General Comments

In our analysis we consider portfolio returns without adjusting them for risk. Unfortunately, due to very low trading frequency of many of Ukrainian stocks, it is not possible to reliably estimate volatility of portfolio return or beta-coefficients for portfolios. But taking into account that the cost of trading for portfolios P1 and P3 is significantly larger than the cost of trading for portfolio P2, it is expected that the momentum portfolios P1 and P3 are more risky than the untraded portfolio P2. Anyway, standard momentum strategies (without adjusting for actual turnover) are not able to outperform the market even without adjusting the portfolios for their higher risk.

Lesmond, Schill, and Zhow (2004) present beta coefficients for each of the portfolios P1, P2, and P3, and mention that P1 and P3 portfolios tend to have higher risk, though the study does not include the coefficients into their analysis of returns of the momentum portfolios.

It is interesting to document that the momentum strategies do bring an above market gross return in Ukraine as well as in many other stock markets as documented in literature. The 10-80-10 strategy brings gross semi-annual return of 8.1% while the P2 portfolio (which is an analogy of market portfolio) brings only 1.44%. The 30-40-30 strategy brings gross semi-annual return of 11.8% while the P2 portfolio a near zero return of -0.6%. Though very high costs of trading in the market in general, as well as particularly high cost of trading for the stocks that comprise the momentum portfolios, hinders investors from realization of the above average returns. Instead of receiving 8.1% of semi-annual return for the 10-80-10 strategy (11.8% for the 30-40-30 strategy), investor actually gains a negative return of -19.0% (-9.6% for the 30-40-30 strategy). The strategy does not outperform the market any more, as net return on portfolio P2 is higher, -6.85% (-8.03% for the 30-40-30 strategy).

A possibility to receive a positive return will appear only with an increase of the portfolio holding period. Though with increase of the portfolio holding period momentum strategy will not be a momentum strategy any more, as the momentum phenomenon was documented for the holding periods of three to twelve months.

It is also interesting that the majority of stocks in the momentum portfolios remain in the same portfolios from one period to another. A momentum investor therefore can save a part of trading costs due to no need of opening and closing positions in these stocks. A big portion of costs saved due to this allows to earn -3.5% of net semi-annual return for the 10-80-10 strategy and 4.4% of net semi-annual return for the 30-40-30 strategy.

The results show that in the majority of the settings analysed, when the cost of trading is taken into account, the momentum strategy is not able to outperform the market, which is in line with the market efficiency hypothesis. Only when actual turnover is considered instead of 100% turnover, 30-40-30 strategy and 10-80-10 strategy (with the effective spread taken as the estimate of transaction costs) can outperform the market.

The estimated high transaction costs explain why Ukrainian investors tend to chose for their portfolios such stocks that they expect to hold for at least 3 years. For the 30-40-30 momentum strategy 73% of stocks were kept from one period to another and held altogether for 1.5 years. This was the only strategy that appeared to bring a positive net return for investor. The semi-annual return that the strategy brought was still quite low, 4.4%. Taking into account quite high risk of many Ukrainian stocks compared to that in the developed stock markets, it is not surprising that investors into Ukrainian stocks focus on long-term stock holdings, because only long-term holdings seem to be able to bring positive returns that would compensate for risk and allow investors to earn profit on their investment.

Nevertheless, the study achieves its goal and demonstrates the importance of taking into account the cost of trading when analysing portfolio returns. Following a simple 10-80-10 momentum strategy (30-40-30 momentum strategy) does bring investor above market gross return of 8.1% (11.8%), which highly exceeds the average market return of 1.4% (-0.6%). But when the cost of trading is taken into account, the return shrinks and becomes highly negative, -19.0% (-9.6%).

7.6. Conclusion

The study has shown the importance of taking into account the cost of equity trading when analysing equity portfolio returns. The results of applying momentum strategy in the Ukrainian stock market suggest that positive gross portfolio returns considerably decrease or even turn into negative returns after taking into account the cost of trading the stocks in the portfolio.

