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The effect of FDI on employment in China

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TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

NOMENCLATURE

FDI	Foreign Direct Investment
GDP	Gross Domestic Product
OECD	Organization for Economic Co-operation and Development
ACF	Autocorrelation Function
PACF	Partial Autocorrelation Function
OLS	Ordinary Least Squares
ML	Maximum Likelihood

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ABSTRACT

Since the launching of its Reform and Opening Policy, China has begun to integrate more fully into the global economy through trade and investments. Along with deepening of the Reform and Opening Policy and the trend toward ever-increasing economic globalization, the scale of attracting foreign investment into China has also grown. Foreign direct investment (FDI) has played a crucial role in promoting China's economic growth, and employment is an important aspect of economic development. To gain a better understanding of the relationship between FDI and employment in China, this thesis examines longitudinal macroeconomic data to assess the effect of FDI inflows on job creation in China. This topic is analyzed from two dimensions: (1) the relationship between FDI and total employment for the entire Chinese national economy, and (2) the relationship between FDI and employment for each of the three sectors of the economy (primary, secondary, and tertiary). This analysis was conducted using time series regression models estimated for annual data between 1985 and 2011. The outcome shows that there is no significant positive relationship between FDI and employment overall for the entire Chinese national economy, and that the relationship between FDI and employment differs by sector. There is a significant positive relationship between FDI and employment for the primary sector. For the secondary sector, there is no significant relationship between FDI and employment, although gross domestic product (GDP) has a significant positive effect on employment. For the tertiary sector, FDI has a significant negative relationship with employment, and GDP has a nearly significant positive effect on employment.

CHAPTER 1

INTRODUCTION

Foreign direct investment (FDI) refers to "the investment in which a firm acquires a substantial controlling interest in a foreign firm (above 10 percent share) or sets up a subsidiary in a foreign country" (Chen, 2000, p 6). FDI has many forms, including "mergers and acquisitions, building new facilities, reinvesting profits earned from overseas operations and intracompany loans" (Hannon & Reddy, 2012). FDI differs from portfolio investment, which is a passive investment in the securities of another country. Portfolio investment covers transactions in equity securities and debt securities. "In economics, foreign portfolio investment is the entry of funds into a country where foreigners make purchases in the country's stock and bond markets, sometimes for speculation" (Sullvian et al., 2003, p. 551).

Under the impact of globalization, more and more FDI has flowed into each country and has had a significant impact on each country's economy. Also, determining how to attract and use FDI has been an important component of economic policy for many developing countries. China began to adopt the Reform and Opening Policy in 1978; since then, the Chinese government has begun to establish policy to attract FDI and the scale of successful efforts to attract FDI has increased.

Since 1979, FDI in China has gone through several different stages of development. During the Initial Stage (1979-1986), FDI began to flow into China and the government began to establish laws and regulations on using FDI. In this period, the total amount of FDI was just $8.304 billion, with annual average value of $1.038 billion and

average annual growth rate near 15%. In this period, foreign investment came mainly from Hong Kong, Macao, and Taiwan and was distributed to the southeastern part of China, led by Fujian and Guangdong provinces. In addition, FDI in China during this Initial Stage was concentrated in labor-intensive sectors, such as footwear, clothing, and textiles (Hale & Long, 2012).

During the Continual Developing Stage (1987-1991), the economic infrastructure for FDI in China was not perfected and China had no sound legal system, so the investment environment was not ideal and potential foreign investors in China lacked confidence. In this stage, the average annual growth rate of FDI was not very high. The total value of FDI during this phase was $16.753 billion, with annual average amount of $3.351 billion. In this period, the average annual growth rate of FDI was 17.75%.

The Rapid Developing Stage spanned 1992-1997. In 1992, China established the overall goal of developing a socialist market economic system, and as new geographic areas of the economy were opened the opportunity for FDI extended further. With development of the Pudong New District of Shanghai, China supported the development of open cities along the Yangtze River and in the Pearl River Delta. Border cities were opened more gradually, thereby establishing the structure for opening up to investment from surrounding countries. The goal of this policy was for China to have great advantages in attracting foreign capital. The value of FDI during this period totaled $196.794 billion, with average annual value of $32.799 billion and average annual FDI growth rate of 40.28%.

The Slowing Improvement Stage extended from 1998 to 2000. Due to the influence of the Southeast Asia financial crisis, the speed of introducing foreign capital

began to slow down. From 1998 to 2000, the total value of FDI in China was $126.497 billion, with annual average of $42.166 billion and average annual rate of change of -5.15%, which means that FDI decreased during this period.

The Stable Fast Developing Stage began in 2001 and continues. Because China entered the World Trade Organization and the environment for international investment began to improve, the inflows of FDI into China resumed their previous rising trend. "China opened up more sectors for foreign investment, including retail, wholesale, banking, and telecommunication" (Hale & Long, 2012, p 11). Moreover, the Chinese government promulgated a new policy to encourage FDI, to help develop the country's western areas. In 2011, the number of registered foreign-funded enterprises was 446,487. From 2001 to 2011, the total value of FDI was $816.044 billion, with annual average of $74.186 billion and average annual growth rate of 9.79%. The 2007-2009 global financial crisis brought about great stress for the world's economy. Most countries were badly affected, including China. However, the 2008 Beijing Olympic games helped China attract a large amount of FDI, so during the period of the Stable Fast Developing Stage only FDI for 2009 showed a decline.

Along with the inflow of FDI, the spillover effects of FDI on indigenous firms in the host country are obvious. "The spillover effects can be broadly categorized into pecuniary effects and demonstration effects" (Hale & Long, 2012, p. 5). Because multinational firms have advanced technology, equipment, and management skill, and their volume of work and production efficiency are higher than those of domestic firms, they bring a pattern of more severe competition into the host country market; this

phenomenon is referred to as the pecuniary effect, or competition effect (Hale & Long, 2012).

The competition effect can be both positive and negative. Higher amounts of work and higher production efficiency can stimulate domestic firms to improve their work and efficiency or to search for new technology. However, if domestic firms cannot keep up with the higher production efficiency and advanced technology, foreign investment firms will snatch market share. The domestic firm can also study advanced knowledge and technology, and then improve their productive efficiency, product quality, and managerial methods; this is known as the demonstration effect (Hale & Long, 2012).

There are five main forms of FDI in China: equity joint venture, contractual joint venture, wholly foreign-owned enterprise, FDI shareholding, and joint exploration (*China Statistical Yearbook*, 2012; Li, 1991). The equity joint venture consists of enterprises jointly owned by foreign and Chinese companies, enterprises, and other economic organization or individuals. The foreign and Chinese companies invest in and manage the enterprise together, and they share profits and risks together according to the proportion of their respective shares of capital contribution.

A contractual joint venture is an enterprise established by both foreign and Chinese companies, enterprises, and other economic organizations or individuals located within the territory of the People's Republic of China. The rights and obligations of the two parties are determined in the contract. Most of the money is provided by the foreign party, whereas Chinese sources offer land, factory, equipment, and facilities, and sometimes also provide a certain amount of money.

Wholly foreign-owned enterprises refer to foreign companies, enterprises, other organizations, or individuals who establish enterprises within Chinese territory according to the laws of China, and foreign investors provide all of the capital investment.

FDI shareholding refers to foreign investors purchasing shareholders' equity in domestic noninvestment enterprises, thereby changing the domestic enterprise to a foreign-invested enterprise.

Joint exploration refers to international economic cooperation used in the field of natural resources. Joint exploration generally is divided into three stages: exploration, exploitation, and production.

Indigenous firms can benefit a lot from cooperation with foreign partners. Because economic and technical development in developing countries occurs later than in developed countries, and because most FDI comes from earlier-developed countries, indigenous firms can study advanced technology and modern management skills from foreign enterprises or their foreign partners (see, e.g., Gerschenkron, 1962, on the advantages of latecoming in economic development). In addition, because of the updated technology, equipment, and management skill that is provided through this arrangement, production efficiency can be improved during this process.

FDI has another important spillover effect: creating employment. The manner in which FDI increases employment can be differentiated between greenfield investment and brownfield investment (Dufaux, 2010). Greenfield investment refers to "investments that create new production facilities in the host countries" (Qiu & Wang 2011, p. 1). Greenfield investment means establishing a new company. It is clear that greenfield

investment will create more work opportunities, because every new company hires employees.

In contrast, brownfield investment refers to investment used in "cross-border mergers and acquisitions" (Qiu & Wang 2011, p. 1). Because brownfield investment is not used to establish a new company, but rather for mergers and acquisitions, it is not clear whether it will be helpful for creating more work opportunities. Instead, it may lead to more unemployment, because updated technology, equipment, and management systems will improve productive efficiency so that not as many workers are needed. However, brownfield investment still leads to the possibility of hiring more employees, because some of the companies will expand after being merged or bought by foreign firms.

From another angle, FDI also has a crowding-out effect. Due to the FDI inflow in China, an increasing number of multinational corporations are located in that country. These foreign capital corporations share a large market in China and exert competitive pressure on domestic firms. Some domestic firms are not competitive enough and can go bankrupt, with workers losing their jobs. So, taking the overall picture into consideration, it is not clear whether FDI will create more work opportunities in the host country.

China not only attracts a large amount of FDI, but also has the largest population in the world and thus experiences severe employment pressure. According to data from the World Bank (http://data.worldbank.org/country/china), in 2011 China's population increased to 1.344 billion, with a labor force of 0.761 billion (*China Statistical Yearbook*, 2012), which is just 56.62% of the country's total population. Such a huge labor base and the low percentage of employment make China's employment pressure intense.

Consequently, unemployment is a big problem in China and the Chinese government tries their best to improve the employment rate. Therefore, given the increasingly serious employment situation in China, conducting an analysis of the impact of FDI on employment in China is of great importance.

With a large amount of FDI entering China, the number of people employed in foreign capital enterprises has increased dramatically. Even though the number of workers in multinational corporations has been a small proportion of total employment until recently, that proportion has grown very quickly. Compared to employment in foreign investment enterprises in 1986, employment in foreign investment enterprises in 2011 had increased 165-fold. In addition, as the proportion of total national employment attributable to foreign capital enterprises has increased, the total number of workers employed in foreign capital corporations increased greatly during these years (*China Statistical Yearbook,* 2012) and has helped create a lot of work opportunities. However, when taking the crowding-out effect into consideration, it is not clear that FDI creates more work opportunity or leads more people to lose their jobs.

The relationship between FDI and employment is affected by many variables, such as growth of the national population, increased exports, and growth of the domestic economy. This thesis will take these variables into consideration, and then conduct data analysis to ascertain whether FDI is helpful for creating more job opportunities for the Chinese economy in general, the magnitude of this impact, and the impact of FDI on employment in China's primary, secondary, and tertiary sectors. The results of this research can be helpful for the Chinese government's implementation of economic policy,

particularly regarding adjustments to FDI policy to address the nation's unemployment problem.

This thesis tests two hypotheses. The first hypothesis is that there is no significant relationship between FDI and employment for the whole national economy, which means that the FDI inflows to China will create more job opportunities. The second hypothesis is that the relationship between FDI inflow and employment differs by sector of the national economy. Statistical models presented later demonstrate that there is a significant positive relationship between FDI and employment in the primary sector, while there is no significant relationship in the secondary sector, and the relationship shows a negative trend in the tertiary sector.

An Outline of the Thesis

This thesis consists of five chapters. Chapter 1 introduces FDI and its effects on domestic firms, and shows the importance of statistical analysis on this topic and consequences for the hypothesis. The second chapter presents the literature review. It includes the viewpoints of both foreign and Chinese researchers. The third chapter introduces the data and methods for testing relevant hypotheses. The fourth chapter presents outcomes and interpretations of statistical tests. The last chapter presents conclusions, and discusses future lines of inquiry and policy advice.

CHAPTER 2

LITERATURE REVIEW

According to the United Nations' 1999 World Investment Report (United Nations Conference on Trade and Development [UNCTAD], 1999) nearly half of global FDI has flowed to countries with developing and transitional economies. FDI is helpful to increase the amount and quality of employment. Unemployment is a severe problem in developing countries. Accordingly, the employment creation effect of FDI is very important for countries to reduce their rates of unemployment. According to a 2006 World Investment Report (United Nations Conference on Trade and Development [UNCTAD], 2006), the UNCTAD has demonstrated that most of the FDI invested from developed countries into developing economies is capital- or technology-intensive, and that it has a crowding-out effect on the economies of recipient countries. After analyzing the relationship between FDI and employment, some researchers have reported that the effect of FDI on employment is positive, while some researchers doubt this point. A detailed discussion of this divergence of views follows.

Mpanju (2012) used the ordinary least squares (OLS) method of statistical model building and analysis to investigate the relationship between employment as the dependent variable and FDI as the independent variable in Tanzania. His results showed that there is a strong positive relationship between the two variables; that is, increased FDI inflows were associated with increased employment.

Nunnenkamp, Bremont, and Waldkirch (2010) analyzed the relationship between FDI and employment data covering almost 200 manufacturing firms in Mexico. They

showed that FDI had a significantly positive, although quantitatively modest, impact on manufacturing employment. Their conclusion applied to both white collar and blue collar employment.

However, some researchers argue that, after taking crowding-out into consideration, the effect of FDI on employment is not substantial. The crowding-out effect is important when foreign multinational enterprises focus on the recipient country's market. Because the influx of FDI will bring about more pressure on domestic enterprises, and because the advanced technology and higher efficiency associated with external investment will require fewer workers than before, the crowding-out effect of FDI will lead to more domestic enterprises going bankrupt and consequently more local employees being laid off.

Pinn, Ching, and Kogidbounds (2011) used a bounds-testing autoregressive distributed lag model approach and an error correction autoregressive distributed lag model for data from 1970 to 2007 in Malaysia. They found that, because of the capital-intensive nature of foreign investment projects in that country, in the long run there is no cointegration relationship between employment and FDI.

Dufaux (2010) argued that the effects of FDI on employment in European countries are different at different stages of economic development, making it very difficult to assess the outcome. He thought that in the first stage, the effect of FDI on employment is characterized by creative destruction, meaning that unproductive jobs will disappear following the appearance of new and more productive jobs at the very start. With the capitalist process, and the move from a managed economy to a market economy, a lot of competition is generated. To get more profits, foreign investors restructured their

production mode earlier than did domestic enterprises. So the extensive use of machinery and division of labor led to more existing workers losing their jobs (Mark & Engels, 2002), and in this process the foreign enterprises also created a more productive workforce. The workers began to be controlled by the bourgeois class and supervisors, and industries began to depend on machines. At a later stage, labor-intensive investment promotes more employment and turns creative destruction into a positive effect on jobs. In addition, Dufaux points out that greenfield investment had a positive effect on employment, but brownfield investment, which occurred along with the trend toward privatization that brings about a competitive market economy, does not have a clearly positive effect on employment. This research shows that FDI is not a panacea for job creation.

Ernst (2005) found that the rapid growth of FDI since the 1990s in Latin American countries has had little influence on employment, because FDI crowds out domestic middle-sized and small enterprises and causes mass unemployment in domestic enterprises.

Henneberger and Ziegler (2006) doubt that the effect of FDI on service sectors is positive. They divided FDI into resource-seeking FDI, efficiency-seeking FDI, and market-seeking FDI, and analyzed the effect of FDI on employment by comparing the costs of international mobility of producers and users of FDI. They arrived at the conclusion that "if users are immobile or have high mobility costs, then market-seeking FDI will dominate and have neutral or positive effects on the domestic labor market. If users' mobility costs are low, then resource- and efficiency-seeking FDI will dominate, with the associated negative impact on the domestic labor market" (p. 3).

A serious unemployment problem has arisen in China because of reforms to its economic system, so maintaining stable employment growth and controlling the unemployment rate have become central to the country's macroeconomic goals. Therefore, both Chinese and foreign researchers have begun to analyze the relationship between FDI inflows to China and national levels of employment. Most scholars who have researched the relationship between FDI inflows and overall employment have arrived at positive conclusions.

Karlsson et al. (2009) examined employment growth in firms of different ownership during the periods 1998-2001 and 2001-2004. He found that employment growth in non-private domestic firms was negative in both periods; the category "other firms" also showed negative employment growth during the 1998-2001 period and a small positive growth during 2001-2004. However, private firms, domestic as well as foreign, showed positive growth in both periods. The authors also concluded that FDI has contributed to job creation in the Chinese manufacturing sector, through access to international markets and spill-over effects on private domestic firms.

Sha and Tao (2007) found that FDI and employment have a long-term equilibrium relationship, with every 1% increase of FDI leading to 0.13% increase in employment.

Fu and Balasubramanyam (2005) analyzed the relationship between the growth of exports and employment in China. They concluded that, assisted by FDI and township and village enterprises, exports successfully have provided an effective vent for surplus productive capacity and surplus labor supply.

Ding (2005) used a double logarithmic regression model and data from 1986-2002 to establish the extent to which domestic fixed investment and FDI predict

employment. He found that both domestic fixed investment and FDI have positive effects on employment, and that the positive effect of domestic fixed investment is bigger than the effect of FDI. Ding concluded that every 1% increase of domestic fixed investment will lead to 0.083% increase in employment, and that there is an increase of 0.064% in employment for every 1% increase of FDI. He also found that FDI has a major positive effect on employment in the tertiary sector, while for the secondary and primary sectors the effect of FDI is not obvious.

Wang and Zhang (2005), based on both microeconomic and macroeconomic theory, built a simultaneous equation model of FDI and employment using 1983-2002 data. They found that FDI had a direct positive effect on employment and a negative indirect effect on employment. However, taking a comprehensive view, FDI had a significant positive impact on employment, with every 1% increase in FDI related to an increase of 0.008% in actual employment.

Cai and Wang (2004) argued that, although the proportion of employment in foreign investment enterprises is still small, FDI can make a big contribution to employment growth in China.

Cao (2003) pointed out that FDI both helps to create more work opportunities for China and changes the employment structure. Cao reported that the effect of FDI on the secondary and tertiary sectors is greater than the effect on the primary sector, and that the inflows of FDI help people move from the primary sector to the secondary and tertiary sectors, thereby changing the proportion of the national economy attributable to each of these three main sectors.

Niu's (2001) quantitative analysis of the relationship between FDI and employment in China from 1986 to 1999 indicated that, with relatively declining domestic investment efficiency, FDI has a positive effect on employment.

However, some scholars have arrived at quite different conclusions about the impact of FDI on employment.

Liu (2012) used 1986-2010 data to arrive at the conclusion that before 1996 FDI had a positive effect on employment but after that date the effect was no longer obvious.

Hu (2011) noted that economic development and capital stock are the two factors influencing employment, and that capital stock includes both domestic fixed investment and FDI. He used the Cobb-Douglas production function and time series data from 1985 to 2009 to analyze the relationship between capital stock and employment. The outcome showed that in the short term FDI did not have a significant positive effect on employment, and that, even though FDI does have a positive effect on employment in the long run, its effect is less than that of domestic fixed investment.

Using a vector autoregressive (VAR) model, Huang and Zhang (2007) found that the effect of FDI on employment is not obvious, and that there is no effect of FDI on wages, while domestic investment has a positive effect on wages. They point out that the VAR method can exclude the effect of other variables on employment and wages, and thus can show the pure relationship between these variables.

Rizvi and Nishat (2009) tested the effect of FDI inflows on employment levels in India, Pakistan, and China from 1985 to 2008. Using employment, FDI, and gross domestic product, this model found that FDI did not have any impact on the creation of employment in the three countries. They found that the "growth elasticity of employment

on average in the three countries is extremely low and employment enhancing policies must be priorities" (p. 8).

Mou (2007) argued that in the initial stage FDI is mainly labor-intensive, with positive effects on employment, but, because the competitive position of domestic enterprises is relatively weak, the negative effects of FDI on job creation are also important. Mou found that after 1993, with increased technology-intensive FDI, the positive effect of FDI on employment decreased and become nonsignificant.

Li (2000) noted that from 1980 to 1995 there was a positive effect of FDI on employment. However, from 1996 to 1998 FDI just transferred employment from the western region of China to the eastern region. There was no obvious positive effect on employment from 1999 to 2000, with FDI bringing about a crowding-out effect on markets and leading to more unemployment.

From these results about the relationship between FDI and employment, it is clear that most researchers have chosen to analyze this relationship for the overall Chinese economy, rather than by economic sector. There are several reasons why a more nuanced assessment of the relationship in China between FDI and employment needs to be undertaken. The structure of FDI inflow into China is different from the pattern for other countries, so previous models estimated for other countries and using earlier time periods need to be updated and applied directly to the current situation in China. In addition, the three main sectors of the economy in China are in different stages of development, and thus require different models to ascertain possible differences in the sector-specific relationships between FDI and employment. Furthermore, the amount and kind of FDI do not flow into the three main sectors equally.

To gain a better understanding of the effect of FDI inflow on employment in China, this thesis applies time series modeling strategy generally, and specifically the AUTOREG procedure in SAS (the Statistical Analysis System) to test and analyze this relationship.

CHAPTER 3

METHODS AND DATA

Methods

This thesis will use time series data and the AUTOREG Procedure in SAS to test the historical relationship between FDI inflows in China and employment.

In this research, because all of the predictor variables and the dependent variable are time series data, the model error terms have a high possibility of being not independent through time. "If the error term is autocorrelated, the efficiency of ordinary least-squares (OLS) parameter estimates is adversely affected and standard error estimates are biased" (SAS OnlineDoc: Version 8, 1999, p. 303 http://www.okstate.edu/sas/v8/saspdf/ets/chap8.pdf). The AUTOREG procedure both estimates and forecasts linear regression models for time series data when the errors are autocorrelated or heteroscedastic, and can fit autoregressive error models of any order and can fit subset autoregressive models.

Dependent and Predictor Variables

As mentioned above, FDI has created a crowding-out effect on employment and thus is an important predictor of employment. In addition to FDI, many other variables can influence employment, such as GDP, wages, and interest rates for deposits and loans.

"GDP is the market value of all final goods and services produced within a country in a given period of time" (Mankiw, 2012, p. 198). More goods and services will need more workers, so GDP is another important variable that influences employment.

There are four components of GDP: consumption, government spending, investment, and value of net exports (Mankiw, 2012). Consumption points to household personal final expenditures, including spending on durable goods, non-durable goods, and services, with the exception of purchases of new housing. Government spending is government expenditures on goods and services. It includes salaries of public servants and any expenditure by a government on public works. It does not include any transfer payments, such as Social Security or unemployment benefits. Investment is the purchase of goods that will be used in the future to produce more goods and services. It is the sum of the "purchases of capital equipment, inventories, and structures" (Mankiw, 2012, p. 201). It includes construction of new mines, software, machinery, and equipment for a factory, and so on. However, the purchase of financial products belongs to saving, not investment. The value of net exports is the value of gross exports minus gross imports.