The study of profitability of momentum strategies assumes possibility of short selling in the Ukrainian stock market. Even though short selling is not allowed in Ukraine, the assumption is important for making the results of the study comparable with the results in other literature. Two approaches to definition of the best and worst performers are taken: 10-80-10 (Jegadeesh and Titman (1993), Chan, Jegadeesh, and Lakonishok (1999)) and 30-40-30 (Hong, Lim, and Stein (2000)). Also, the cost of trading is considered in two settings, as the quoted bid-ask spread and as the effective bid-ask spread.

The momentum strategies tested in the study do outperform the market when gross returns on the strategies are considered, which is in line with other literature (Givoly and Lakonishok (1979), Bernard and Thomas (1989), and Chan, Jegadeesh, and Lakonishok (1999)). But due to particularly high cost of trading for momentum stocks, standard momentum strategies fail to outperform the market in terms of net returns. A similar result was found in Lesmond Schill, and Zhow (2004). Only when actual turnover is considered (the stocks that remain in the portfolio from one period to another are not traded, which significantly saves the costs of trading as the percentage of such stocks in Ukraine is very high), momentum strategies are able to outperform the market.

Chapter 8

Conclusion

The thesis examined the cost of equity trading, effective liquidity measures, and the components of the bid-ask spread in the Ukrainian stock market PFTS during 2005-2006. The importance of inclusion of the cost of trading when analysing portfolio performance was demonstrated by analysing gross and net returns on a momentum trading strategy.

PFTS is a dealership-type market. Independent brokers post their firm quotes together with desired quantities in an electronic trading system, which allows brokers to trade the PFTS-listed securities, inter-regionally from their offices. The trades are done in an on-line mode through a private network. The information posted by the brokers such as the name of the stock, bid and ask prices, and bid and ask quantities is visible on the screen to all the authorized subscribers to the trading system. Trades are performed online by one broker accepting a bid/offer of another broker within the specified quantity. Brokers can act as agents (executing an order of an investor) or as principals, trading for their own account.

Main Findings

The study has brought the following conclusions:

1. The cost of equity trading in the Ukrainian stock market is very high relative to the developed and many other emerging markets.

Two measures of the cost of trading were analysed in the thesis, the quoted bid-ask spread and the effective bid-ask spread.

It was found that quoted bid-ask spread for Ukrainian stocks is large compared to many other stock markets and varies from 4.9% for the most liquid stocks to 129.5% for the least liquid stocks. The relative quoted bid-ask spread is lower in all developed and many emerging markets. For comparison, relative quoted bid-ask spread for liquid stocks is 0.2% in NYSE, 0.9% in the London Stock Exchange, 1.2% in the Warsaw Stock Exchange, and 4.6% in the Bucharest Stock Exchange (Jain (2003)).

A more accurate measure of the cost of trading, effective bid-ask spread, varies across the Ukrainian stocks of different liquidity from 2.2% to 81.7%. In line with the findings in other literature, effective bid-ask spread is less than quoted bid-ask spread, which gives evidence that trades in the Ukrainian stock market are often executed within the quoted bid-ask spread. In other words, traders are able to negotiate price improvement from brokers relative to the quoted stock prices. The reason of suggesting price improvement in the dealership market, like PFTS, is an intention of brokers to keep long-term relationships with their clients in order to secure future deals with them.

2. The reasons of the high cost of trading are seen in the specific features of the Ukrainian stock market, mainly very low free float, low information transparency of public companies, and weak system of property rights protection of minority shareholders.

Many large industrial companies, which are interesting to investors, have very small free floats (about 4% of their market capitalization) as large stakes in them belong either to the financial-industrial groups or to the state. Low number of stocks in circulation results in low liquidity of the stocks and, as a consequence, in wide bid-ask spreads.