No explanation is available about whether the GDP data from the *China Statistical Yearbook* used in this analysis already includes FDI as part of the investment component. Thus, this analysis was conducted using both the GDP values taken directly from that source and the given values of GDP minus FDI. Results of model estimation obtained from both data configurations were used to test the relationship between GDP and employment and to compare these outcomes. For ease of interpretation, the model results for GDP as taken directly from the primary Chinese data source are used throughout this document. The model estimates are very similar, with the same predictors significant under alternative model specifications.

Model results for the GDP data without adjusting for FDI are shown in Chapter 4. Model results using aggregate GDP rather than the four components that add up

separately to aggregate GDP are shown in Appendix A.1 (see Tables A.1.1 and A.1.2, and Figure A.1.1). For model results using GDP minus FDI, see Appendix A.2 (Tables A.2.1 and A.2.2, and Figure A.2.1). In addition, because Chinese FDI data from the World Bank starting in 2005 show substantially larger amounts than are shown in the *China Statistical Yearbook*, but GDP and employment data are similar between these two sources, models were estimated using FDI from the World Bank and the other variables from the *China Statistical Yearbook*. Results for these models are presented in Appendix A.3 (Tables A.3.1 and A.3.2, and Figure A.3.1). Sectoral model results based on GDP minus FDI are shown in Appendix A.4 (Tables A.4.1 and A.4.2, and Figure A.4.1, for the primary sector; Tables A.4.3 and A.4.4, and Figure A.4.2, for the secondary sector; and Tables A.4.5 and A.4.6, and Figure A.4.3, for the tertiary sector).

Wages also will influence employment. Many researchers have analyzed the relationship between wages and employment. According to the analysis of ten different OECD (Organization for Economic Cooperation and Development) countries from 1950 to 2005, Nicholas (2008) found that wages cannot influence employment; that is, cutting real wages is not helpful for increasing employment. However, Nicholas argues that increased employment does influence wages. The increase in employment means an increase in demand, with the result that real wages rate will fall.

In contrast, Geary and Kennan (1982) used data from twelve OECD countries to test the relationship between wages and employment for about 40 years. They found that there is no significant relationship between wages and employment.

Interest rates on deposits and loans can also influence employment. If the interest rate on deposits decreases, people will choose to put less money in the bank, which

would promote household consumption and thus help promote production and hiring because the market will need more workers. If the interest rate on loans decreases, manufacturers could borrow more money at a lower cost, which would help expand production, and society then would need more workers.

Data Source

In this research, for testing the relationship between FDI and employment in China's overall economy, there are 8 predictor variables: FDI, total wages, consumption, government spending, investment, net exports, interest rates for deposits, and interest rates for loans. The data employed are for the years 1985 to 2011.

China's Reform and Opening Policy was initiated in 1978, and from that point FDI began to flow into China. However, due to the limited availability of data on FDI, wages, and interest rates for deposits and loans, and to ensure that all of the predictor variables' data come from the same data source and the same period, data from 1985 to 2011 were collected and analyzed.

For statistical analysis of data for the three main sectors of the Chinese economy, data for the four components of GDP and interest rates for deposits and loans could not be found. Consequently, analysis of data for the three main sectors of the economy used just three predictor variables: FDI, GDP, and total wages. Data for the sectoral analysis were available only between 1997 and 2011. For both the overall national economy and the sectoral analysis, the dependent variable is the same: the number of people employed.

In the original Chinese data source, the number of people employed is expressed in terms of the number of 100 million jobs. Also, the units for FDI, household

expenditures, government expenditures, gross capital formation, net exports, and total wages are expressed in terms of 100 million United States dollars. The units of the original data for household expenditures, government expenditures, gross capital formation, net exports, and total wages are expressed in terms of the Chinese national currency, renminbi (RMB). To make sure that the units for all the data are the same, the exchange rate of RMB to U.S. dollars for each year from 1985 to 2011 was used to transform the RMB to units of 100 million dollars. The unit of interest rates is percentage points.

Because every sector consists of different industries, the data values for the primary, secondary, and tertiary sectors are the sum of the data values for each of the different industries within each sector. The primary sector includes agriculture, forestry, animal husbandry, and fishing. The secondary sector includes mining, manufacturing, the production and supply of electricity, gas, and water, and construction. The tertiary sector refers to other industries not included in the primary and secondary sectors. It includes transport; storage and postal delivery; information transmission; computer services and software; wholesale and retail trades; hotels and catering services; financial intermediation; real estate; leasing and business services; scientific research; technical services and geological prospecting; management of water conservancy, the environment, and public facilities; services to households and other services; education; health, Social Security, and social welfare; culture, sports, and entertainment; and public management and social organization (*China Statistical Yearbook*). Thus, the data for the three main sectors, and the data for FDI and total wages are calculated. GDP data are taken directly from the *China Statistical Yearbook*.

Data for the overall Chinese national economy are shown in Table 3.1 and Table 3.2. Table 3.3 provides data for the primary sector of the Chinese economy. Table 3.4 presents data for the secondary sector of the Chinese economy. Table 3.5 shows data for the tertiary sector of the Chinese economy.

Table 3.1 Data for the Overall Chinese National Economy

Unit (100 million $US)

Year	Employment (100million)	FDI	FDI（World Bank）	GDP	GDP-FDI	total wage	interest rate for deposits	interest rate for loans	Exchange rate
1985	4.9873	19.56	16.59	2943.07	2923.51	430.91	8.28	7.92	3.2095
1986	5.1282	22.44	18.75	2816.23	2793.79	444.79	9.36	7.92	3.7314
1987	5.2783	23.14	23.14	3290.29	3267.15	504.13	9.36	7.92	3.7314
1988	5.4334	31.94	31.94	4124.09	4092.15	620.73	10.80	13.32	3.7314
1989	5.5329	33.92	33.93	4113.11	4079.19	622.15	14.94	19.26	4.2088
1990	6.4749	34.87	34.87	3695.71	3660.84	563.70	11.52	11.16	5.2352
1991	6.5491	43.66	43.66	4162.96	4119.3	612.88	9.00	9.72	5.4234
1992	6.6152	110.08	111.56	4739.05	4628.97	677.23	9.00	9.72	5.8166
1993	6.6808	275.15	275.15	6345.66	6070.51	844.56	12.06	12.24	5.8210
1994	6.7455	337.67	337.87	5906.27	5568.6	782.88	13.86	14.04	8.5024
1995	6.8065	375.21	358.492	7584.42	7209.21	966.49	13.86	14.04	8.3351
1996	6.8950	417.26	401.8	8904.27	8487.01	1076.29	12.06	15.12	8.3290
1997	6.9820	452.57	442.37	9874.06	9421.49	1161.11	6.66	10.53	8.2700
1998	7.0637	454.63	437.51	10463.32	10008.69	1228.04	6.66	8.01	8.2700
1999	7.1394	403.19	387.53	11018.74	10615.55	1324.66	2.88	6.21	8.2700
2000	7.2085	407.15	383.993	11940.63	11533.48	1324.63	2.88	6.21	8.2700
2001	7.3025	468.78	442.41	13183.56	12714.78	1475.86	2.88	6.21	8.2700
2002	7.3740	527.43	493.079766	14567.79	14040.36	1649.11	2.79	5.76	8.2700

Table 3.1 (continued)

2003	7.4432	535.05	494.568471	16519.16	15984.11	1853.64	2.79	5.76	8.2700
2004	7.5220	606.30	621.08043	19462.7	18856.4	2129.99	3.60	6.12	8.2700
2005	7.5825	603.25	1041.08694	23208.33	22605.08	2554.22	3.60	6.12	8.0757
2006	7.4978	630.21	1240.82036	28471.13	27840.92	3101.64	4.14	6.39	7.8224
2007	7.5321	747.68	1562.49335	36166.7	35419.02	3998.09	4.41	6.39	7.3714
2008	7.5564	923.95	1715.3465	46083.95	45160	5147.09	5.58	7.47	6.8565
2009	7.5828	900.33	1310.57053	51082.38	50182.05	5900.70	5.58	7.47	6.8227
2010	7.6105	1057.35	2437.03435	60602.15	59544.8	7111.57	4.20	6.14	6.6469
2011	7.6420	1160.11	2800.72219	73453.39	72293.28	9455.83	5.00	6.60	6.3405

Data Source: ***China statistical yearbook*****.**

Table 3.2 Disaggregated GDP Data for the Chinese National Economy

Unit (100 million US$)

Year	Gross Domestic Product			
	household expenditure	government expenditure	Gross capital formation	Net export
1985	1460.48	404.70	1077.27	0.62
1986	1420.94	407.27	1056.41	-68.39
1987	1641.77	449.83	1195.80	2.89
1988	2108.62	528.33	1527.63	-40.49
1989	2093.85	558.73	1504.63	-44.10
1990	1805.26	504.20	1288.78	97.47
1991	1978.57	619.78	1450.75	113.86
1992	2235.00	722.62	1734.05	47.38
1993	2819.46	942.76	2700.17	-116.73
1994	2569.18	870.11	2392.40	74.58
1995	3403.64	1005.21	3055.76	119.81
1996	4076.83	1196.25	3455.99	175.20
1997	4464.51	1356.60	3623.70	429.25
1998	4743.57	1494.43	3786.48	438.84
1999	5068.97	1658.59	3984.46	306.72
2000	5544.69	1893.76	4213.16	289.02
2001	5977.74	2115.84	4808.88	281.10
2002	6415.55	2268.43	5509.67	374.14
2003	6970.96	2422.70	6766.99	358.51
2004	7886.15	2700.62	8363.77	512.16
2005	9034.35	3268.92	9640.88	1264.18
2006	10556.29	3902.69	11883.06	2129.09
2007	13068.41	4870.23	15050.50	3177.56
2008	16286.79	6089.42	20174.33	3533.41
2009	18100.47	6691.89	24087.65	2202.37
2010	21176.58	8027.25	29126.95	2271.37
2011	26014.54	10033.29	35487.21	1918.35

Data Source: ***China statistical yearbook*****.**

Table 3.3 Data for the Primary Sector of the Chinese Economy

Unit (100 million US$)

Year	Employment (100 million)	FDI	GDP	GDP-FDI	Total Wage
1997	3.484	6.2763	1746.3	1740.02	31.78
1998	3.5177	6.2375	1791.73	1785.49	30.22
1999	3.5768	7.1015	1786	1778.9	30.58
2000	3.6043	6.7594	1807.1	1800.34	31.45
2001	3.6513	8.9873	1908.26	1899.27	32.43
2002	3.687	10.2764	1999.64	1989.36	33.63
2003	3.6546	10.0084	2101.78	2091.77	40.6
2004	3.5269	11.1434	2589.21	2578.07	42.46
2005	3.397	7.1826	2776.23	2769.05	45.65
2006	3.1941	5.9945	3073.23	3067.24	51.56
2007	3.0731	9.2407	3883.52	3874.28	63.03
2008	2.9923	11.9102	4915.34	4903.43	75.32
2009	2.889	14.2873	5159.28	5144.99	78.71
2010	2.7931	19.1195	6098.12	6079	94.34
2011	2.6594	20.0888	7489.35	7469.26	110.03

Data Source: *China statistical yearbook*.

Table 3.4 Data for the Secondary Sector of the Chinese Economy

Unit (100 million US$)

Year	Employment (100 million)	FDI	GDP	GDP-FDI	Total Wage
1997	1.6547	325.6989	4539.66	4213.96	556.41
1998	1.66	313.2749	4716.35	4403.08	514.97
1999	1.6421	277.8432	4961.74	4683.9	521.02
2000	1.6219	295.798	5508.57	5212.77	546.18
2001	1.6284	348.0844	5986.98	5638.9	575.7
2002	1.578	394.7185	6517.14	6122.42	627.26
2003	1.6077	391.9696	7549.94	7157.97	719.88
2004	1.692	454.6306	8936.43	8481.8	831.48
2005	1.8084	446.9243	10847.12	10400.2	1009.74
2006	1.8894	425.066	13259.3	12834.2	1248.39
2007	2.0186	428.6105	17070.21	16641.6	1587.29
2008	2.0553	532.5624	21731.71	21199.1	2018.55
2009	2.108	500.7582	23088.12	22587.4	2272.02
2010	2.1842	538.6037	28191.07	27652.5	2789.19
2011	2.2544	557.487	34762.69	34205.2	4030.86

Data Source: ***China statistical yearbook*****.**

Table 3.5 Data for the Tertiary Sector of the Chinese Economy

Unit (100 million US$)

Year	Employment (100 million)	FDI	GDP	GDP-FDI	Total Wage
1997	1.8432	120.5952	3263.38	3142.78	549.09
1998	1.886	135.1151	3697.76	3562.64	578.94
1999	1.9205	118.2424	4095.94	3977.7	642.53
2000	1.9823	104.5907	4681.25	4576.66	710.91
2001	2.0228	111.7042	5361.16	5249.46	822.43
2002	2.109	122.4337	6033.72	5911.29	930.53
2003	2.1809	133.0687	6772.03	6638.96	1093.16
2004	2.3011	140.5258	7806.69	7666.16	1256.05
2005	2.3771	149.14	9277.12	9127.98	1498.82
2006	2.4143	199.0819	11320.68	11121.6	1801.7
2007	2.4404	309.8277	15105.94	14796.1	2347.77
2008	2.5087	379.4812	19155.54	18776.1	3053
2009	2.5857	385.2817	21681.98	21296.7	3549.97
2010	2.6332	499.6292	26116.83	25617.2	4228.04
2011	2.7282	582.5342	32329.08	31746.5	5314.93

Data Source: ***China statistical yearbook*****.**

CHAPTER 4

RESULTS

Using the AUTOREG procedure to analyze the data, we can summarize the relationship between the predictor variables and the dependent variable of employment. Our modeling strategy adjusts for the lack of independence among data values and prediction errors by modeling the errors as a lag-one autoregressive, or AR(1), structure. Distributions of model errors presented in the visual analysis of fit statistics indicate the presence of a modest degree of skewness for some model errors and approximate normality in other cases. Possible heteroskedasticity of the errors is not addressed in these models directly, but the AUTOREG procedure is built to address such concerns; given the general lack of volatility in the data used to estimate these models, it is not believed that heteroskedasticity is a serious concern.

The validity of the time series model estimates can be measured in terms of the proportion of variation in the dependent variable that can be predicted by the independent variables. It is usual to use R^2 to measure the effect size and validity of estimated models. The R^2 value comes from the equation

$$R^2 = 1 - \frac{SS_{\hat{a}}}{SS_{y_t}}$$

"where the proportion of systematic variance explained by the model (R^2) is one minus the sum of squared residuals divided by the sum of squared Y_t values, where Y_t is the difference-adjusted dependent variable" (Tabachnick & Fidell, 2012, Chapter 8, p. 46).

Results for the Overall Chinese National Economy

For the Chinese economy overall, we can see that the 8 predictor variables (FDI, household expenditure, government spending, gross capital formation, net exports, total wages, and the interest rates of deposits and loans) have large associations with the dependent variable (employment). From the Ordinary Least Squares (OLS) estimates, 84.95% of the variation in the dependent variable's values can be predicted by these 8 independent variables (see Table 4.1). From the maximum likelihood (ML) estimated model, which includes the adjustment for autocorrelated errors, 95.89% of the variation in the dependent variable can be predicted by the same 8 independent variables (see Table 4.2).

The relationship between each predictor and the dependent variable can be obtained from Tables 4.1 and 4.2. Because the data are limited to 27 years and hence standard errors are larger than they would be for a larger dataset, the significance tests show that some *p*-values are a little bigger than 0.05. From OLS estimates, we can see that there is a positive relationship between FDI and employment; the *p*-value is 0.031, and the parameter estimate is 0.003170. There are no other obvious relationships between employment and other predictor variables (see Table 4.1).

From the ML estimates, which include the effect of the autoregressive lag-1 structure of the model errors, we can see that there is some evidence of a negative relationship between interest rates for loans and employment, with *p*-value of 0.0616, which is near the standard benchmark Type I error level of 0.05. If data for additional years were available, the standard error would be smaller and thus the *p*-value also would be smaller and closer to the 0.05 threshold for statistical significance with 95% confidence. Although not significant, this relationship is suggestive and opens up avenues

for future research. There are no other obvious relationships between employment and other predictor variables (see Table 4.2).

The AR(1), or first-order autoregressive, model structure is employed to account for the pattern of high serial dependence among the data values. The AR(1) parameter estimate is -0.9779, with $p < 0.0001$. This result means that the predictor errors related to the data values one time period apart are very closely related; that is, each year's prediction error value is closely related to the previous year's prediction error value.

For the two methods for model estimation, ordinary least squares (OLS) and maximum likelihood (ML), the relationships between the predictor variables and employment are different. The OLS estimates show that there is a significant positive relationship between FDI and employment (see Table 4.1; $p = 0.031$, and the parameter estimate is 0.00317). In contrast, for the ML estimates the relationship between FDI and employment is not significant, and there is a significant negative relationship between loan interest rates and employment (see Table 4.2; $p = 0.0653$, and the parameter estimate is -0.062). The reason for this difference is that the ML estimates take the AR(1) process in the error structure into consideration along with the effect of the predictor variables, which influences the parameter estimates of each independent variable in the model. This outcome means that taking the autoregressive structure into consideration, FDI's effect is weakened and loan interest rates show a stronger effect on employment.

Analysis of the residuals from this model is summarized in Figure 4.1. The residual measures the difference between the observed value and the estimated value for each year's level of employment. For the dependent variable (the number of people employed in China), the residual for each year is between -1 and 1 except for 1988-1990.

That is, the observed value is close to the estimated value except for 1988-1990. Analysis of the lag structure demonstrates that the white noise probability decreases as the lag period becomes longer; the longer the lag period, the harder it is to predict the level of employment. “The autocorrelation function (ACF) is the pattern of autocorrelations in a time series at numerous lags. The partial autocorrelation function (PACF) is the pattern of partial autocorrelations in a time series at numerous lags after partialing out the effects of autocorrelations at intervening lags” (Tabachnick & Fidell, 2012, Chapter 8, p. 4). “Both autocorrelations and partial autocorrelations are computed for sequential lags in the series” (Tabachnick & Fidell, 2012, Chapter 8, p. 13).

The ACF equation (Tabachnick & Fidell, 2012, Chapter 8, p. 14) is

$$r_k = \frac{\frac{1}{N-k}\sum_{t=1}^{N-k}(Y_t - \bar{Y})(Y_{t-k} - \bar{Y})}{\frac{1}{N-1}\sum_{t=1}^{N}(Y_t - \bar{Y})^2}$$

where N is the number of observations in the whole series and k is the lag, $\bar{Y}$ is the mean of the whole series, and the denominator is the variance of the whole series (Tabachnick & Fidell, 2012, Chapter 8, p. 14).

The PACF equation (Tabachnick & Fidell, 2012, Chapter 8, p. 15) is

$$PACF(1) = ACF(1)$$

$$PACF(2) = \frac{ACF(2) - (ACF(1))^2}{1 - [ACF(1)]^2}$$

$$ACF(3) = \frac{-2\big(ACF(1)\big)ACF(2) - [ACF(1)]^2 ACF(3)}{1 + 2[ACF(1)]^2 ACF(2) - [ACF(2)]^2 - 2[ACF(1)]^2}$$

The ACF chart shows a strong lag-1 autocorrelation throughout the dataset, with some evidence of a cyclical pattern about every five years. Because China has five-year plans

for the national economy, the estimated model in this paper reflects the fact that economic data reflect the five-year periodicity. There is no obvious pattern in the PACF chart.

Results for the Three Main Sectors of the Chinese Economy

For the primary sector of the Chinese economy, we can see that the three predictor variables (FDI, GDP, and total wages) collectively have a strong association with the dependent variable (number of people employed). From the OLS estimates, 97.36% of the variation in the dependent variable is "explained" by these three predictor variables (see Table 4.3), and the ML model accounts for 97.39% of the variation in the dependent variable (see Table 4.4). The relationship between each predictor and the dependent variable can be obtained from Tables 4.3 and 4.4. Because the data are limited to just 15 years of usable information, it is difficult to attain small *p*-values that indicate statistical significance. From the OLS estimates, we can see that there is a significant positive relationship between FDI and employment ($p = 0.001$, with parameter estimate of 0.0373). From the ML estimates, we can see that there still is a significant positive relation between FDI and employment ($p = 0.005$, with parameter estimate of 0.0345). There are no other significant relationships. Figure 4.2 summarizes model fit for the primary sector.

For the secondary sector, we can see that the three predictor variables (FDI, GDP, and total wages) still have a strong association with the dependent variable (employment). From the OLS estimates, 96.63% of the variation in the dependent variable values can be predicted by these three independent variables (see Table 4.5), and the ML estimates

show that 97.91% of the variation in the dependent variable can be predicted by these three independent variables (see Table 4.6). From the OLS estimates, we can see that there is a significant positive relationship between GDP and employment (p = 0.0007, with parameter estimate of 0.00000588) and a significant negative relationship between wages and employment (p = 0.0187, with parameter estimate of -0.000276). From the ML estimates, the outcome still shows that there is a significant positive relationship between GDP and employment (p = 0.0027, with parameter estimate of 0.0000461). Although the relationship between wages and employment is not statistically significant, the sign of the ML parameter estimate is consistent with the OLS result. Figure 4.3 summarizes model fit for the secondary sector.

For the tertiary sector, the three predictor variables (FDI, GDP, and total wages) have strong associations with the dependent variable (employment). From the OLS estimates, 95.16% of the variation in the dependent variable values can be accounted for by these three predictor variables, and the ML estimate shows that 98.27% of variation in the dependent variable values can be "explained" by these three predictors. From the OLS parameter estimates, we can see that there is a significant negative relationship between FDI and employment (p = 0.0251, with parameter estimate of -0.002095), a significant negative relationship between total wages and employment (p = 0.0264, with parameter estimate of -0.001326), and a significant positive relationship between GDP and employment (p = 0.0046, with parameter estimate of 0.00312). From the ML results, the parameter estimates still show a negative relationship between FDI and employment (p = 0.0251, with parameter estimate of -0.002095) and a significant positive relationship between GDP and employment (p = 0.0604, with parameter estimate of 0.00017). The

significant negative relationship between total wages and employment in the OLS model is not significant under the ML model specification. Figure 4.4 summarizes model fit for the tertiary sector.

To make sure these relationships are accurate, additional estimates were generated with FDI subtracted from GDP, instead of using the GDP data reported directly from the *China Statistical Yearbook*, to verify the relationships reported above between predictor and dependent variables for the whole national economy and for its three main sectors. These outcomes are consistent with the results presented above. These new results help verify the validity of the previously-reported relationships. Detailed results are provided in the Appendix.

In addition, the FDI data obtained from the *China Statistical Yearbook* were compared with FDI data from the World Bank to ensure that the previously-reported results are robust with respect to alternate data sources. The model results are consistent outcome with previously presented results. These detailed results also are provided in the Appendix.