Information transparency of Ukrainian public companies is low. Index of informational transparency of public companies estimated by Standard & Poors' and Financial Initiatives Agency for Ukraine was only 23.9% in 2007 out of the highest possible score of 100%. The reason of such a low level of disclosure is seen not only in the low regulatory disclosure requirements but also in a lack of motivation of the stock issuers for the disclosure. The importance of the stock market as a source of capital is not high in Ukraine due to its low liquidity and high availability of bank capital.

The level of protection of shareholders' rights in Ukraine is low and equal treatment of shareholders is not guaranteed (EBRD, 2007). A significant number of violations are present in the market, primarily violations of shareholders' rights during additional share issuances (share dilution resulting from issuing additional shares at below fair market value) and asset stripping (the sale or transfer of company assets by management to a related party for below fair market value) (SCSSM, 2006). Weak legal enforcement adds to the problems caused by unsatisfactory (until very recently) legislation in Ukraine in the area of corporate governance.

The results of the interviews conducted with the investment practitioners supported the findings described above.

3. The study of the cost of trading relative to the trade size have shown that the effective bid-ask spread is the lowest for the medium-sized trades, higher for large trades, and the highest for small trades.

That the cost of trading for the trades of small size is higher than for the trades of larger size was also documented in other literature for dealership markets (Reiss and Werner (1996), Hansch et. al (1999), and Huang and Stoll (1996)). The reason for this is that small trades are not viewed as valuable for brokers and therefore price improvement is not suggested for them and they have to be executed at the prices, which are near to the quotes. Larger trades are those that bring the most valuable business to the brokers and, in order to keep the relationship with the clients in the long-term, price improvement is suggested for these trades. The finding that the cost of trading for very large orders starts growing in the order size is in line with the findings in Reiss and Werner (1996) and Bernhard et al. (2005) for the London Stock Exchange. According to Bernhard et al. (2005), the reason of this is that temptation to refuse to offer price improvement rises with trade size.

4. The study of the influence of the trade direction on the cost of trading has shown that the average cost of trading for an institutional sale is higher than that for an institutional purchase in the Ukrainian stock market in any market condition (rising, falling, or neutral market) for the reasons that are not entirely understood.

Empirical findings in other literature tend to show that institutional purchases are more expensive than sales in a rising market, while the opposite is true in the falling market (Chan and Lakonishok (1993), Keim and Madhavan (1998), Chiyachantana et al. (2004) and Bikker et al. (2007)).

At the same time, relative cost of trading in the Ukrainian stock market during falling and rising market conditions compared to the cost of trading during neutral market condition follows the pattern predicted in Chiyachantana et al. (2004): in the falling market the cost of trading sales rises more than the cost of trading purchases relative to their values in the neutral market, while in the rising market the opposite is true.

5. The study of the determinants of the cost of trading has shown that quoted and effective bid-ask spreads depend on the stock liquidity (measured as the number of no-trading days and the number of trades per day[28]) with higher liquidity stocks, as expected, having narrower bid-ask spreads. Also, proportional quoted and effective bid-ask spreads depend on the risk of the adverse price change for a stock

[28] Number of trades per day was found significantly different from zero only for the quoted spread regression and not for the effective spread regression.

(measured as return volatility and stock price) with more risky stocks having wider bid-ask spreads. The results are in line with the findings for other exchanges, in particular, NYSE and Nasdaq (Stoll (2000)), London Stock Exchange (Naik and Yadav (2003)), and Euronext Paris (Gajewski and Gresse (2007)). Firm size (measured as market capitalization) was found not important in determining the width of the bid-ask spread, which is probably the result of a specific feature of the Ukrainian stock market that for many large companies the free float is very low.

The empirical results on the determinants of the cost of trading are in line with the findings about the reasons of the high cost of trading in Ukraine drawn from the analytical studies and discussed in the point 2 of the conclusion.