The outcome for the primary sector shows that after taking the autoregressive structure into consideration, the positive relationship between FDI and employment remains significant. This result affirms that FDI indeed has a positive effect on employment for the primary sector. For the secondary sector, the OLS estimates and ML estimates show the same relationship between the predictor and dependent variables, so GDP and total wages influence employment, with GDP having a positive effect and total wages having a negative effect. For the tertiary sector, the negative relationship between total wages and employment becomes nonsignificant under ML model estimates; GDP

has a positive effect on employment for the OLS model and GDP is very nearly a positive significant predictor of employment for the ML model. FDI clearly appears to have a negative effect on employment in the tertiary sector.

For the overall Chinese national economy, there is no significant relationship between FDI and employment, and there is a nearly significant negative relationship between loan interest rates and employment.

Table 4.1 Ordinary Least Squares Results for the Chinese National Economy

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates			
SSE	2.74028586	**DFE**	18
MSE	0.15224	**Root MSE**	0.39018
SBC	44.5152978	**AIC**	32.852766
MAE	0.22047964	**AICC**	43.4410013
MAPE	3.56510991	**HQC**	36.3206481
Durbin-Watson	0.7275	**Regress R-Square**	0.8492
		Total R-Square	0.8492

Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	5.4839	0.8842	6.20	<.0001
FDI	1	0.003170	0.001355	2.34	0.0310
household	1	-0.000139	0.000722	-0.19	0.8497
government	1	0.001427	0.001350	1.06	0.3044
GCF	1	-0.000182	0.000230	-0.79	0.4394
export	1	-0.000146	0.000220	-0.67	0.5144
wage	1	-0.000588	0.000951	-0.62	0.5443
deposit	1	0.006644	0.1214	0.05	0.9569
loan	1	0.0137	0.0893	0.15	0.8795

Estimates of Autocorrelations			
Lag	**Covariance**	**Correlation**	**-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1**
0	0.1015	1.000000	|**********|
1	0.0567	0.559071	|********** |

Preliminary MSE 0.0698

Estimates of Autoregressive Parameters			
Lag	**Coefficient**	**Standard Error**	**t Value**
1	-0.559071	0.201091	-2.78

Algorithm converged.

Table 4.2 Maximum Likelihood Results for the Chinese National Economy

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.74717718	**DFE**	17
MSE	0.04395	**Root MSE**	0.20965
SBC	15.8542916	**AIC**	2.89592298
MAE	0.1054964	**AICC**	16.645923
MAPE	1.7005371	**HQC**	6.74912531
Log Likelihood	8.55203851	**Regress R-Square**	0.3344
Durbin-Watson	1.0536	**Total R-Square**	0.9589
		Observations	27

Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	6.0520	1.8388	3.29	0.0043
FDI	1	0.000752	0.001053	0.71	0.4847
household	1	0.000243	0.000362	0.67	0.5114
government	1	-0.000084	0.000736	-0.11	0.9100
GCF	1	-0.000082	0.000124	-0.66	0.5164
export	1	-0.000076	0.000144	-0.52	0.6067
wage	1	-0.000226	0.000622	-0.36	0.7207
deposit	1	0.0310	0.0421	0.74	0.4715
loan	1	-0.0620	0.0315	-1.97	0.0653
AR1	1	-0.9779	0.0780	-12.53	<.0001

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	6.0520	1.0176	5.95	<.0001
FDI	1	0.000752	0.001001	0.75	0.4625
household	1	0.000243	0.000337	0.72	0.4800
government	1	-0.000084	0.000728	-0.12	0.9091
GCF	1	-0.000082	0.000121	-0.68	0.5077
export	1	-0.000076	0.000140	-0.54	0.5971
wage	1	-0.000226	0.000548	-0.41	0.6850
deposit	1	0.0310	0.0421	0.74	0.4713
loan	1	-0.0620	0.0310	-2.00	0.0616

Table 4.3 Ordinary Least Squares Results for the Primary Sector of the Chinese Economy

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	0.04483362	**DFE**	11
MSE	0.00408	**Root MSE**	0.06384
SBC	-33.792351	**AIC**	-36.624552
MAE	0.04631128	**AICC**	-32.624552
MAPE	1.45802629	**HQC**	-36.65472
Durbin-Watson	1.6378	**Regress R-Square**	0.9736
		Total R-Square	0.9736

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	3.8518	0.0816	47.20	<.0001
FDI	1	0.0373	0.008359	4.47	0.0010
GDP	1	-0.000145	0.000142	-1.02	0.3318
wage	1	-0.008516	0.0100	-0.85	0.4133

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.00299	1.000000	|**********|
1	0.000132	0.044100	|* |

Preliminary MSE 0.00298

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.044100	0.315920	-0.14

Algorithm converged.

Table 4.4 Maximum Likelihood Results for the Primary Sector of the Chinese Economy

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.04440654	**DFE**	10
MSE	0.00444	**Root MSE**	0.06664
SBC	-31.195585	**AIC**	-34.735836
MAE	0.04696401	**AICC**	-28.069169
MAPE	1.47603633	**HQC**	-34.773547
Log Likelihood	22.3679178	**Regress R-Square**	0.9642
Durbin-Watson	1.7318	**Total R-Square**	0.9739
		Observations	15

Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	3.8599	0.0878	43.95	<.0001
FDI	1	0.0345	0.009636	3.58	0.0050
GDP	1	-0.000118	0.000147	-0.81	0.4395
wage	1	-0.009767	0.0103	-0.95	0.3642
AR1	1	-0.1782	0.3637	-0.49	0.6346

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	3.8599	0.0878	43.95	<.0001
FDI	1	0.0345	0.009634	3.58	0.0050
GDP	1	-0.000118	0.000143	-0.83	0.4270
wage	1	-0.009767	0.0101	-0.97	0.3546

Table 4.5 Ordinary Least Squares Results for the Secondary Sector of the Chinese Economy

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	0.02639838	**DFE**	11
MSE	0.00240	**Root MSE**	0.04899
SBC	-41.737184	**AIC**	-44.569385
MAE	0.03570269	**AICC**	-40.569385
MAPE	2.04955226	**HQC**	-44.599554
Durbin-Watson	0.8386	**Regress R-Square**	0.9663
		Total R-Square	0.9663

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	1.6900	0.1108	15.25	<.0001
FDI	1	-0.000659	0.000370	-1.78	0.1025
GDP	1	0.0000588	0.0000126	4.67	0.0007
wage	1	-0.000276	0.0000999	-2.76	0.0187

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.00176	1.000000	|**********|
1	0.000878	0.498961	|********** |

Preliminary MSE 0.00132

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.498961	0.274051	-1.82

Algorithm converged.

Table 4.6 Maximum Likelihood Results for the Secondary Sector of the Chinese Economy

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.01634521	**DFE**	10
MSE	0.00163	**Root MSE**	0.04043
SBC	-45.613716	**AIC**	-49.153967
MAE	0.02850222	**AICC**	-42.4873
MAPE	1.61528937	**HQC**	-49.191678
Log Likelihood	29.5769833	**Regress R-Square**	0.9043
Durbin-Watson	1.4633	**Total R-Square**	0.9791
		Observations	15

Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	1.6947	0.1231	13.77	<.0001
FDI	1	-0.000566	0.000416	-1.36	0.2030
GDP	1	0.0000461	0.0000140	3.29	0.0081
wage	1	-0.000179	0.0000977	-1.83	0.0973
AR1	1	-0.6741	0.2846	-2.37	0.0394

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	1.6947	0.1122	15.10	<.0001
FDI	1	-0.000566	0.000350	-1.62	0.1368
GDP	1	0.0000461	0.0000117	3.95	0.0027
wage	1	-0.000179	0.0000871	-2.05	0.0673

Table 4.7 Ordinary Least Squares Results for the Tertiary Sector of the Chinese Economy

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	0.0575544	**DFE**	11
MSE	0.00523	**Root MSE**	0.07233
SBC	-30.045767	**AIC**	-32.877968
MAE	0.05335451	**AICC**	-28.877968
MAPE	2.43408024	**HQC**	-32.908137
Durbin-Watson	0.6232	**Regress R-Square**	0.9516
		Total R-Square	0.9516

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	1.9794	0.0434	45.56	<.0001
FDI	1	-0.003788	0.000813	-4.66	0.0007
GDP	1	0.000312	0.0000879	3.55	0.0046
wage	1	-0.001326	0.000517	-2.56	0.0264

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.00384	1.000000	|**********|
1	0.00241	0.627673	|********** |

Preliminary MSE 0.00233

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.627673	0.246176	-2.55

Algorithm converged.

Table 4.8 Maximum Likelihood Results for the Tertiary Sector of the Chinese Economy

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.02062503	**DFE**	10
MSE	0.00206	**Root MSE**	0.04541
SBC	-41.002483	**AIC**	-44.542734
MAE	0.02808998	**AICC**	-37.876067
MAPE	1.28657311	**HQC**	-44.580445
Log Likelihood	27.2713669	**Regress R-Square**	0.7989
Durbin-Watson	0.8079	**Total R-Square**	0.9827
		Observations	15

Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	2.0011	0.1522	13.15	<.0001
FDI	1	-0.002095	0.000796	-2.63	0.0251
GDP	1	0.000170	0.0000804	2.11	0.0606
wage	1	-0.000676	0.000421	-1.61	0.1395
AR1	1	-0.9069	0.1899	-4.78	0.0008

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	2.0011	0.1033	19.38	<.0001
FDI	1	-0.002095	0.000793	-2.64	0.0246
GDP	1	0.000170	0.0000803	2.12	0.0604
wage	1	-0.000676	0.000421	-1.61	0.1395