6. The study of efficacy of different liquidity measures for measuring liquidity of the Ukrainian stock market has shown that four measures out of the five applied (Amihud's measure, the proportion of no-trading days, the proportion of zero daily returns, and volatility) have shown high correlation with the quoted bid-ask spread. Therefore they are concluded to have a high ability in measuring liquidity of stocks in the Ukrainian stock market. Out of them, the proportion of no-trading days has shown the highest (and significant) correlations (both cross-sectional and rank) with the quoted bid-ask spread and therefore is concluded to be a superior measure out of the other measures applied. It is followed by the proportion of zero daily returns, volatility of return, and, finally, Amihud's measure.

High efficacy of the proportion of zero daily returns in measuring liquidity of emerging stock markets was also found in Lesmond (2005) and Bekaert et al. (2006). Though this measure does not seem to be effective for measuring liquidity in the developed stock market of the U.S. (Goyenko et al., 2009).

Amihud's measure was found quite effective for measuring stock liquidity in both emerging and developed markets (Lesmond (2005), Goyenko et al. (2009), and the results of our study).

Turnover has shown a very low association with the quoted bid-ask spread and is concluded to be inappropriate for measuring liquidity of stocks in the Ukrainian stock market. The result is in line with the findings for emerging stock markets in other literature (Lesmond (2005) and Bekaert et al. (2006)).

It is argued that in the universe of emerging stock markets, the markets of Korea and Taiwan are the most liquid and the markets of Chile and Colombia are the least liquid. Comparison of liquidity of the Ukrainian stock market to these four markets have shown that based on the non-volume-related liquidity measures (quoted bid-ask spread and proportion of zero daily returns), Ukrainian stock market is less liquid than those of Korea and Taiwan and more liquid than those of Chile and Colombia.
Low liquidity of the Ukrainian stock market is seen as an important reason of the high cost of trading in this market.

7. Application of three bid-ask spread decomposition models (Stoll (1989), Huang and Stoll (1997), and Glosten and Harris (1988)) has given the following estimates of the components of the bid-ask spread:

<table>
<tr><th></th><th>Asymmetric information component</th><th>Inventory holding cost component</th><th>Order processing cost component</th></tr>
<tr><td>Stoll (1989)</td><td>6%</td><td>49%</td><td>45%</td></tr>
<tr><td>Huang and Stoll (1997)</td><td colspan="2">17.6%***</td><td>82.4%</td></tr>
<tr><td>Glosten and Harris (1988)</td><td>14.1%**</td><td colspan="2">85.9%</td></tr>
</table>

The estimation results of the Stoll model differ considerably from the results of the other two models estimated in the chapter. Taking into account the George, Kaul, and Nimalendran (1991) critique of the Stoll (1989) model and the substantial differences in the estimates of the model found in literature, we tend to give little credence to the estimates of the spread component based on the model of Stoll (1989).

The results of estimation the Huang and Stoll (1997) model suggest that the sum of the asymmetric information component and the inventory holding cost component is 17.6%. As the inventory holding cost component is usually assumed in literature to be zero in the multiple dealer markets (as Ukrainian stock market PFTS), the value of 17.6% is attributed solely to the asymmetric information component. The estimation results of the Glosten and Harris (1988) model give a very close estimate, 14.1%. Similar result for the asymmetric information component for the Ukrainian stock market was found in Ryzhkov (2007), 10%, and for the Prague Stock Exchange in Hanousek and Podpiera (2003), 17%. It is surprising that the value of the asymmetric information component was found that low for these markets given that insider trading is considered a serious risk in Ukraine and the Czech Republic and practices of investigation and prosecution are limited (EBRD (2008 [1]), Hanousek and Podpiera (2002)). The low estimates seem to be even more surprising when taking into account that the asymmetric information component was found much higher in NYSE (47.4%, on average, in Glosten and Harris (1988) and 46.6%, on average, in Madhavan, Richardson and Roomans (1997)), where the information trading is seen not as widespread as in the emerging markets.

A low estimate of the asymmetric information component found for the Prague Stock Exchange and for the Ukrainian stock market, can be viewed as evidence in support of the general criticism of the spread decomposition models that accuses the models in that they do not measure what they claim to measure. For example, a study that compared the asymmetric information component estimates to two measures of informed trading (the number of analysts that follow the stock and the percentage of shares owned by institutions) have found that asymmetric information components appeared unrelated to the measures of uncertainty (Neal and Wheatley (1998)).

Despite the critique of the spread decomposition models related to their ability of estimating the components of the bid-ask spread, Huang and Stoll (1997) model has shown high ability in estimation of the effective bid-ask spread, both overall and relative to the trade size. The pattern of the effective bid-ask relative to the trade size was found the same and the values were found very close to the estimates of the effective bid-ask spread found from the comparison of the trade price to the midquote (Chapter 4). Glosten and Harris (1988) model was found able to estimate the overall effective bid-ask spread but did not do well in estimating the effective bid-ask spread relative to the trade size due to the assumption of the model of linear relationship between effective spread and trade size, which is not true for Ukraine.

8. The study of profitability of a momentum strategy in the Ukrainian stock market has shown a considerable difference between the gross and net returns for the strategy and emphasized the importance of taking into account the cost of equity trading when analysing equity portfolio returns.
The results of applying a momentum strategy (in a few different settings and under the assumption that short selling is allowed, though it is not allowed in Ukraine yet) have shown that in the Ukrainian stock market the momentum strategy return does outperform the market when gross return on the strategy is considered, which is in line with other literature (Givoly and Lakonishok (1979), Bernard and Thomas (1989), and Chan, Jegadeesh, and Lakonishok (1999)). But due to particularly high cost of trading for momentum stocks, the momentum strategy fails to outperform the market in terms of net returns. A similar result was found in Lesmond Schill, and Zhow (2004).

Limitations of the Study

The study is limited by some problems with the data. Despite the quality of the data in PFTS is very high, which is not typical for many emerging stock markets, the PFTS data has a few considerable drawbacks.

First, it does not reflect all the trades executed with PFTS-listed securities as some of the trades can be performed over the counter with no reporting to PFTS. Though the proportion of such trades in the total number of trades is expected to be low.

Second, some of the trades performed directly between a PFTS broker and an outside investor (the "third party trades") could have been voluntarily (though not obligatory) reported to PFTS before the opening of the trading session (before 11 a.m.) during the next two trading days after the trade execution. As a result, a portion of the third party trades, which stayed unreported, are lost for our study. Though, taking into account that the reported third party trades take quite a large portion of the total trades (44.2% of the total PFTS volume and 34.8% of the total PFTS number of trades), we tend to conclude that the majority of the third party trades were actually reported to PFTS. This means that our dataset reflects actual PFTS trading volume quite accurately.

Finally, an important limitation of the data is that the reported data on the third party trades do not contain actual time of trade execution but only the time of trade reporting. Since our study in Chapters 4 and 6 requires data on the actual time of trade execution, all the third party trades are lost for the study, which considerably decreases our dataset.

Another limitation of the study is a result of low liquidity in the Ukrainian stock market. Due to the low number of executed trades with the stocks of medium and low liquidity, the effective bid-ask spread, the cost of trading relative to the trade size, the cost of trading relative to the trade direction, and the components of the bid-ask spread could have been estimated only for the 15 stocks with the highest liquidity out of more than 250 listed companies.

Most Interesting Findings of the Thesis and Directions for Further Research

In the opinion of the author, very interesting results were found for the trades with different trading characteristics. In particular, the medium-sized trades were found to be cheaper to execute than small and large trades. This differs the Ukrainian stock market (which is a dealership market) from the electronic order book markets, where small trades are the cheapest to execute. This also differs the Ukrainian stock market from many other dealership markets, where large trades are usually the cheapest to execute. The finding is due to the prevalence of institutional trades in the Ukrainian stock market, which results in the larger, on average, size of the orders. So, medium-sized trades in the Ukrainian stock market can be compared in size to the large trades in many other markets. When the difference is taken into account, the results for the Ukrainian stock market become in line with the findings for other dealership markets. Another interesting result is that sales were found more costly to execute than purchases in PFTS at any market condition, while in other markets purchases are often found to be more expensive than sales during rising market.