Figure 4.1 Fit Diagnostics for the Whole Chinese National Economy

The SAS System

The AUTOREG Procedure

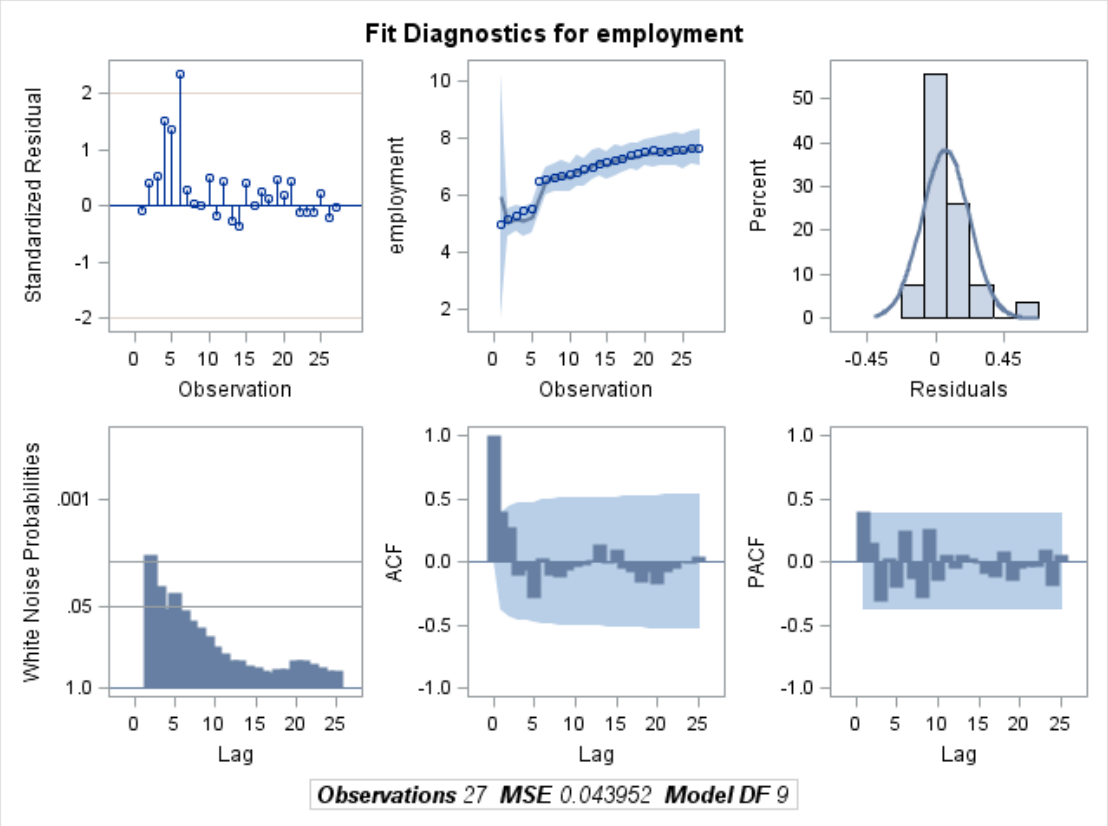


Figure 4.2 Fit Diagnostics for the Primary Sector of the Chinese Economy

The SAS System

The AUTOREG Procedure

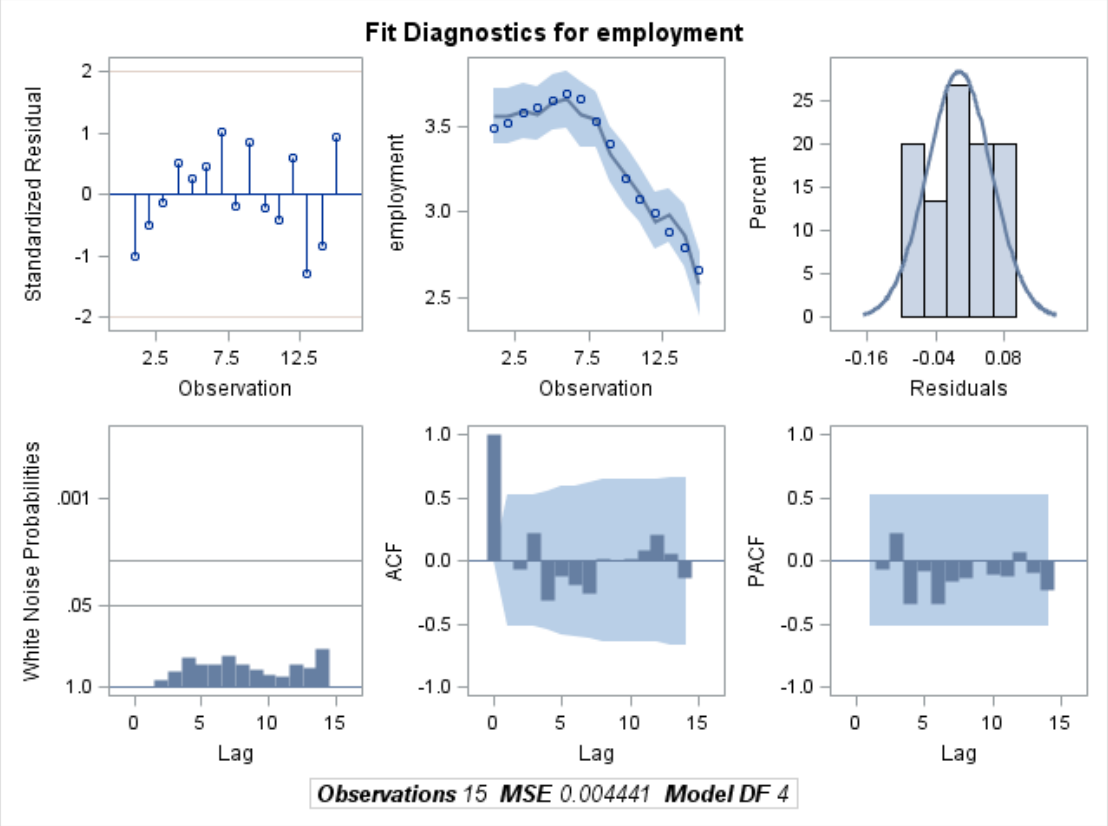


Figure 4.3 Fit Diagnostics for the Secondary Sector of the Chinese Economy

The SAS System

The AUTOREG Procedure

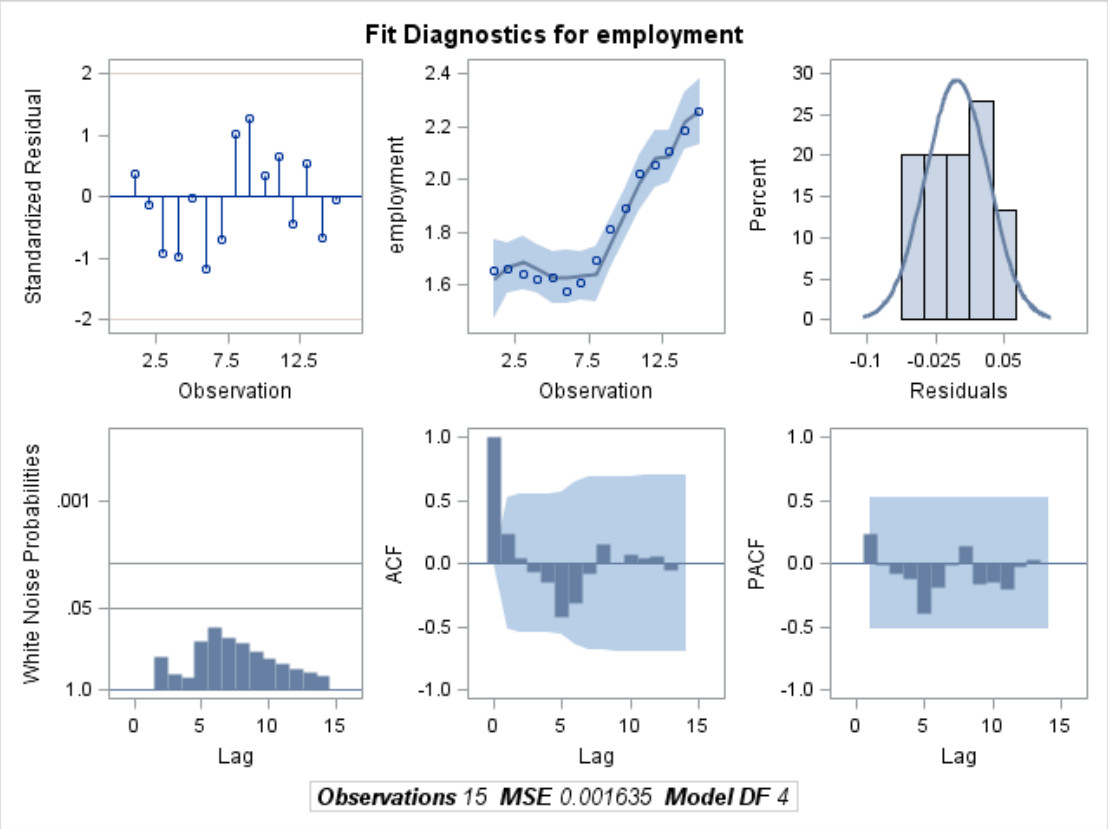
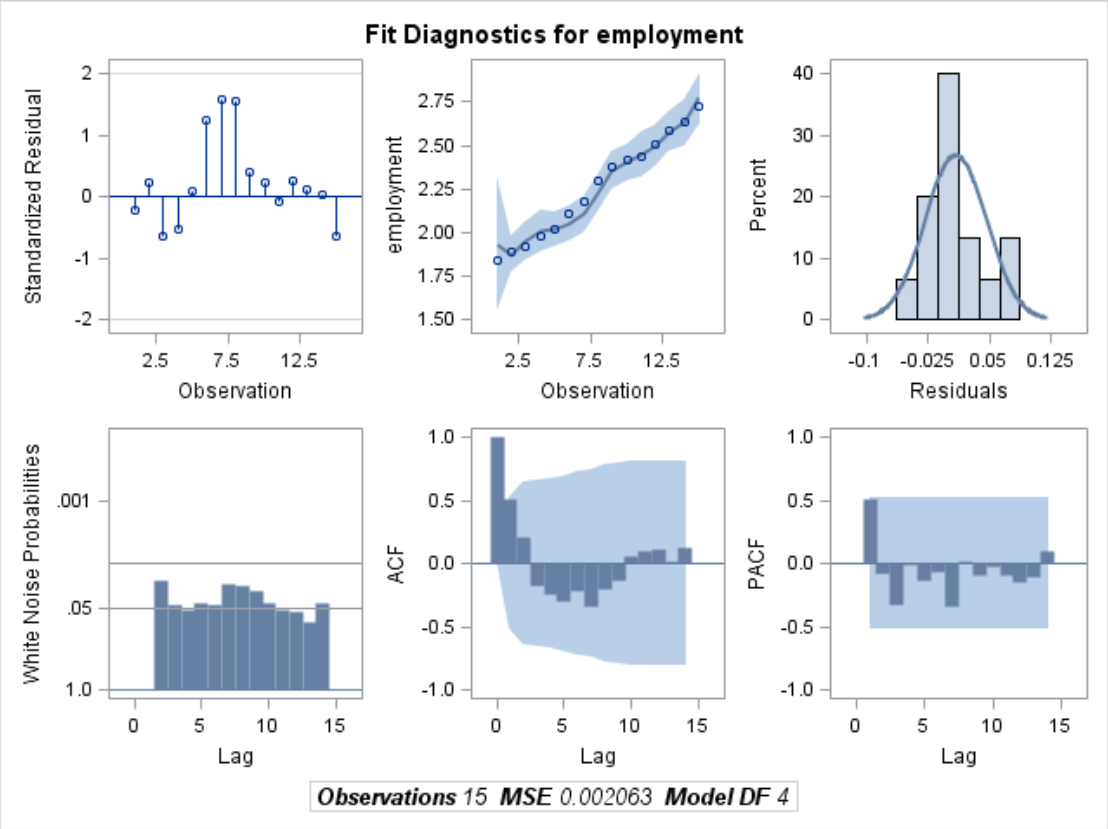


Figure 4.4 Fit Diagnostics for the Tertiary Sector of the Chinese Economy

The SAS System

The AUTOREG Procedure



CHAPTER 5

SUMMARY AND CONCLUSIONS

Limitations

There are some limitations of this research.

To find data covering the same period for each predictor and dependent variable and thereby provide a consistent basis for assessing relationships among variables for the overall national economy, data were available for 27 years (1985-2011). Because FDI began to flow into China in substantial amounts after 1979, only a limited number of years were available. The longer the number of time series data values that are available, the more accurate will be the results of estimated models. It was felt that the number of time series data values available for all relevant variables was not adequate to conduct meaningful forecasting of future levels of employment in China.

For the separate analyses of the three main sectors of the Chinese economy, only limited data were available for the four components of GDP and no separate sector-specific interest rates were available, so only three predictor variables (FDI, GDP, and total wages) were used to analyze their relationship with employment. Just 15 years of data were available to do this research for the three main sectors. Fifteen years of data is a short period, so the accuracy of the estimated model results may not be high and standard errors are inflated relative to larger time series; accordingly, some *p*-values are a little bigger than 0.05. More predictor variables and longer time series datasets may be used in the future to analyze the relationships among these variables with greater precision.