Also, it was interesting to find that the proportion of no-trading days and the proportion of zero daily returns, the measures that are not widely applied in literature, are the most effective liquidity measures for the Ukrainian stock market, while turnover, a measure that has proven to be effective for developed stock markets, is not able to measure liquidity well in the Ukrainian stock market.

An unexpected finding is inability of the established spread decomposition models to correctly decompose the asymmetric information spread component in the Ukrainian stock market. The estimated asymmetric information spread component seems to be too low for the Ukrainian stock market, a market with low informational transparency and a high risk of informed trading.

A promising finding is that, under assumption of no short-selling constraints, the momentum strategy (with no accounting for the cost of trading) is actually able to outperform the market. With time the Ukrainian stock market will become more liquid, the cost of trading will decrease, and the short selling will be allowed. Maybe then the momentum strategy will allow investors to earn abnormal returns.

One of the directions for further research can be estimation of the price impact of large trades. As there are many large trades in the Ukrainian stock market and the market depth is low, estimation of the temporary and permanent price impact of the large trades on the stock price can shed more light on the process of price formation in the market.

Another direction for further research can be a study of the influence of the stock liquidity on the stock's expected return, which has not been studied for Ukraine yet. The effective liquidity measures found in the thesis will help for shaping of the study.

Development of a model that can estimate the asymmetric information spread component in the Ukrainian stock market can add to knowledge as existing spread decomposition models cannot cope with the task. Also, formalisation of the relationship between various informational factors such as, for example, low informational transparency and weak property rights protection, and the asymmetric information spread component, can help to estimate the influence of these factors on the width of the bid-ask spread in the Ukrainian stock market.

Another direction for further research is to test the profitability of other conventional trading strategies and to see their performance in such a quickly growing emerging market like the Ukrainian stock market.

Appendix 2.1.

OPERATION AND PROSPECTS OF THE INVESTMENT MARKET OF UKRAINE

QUESTIONNAIRE

Name
Company
Position
Age group 21-30 31-40 41-50 50+
Education (Highest qualification)

I. Stock Market of Ukraine

1. How can you evaluate investment activity in Ukraine in comparison with that in the developed stock markets?

2. Which industries are the most attractive for investment in Ukraine? Why?

3. Is there a balance between the demand for the stock market equity and the supply of equity in the stock market?

4. What are the characteristic features of companies that enter PFTS listing?
(f.i. industry, size, age)

5. Does the stock market price the equity correctly?

6. In your opinion, what are the main problems of the investment market of Ukraine?

7. What have been the main changes in the stock market of Ukraine during the last three years?

8. In your opinion, what are the main reasons of the small number of foreign investors in Ukraine?

II. Asset Management

1. Does your company do fund management for Ukrainian clients?
2. What are the criteria for selecting a company for the investment portfolios of your company?
3. How important is each of the criteria for the decision making about the investment in equity of a potential company?
4. What are the company valuation methods that you use?
5. Can you always trust the company accounting reports?
6. Please describe the process of decision making on choosing a stock for the investment portfolios of your company.
7. Are there any legal requirements or restrictions regarding the investment portfolios composition and management?
8. Does your company have any formalized requirements for its own investment portfolios?
9. What are the transaction costs for equity transactions? Do they considerably differ in each case?
10. How long, on average, do you keep certain equity in the investment portfolios of your company?
11. What are the risks that an investor has to falling when he invests in Ukrainian equity?
12. What is the average (minimum) profitability of the companies you invest in?
13. How many companies are there in Ukraine, in equity of which an investor can invest a large amount of capital ($5-10 mln.).
14. How fast would it be possible to buy such a package?
15. How, on average, can the equity price change during the buy process?

III. Prospects of the stock market of Ukraine

1. How do you see the investment market of Ukraine in 3 years?

2. In your opinion, what is the potential of the Ukrainian stock market?

3. Are there large companies with good prospects in the Ukrainian economy that are not listed on PFTS yet?

4. In your opinion, will the free float of large companies grow?

5. When can one expect that activity on the Ukrainian stock market will reach the stock market activity of such countries as Poland and Czech Republic?

6. In your opinion, what are the necessary steps to be undertaken for active development of the Ukrainian stock market?

Appendix 6.1.

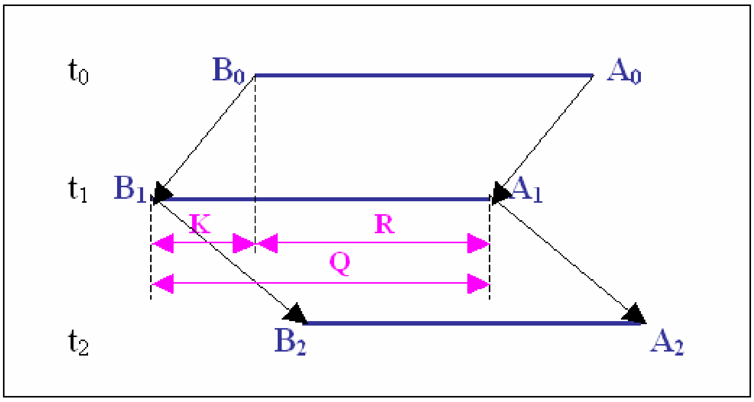
An illustration of why the realized spread in the Stoll (1989) model equals the difference of the expected price change conditional on sale trade and the expected price change conditional on buy trade

The discussion below shows why realized spread equals the difference between equations (6.3) and (6.4).

Let us assume that a broker executed a sale trade at t_0, and then executed a purchase at t_1. It is also assumed that no new public information about the stock arrived in the market during this time (to exclude the influence of the error term). Our goal is to show that the realized spread of the broker (in other words, his profit) as a consequence of the two transactions equals the expected price change after a sale less the expected price change after a purchase. This relationship is a corner stone of the Stoll model.

Figure A.1. The development of a stock price following a sale and a purchase trades.

B_0, B_1, and B_2 are the bid prices at times t_0, t_1, and t_2 correspondently. A_0, A_1, and A_2 are the ask prices at times t_0, t_1, and t_2 correspondently. A_0-B_0, A_1-B_1, and A_2-B_2 are the values of the bid-ask spread at times t_0, t_1, and t_2 correspondently. K is the value of the decrease of bid and ask quotes following a sale trade at time t_0. Q is the quoted spread, R is the realized spread.



After a sale at t_0 the bid and ask prices have decreased to B_1 and A_1 (due to the brokers' adjustment of prices in order to balance his inventory holdings and asymmetric information costs). After a purchase at t_1 the bid and ask prices rose to B_2 and A_2 (for the same reason). As a result of the two transactions, the broker has sold the stock at B_0 and then has bought it at A_1. So, his realized spread, in other words, his profit, should equal to (A_1-B_0). Let us denote the realized spread as R:

$$RealizedSpread = R = A_1 - B_0$$

And the quoted spread as Q:

$$QuotedSpread = Q = A_0 - B_0 = A_1 - B_1 = A_2 - B_2$$

According to Stoll (1989), the realized spread is the expected price change after a broker purchase less the expected price change after a broker sale. From the following expression we can see that this is true:

$$\Delta P_{t1} - \Delta P_{t2} = -(B_1 - B_0) - (A_2 - A_1) = -B_1 + B_0 - A_2 + A_1 = (A_1 - B_1) - (A_2 - B_0) = Q - K = R$$

A similar reasoning applies to the other combinations of buy and sale trades.

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