Second, FDI has five main existing patterns: equity joint venture, contractual joint

venture, wholly foreign-owned enterprise, FDI shareholding incorporation, and joint exploration. FDI in these different forms may have different effects on employment in the accepting country, so in future research it would be meaningful to test each FDI component separately and ascertain whether each of them has a positive effect by increasing employment or a crowding-out effect on employment.

Third, although the predictor variables and the dependent variable mutually influence each other, future research should take into consideration interactions and multicollinear dependencies among the predictor variables. The predictor variables are related to each other, so there is a need for future research to take this condition into consideration and to adjust for more nuanced partial relationships between each predictor variable and the dependent variable. It will be important to elaborate more clearly the effect of each of the predictor variables on employment when controlling for other predictor variables.

Fourth, there are a number of other interventions that influence the outcome variable of employment, such as the transition of leaders and governments, important events in the economy, wars, and other systemic shocks. The leadership of every government has their own standards for collecting and analyzing data, and these standards may change from one government to another, so the available data may not have been collected according to the same standard over time. In addition, important events also can influence employment outcomes. For example, economic crisis will attack economic markets and lead to more people losing jobs, and important events such as the 2008 Beijing Olympic Games and Shanghai World Expo have been helpful for stimulating the domestic market in China, thus providing more work opportunities.

Future research should take such interventions into consideration to yield more accurate models.

The fifth limitation is that the unit of data collection for several key variables is in terms of 100 million dollars, so the exchange rate was taken into consideration. However, the exchange rate between US dollars and Chinese renmimbi (yuan) has changed a lot during the 27 years covered in this study period. The true value of FDI and GDP also may change during this period. If we take this reality into consideration, the outcomes from model estimation may be affected. It is important in future research to make sure that all of the data have the same value standard.

Last, there is a geographical component to the analysis of this topic. China has three major regional areas: the east coastal area, the central inland area, and the western area. The three regions have developed unequally, and the amounts of FDI that flow into the three main areas are different. Most of the FDI has flowed into the east coastal area, and there has been considerable population mobility from the central inland area and the western area to the east coastal area. The topic of this research is also meaningful for subsequent analysis for these three areas in China.

Policy Implications

From the SAS results, there is an empirical basis for some advice for economic policy in China.

For the overall national economy of China, FDI didn’t show a significant relationship with employment. However, taking the autoregressive error structure into consideration, the interest rates for loans has a stronger effect on employment. To solve

China's employment problem and provide more work opportunities, the Chinese government could choose to decrease the interest rate for loans to stimulate the economy, and then the economy will be stimulated and thereby need to employ more workers.

For the separate analyses of the three main sectors of the Chinese economy, the effect of each predictor variable on employment is different. The FDI used in the primary sector has a significant positive effect on employment. To address the problem of the need for expanded employment opportunities in the rural sector of the economy, the Chinese government can attract more FDI focused on the primary sector in the future. Also, because of limited work opportunities in urban areas, the large-scale mobility of rural populations from the primary sector to the secondary and tertiary sectors after 2007 may be unsustainable, so the primary sector needs the infusion of greater economic support in general and specifically a greater role for FDI.

For the secondary sector, the effect of FDI on employment is not significant, while GDP has a large positive effect on employment. So the Chinese government could choose to expand the four components of GDP for the secondary sector. The outcome of the models estimated in this research also shows that total wages has a nearly significant negative effect on employment. However, lower wages will influence GDP downward, so it is very important for the Chinese government to control total wages and maintain wages at a proper level, balancing wages and GDP appropriately according to economic conditions and the government's purpose.

For the tertiary sector, the effect of total wages is not significant, while FDI has a negative effect on employment and GDP has a positive effect on employment, with FDI's negative effect bigger than GDP's positive effect. However, FDI is very useful for the

development of the tertiary sector and it is helpful for China to become more fully integrated into the world economy, so FDI is needed right now. However, to maintain a high level of employment, the Chinese government needs to allocate more funds to the tertiary sectors to balance the negative effect of FDI.

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APPENDIX A. MODEL ESTIMATES USING GDP DATA FROM *CHINA STATISTICAL YEARBOOK*, WITH AGGREGATE GDP (RATHER THAN THE FOUR GDP COMPONENTS SEPARATELY)

Table A.1 Ordinary Least Squares Results for the Chinese National Economy, with Aggregate GDP

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	3.03096488	**DFE**	21
MSE	0.14433	**Root MSE**	0.37991
SBC	37.3498939	**AIC**	29.5748727
MAE	0.23424877	**AICC**	33.7748727
MAPE	3.79827408	**HQC**	31.8867941
Durbin-Watson	0.5666	**Regress R-Square**	0.8332
		Total R-Square	0.8332

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	5.9495	0.3054	19.48	<.0001
FDI	1	0.003755	0.000752	5.00	<.0001
GDP	1	-0.000030	0.0000595	-0.50	0.6213
wage	1	-0.000045	0.000449	-0.10	0.9215
deposit	1	-0.0516	0.0573	-0.90	0.3774
loan	1	0.0296	0.0569	0.52	0.6088

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.1123	1.000000	|**********|
1	0.0704	0.627534	|********** |

Preliminary MSE 0.0681

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.627534	0.174098	-3.60

Table A.2 Maximum Likelihood Results for the Chinese National Economy, with Aggregate GDP

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.76698492	**DFE**	20
MSE	0.03835	**Root MSE**	0.19583
SBC	6.94882138	**AIC**	-2.1220367
MAE	0.11079359	**AICC**	3.77270016
MAPE	1.77867189	**HQC**	0.57520494
Log Likelihood	8.06101834	**Regress R-Square**	0.3061
Durbin-Watson	1.0599	**Total R-Square**	0.9578
		Observations	27

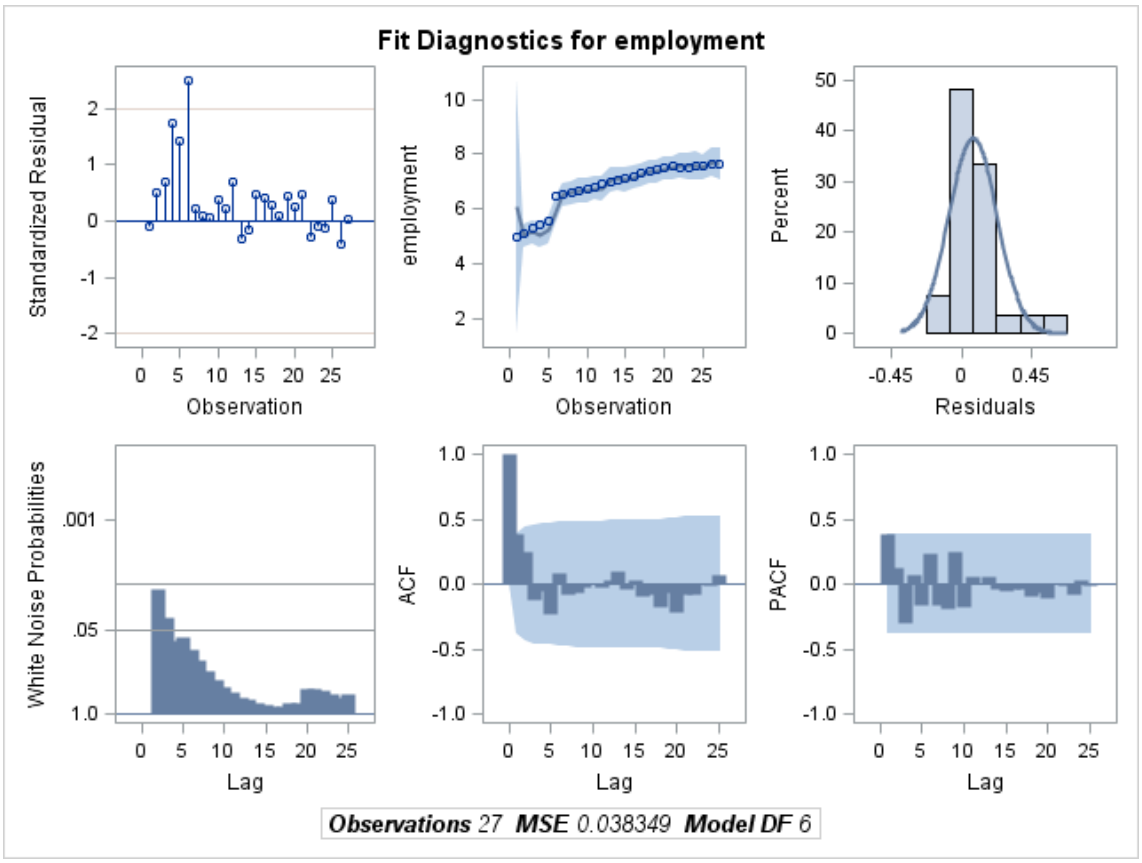
Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	6.3360	1.9073	3.32	0.0034
FDI	1	0.000881	0.000954	0.92	0.3671
GDP	1	-7.095E-6	0.0000525	-0.14	0.8939
wage	1	0.0000225	0.000318	0.07	0.9443
deposit	1	0.0152	0.0350	0.44	0.6678
loan	1	-0.0498	0.0251	-1.99	0.0605
AR1	1	-0.9833	0.0590	-16.65	<.0001

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	6.3360	1.0287	6.16	<.0001
FDI	1	0.000881	0.000909	0.97	0.3441
GDP	1	-7.095E-6	0.0000482	-0.15	0.8846
wage	1	0.0000225	0.000301	0.07	0.9413
deposit	1	0.0152	0.0337	0.45	0.6565
loan	1	-0.0498	0.0250	-1.99	0.0603

Figure A.1 Fit Diagnostics for the Whole Chinese National Economy

The SAS System

The AUTOREG Procedure



APPENDIX B.MODEL ESTIMATES USING GDP-FDI DATA FROM CHINA STATISTICAL YEARBOOK, WITH AGGREGATE GDP (RATHER THAN THE FOUR GDP COMPONENTS SEPARATELY)

Table B.1 Ordinary Least Squares Results for the Chinese National Economy, with Aggregate GDP-FDI Data

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	3.03096488	**DFE**	21
MSE	0.14433	**Root MSE**	0.37991
SBC	37.3498939	**AIC**	29.5748727
MAE	0.23424877	**AICC**	33.7748727
MAPE	3.79827408	**HQC**	31.8867941
Durbin-Watson	0.5666	**Regress R-Square**	0.8332
		Total R-Square	0.8332

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	5.9495	0.3054	19.48	<.0001
FDI	1	0.003725	0.000722	5.16	<.0001
GDP	1	-0.000030	0.0000595	-0.50	0.6213
wage	1	-0.000045	0.000449	-0.10	0.9215
deposit	1	-0.0516	0.0573	-0.90	0.3774
loan	1	0.0296	0.0569	0.52	0.6088

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.1123	1.000000	|**********|
1	0.0704	0.627534	|********** |

Preliminary MSE 0.0681

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.627534	0.174098	-3.60

Table B.2 Maximum Likelihood Results for the Chinese National Economy, with Aggregate GDP-FDI Data

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.76698492	**DFE**	20
MSE	0.03835	**Root MSE**	0.19583
SBC	6.94882138	**AIC**	-2.1220367
MAE	0.11079359	**AICC**	3.77270016
MAPE	1.77867189	**HQC**	0.57520494
Log Likelihood	8.06101834	**Regress R-Square**	0.3061
Durbin-Watson	1.0599	**Total R-Square**	0.9578
		Observations	27

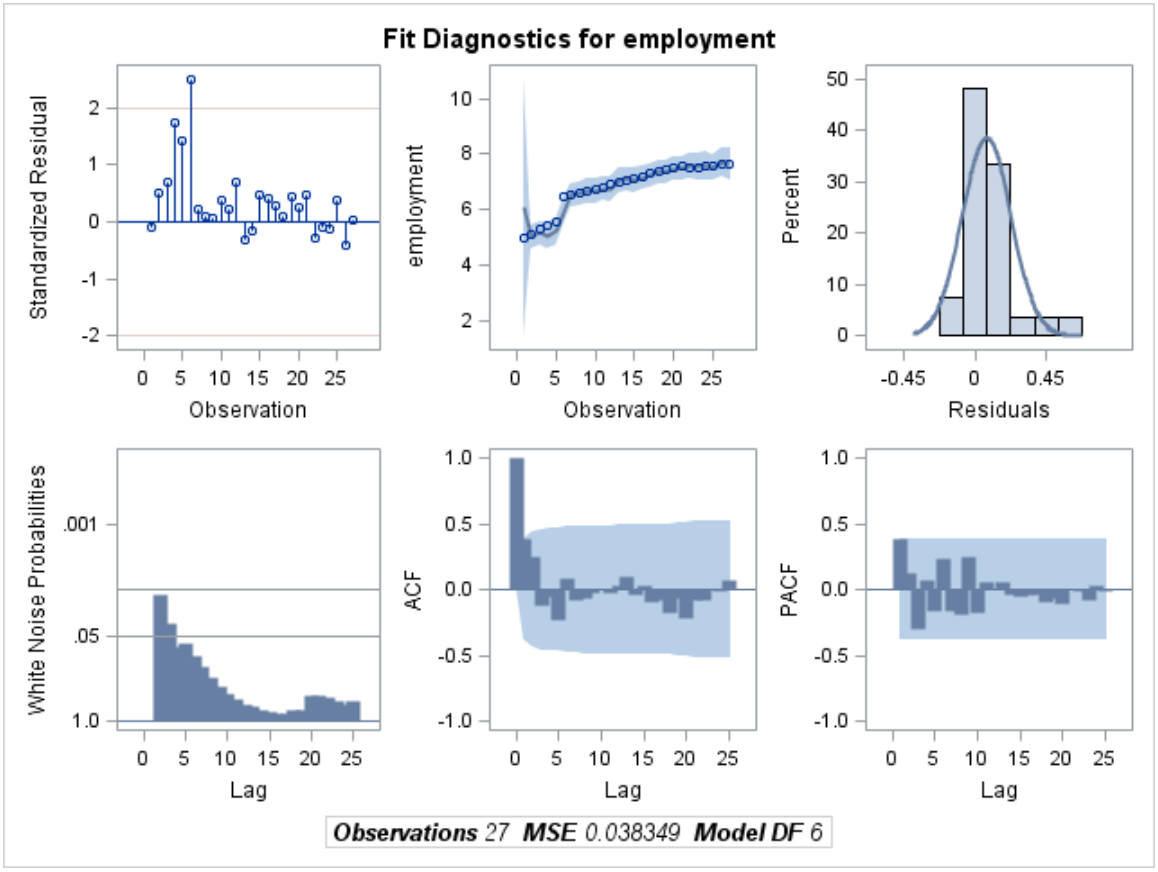
Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	6.3360	1.9073	3.32	0.0034
FDI	1	0.000873	0.000935	0.93	0.3613
GDP	1	-7.095E-6	0.0000525	-0.14	0.8939
wage	1	0.0000225	0.000318	0.07	0.9443
deposit	1	0.0152	0.0350	0.44	0.6678
loan	1	-0.0498	0.0251	-1.99	0.0605
AR1	1	-0.9833	0.0590	-16.65	<.0001

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	6.3360	1.0287	6.16	<.0001
FDI	1	0.000873	0.000881	0.99	0.3336
GDP	1	-7.095E-6	0.0000482	-0.15	0.8846
wage	1	0.0000225	0.000301	0.07	0.9413
deposit	1	0.0152	0.0337	0.45	0.6565
loan	1	-0.0498	0.0250	-1.99	0.0603

Figure B.1 Fit Diagnostics for the Whole Chinese National Economy, with Aggregate GDP-FDI Data

The SAS System

The AUTOREG Procedure



APPENDIX C. MODEL ESTIMATES USING FDI DATA FROM WORLD BANK

Table C.1 Ordinary Least Squares Results for the Chinese National Economy, with Data from World Bank

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	6.13797055	**DFE**	21
MSE	0.29228	**Root MSE**	0.54063
SBC	56.4014489	**AIC**	48.6264277
MAE	0.39360027	**AICC**	52.8264277
MAPE	6.330774	**HQC**	50.9383491
Durbin-Watson	0.7063	**Regress R-Square**	0.6623
		Total R-Square	0.6623

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	6.5801	0.4039	16.29	<.0001
FDI	1	0.000888	0.000682	1.30	0.2069
GDP	1	0.0000858	0.0000783	1.10	0.2855
wage	1	-0.000830	0.000594	-1.40	0.1769
deposit	1	-0.1738	0.0735	-2.36	0.0278
loan	1	0.1294	0.0755	1.71	0.1013

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.2273	1.000000	|**********|
1	0.1248	0.548859	|********** |

Preliminary MSE 0.1588

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.548859	0.186916	-2.94

Table C.2 Maximum Likelihood Results for the Chinese National Economy, with Data from World Bank

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.79632396	**DFE**	20
MSE	0.03982	**Root MSE**	0.19954
SBC	8.13218711	**AIC**	-0.938671
MAE	0.11550175	**AICC**	4.95606589
MAPE	1.85349675	**HQC**	1.75857067
Log Likelihood	7.46933548	**Regress R-Square**	0.2742
Durbin-Watson	1.0332	**Total R-Square**	0.9562
		Observations	27

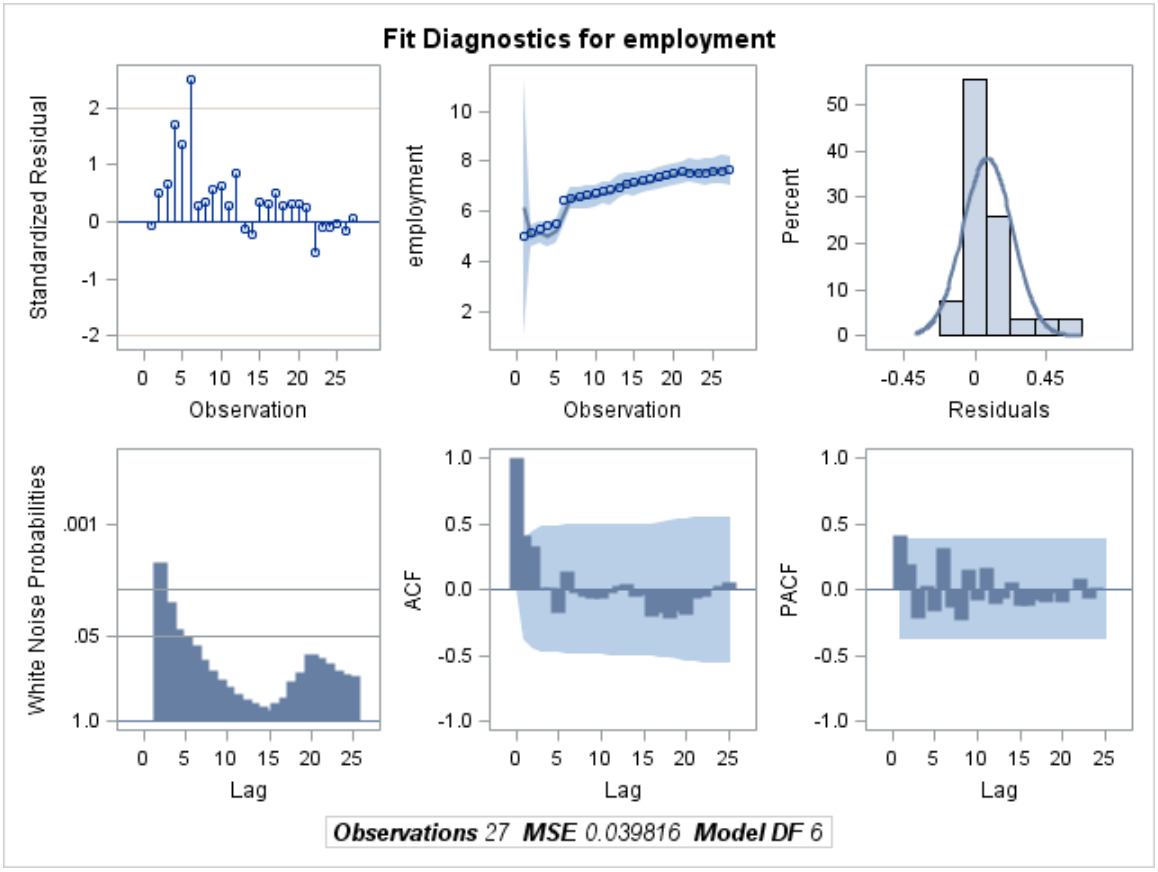
Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	6.3605	2.1291	2.99	0.0073
FDI	1	-0.000033	0.000199	-0.16	0.8706
GDP	1	0.0000220	0.0000540	0.41	0.6879
wage	1	-0.000100	0.000324	-0.31	0.7606
deposit	1	0.0233	0.0340	0.69	0.5001
loan	1	-0.0527	0.0253	-2.08	0.0507
AR1	1	-0.9859	0.0507	-19.46	<.0001

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	6.3605	1.1485	5.54	<.0001
FDI	1	-0.000033	0.000196	-0.17	0.8687
GDP	1	0.0000220	0.0000434	0.51	0.6178
wage	1	-0.000100	0.000288	-0.35	0.7316
deposit	1	0.0233	0.0333	0.70	0.4914
loan	1	-0.0527	0.0253	-2.08	0.0507

Figure C.1 Fit Diagnostics for the Whole Chinese National Economy

The SAS System

The AUTOREG Procedure



APPENDIX D. MODEL ESTIMATES USING GDP-FDI DATA FROM CHINA STATISTICAL YEARBOOK, WITH AGGREGATE GDP (RATHER THAN THE FOUR GDP COMPONENTS SEPARATLEY), BY SECTOR

Table D.1 Ordinary Least Squares Results for the Primary Sector of the Chinese Economy, using GDP-FDI Data

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	0.04483362	**DFE**	11
MSE	0.00408	**Root MSE**	0.06384
SBC	-33.792351	**AIC**	-36.624552
MAE	0.04631128	**AICC**	-32.624552
MAPE	1.45802629	**HQC**	-36.65472
Durbin-Watson	1.6378	**Regress R-Square**	0.9736
		Total R-Square	0.9736

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	3.8518	0.0816	47.20	<.0001
FDI	1	0.0372	0.008339	4.46	0.0010
GDP	1	-0.000145	0.000142	-1.02	0.3318
wage	1	-0.008516	0.0100	-0.85	0.4133

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.00299	1.000000	|**********|
1	0.000132	0.044100	|* |

Preliminary MSE 0.00298

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.044100	0.315920	-0.14

Table D.2 Maximum Likelihood Results for the Primary Sector of the Chinese Economy, using GDP-FDI Data

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.04440654	**DFE**	10
MSE	0.00444	**Root MSE**	0.06664
SBC	-31.195585	**AIC**	-34.735836
MAE	0.04696401	**AICC**	-28.069169
MAPE	1.47603633	**HQC**	-34.773547
Log Likelihood	22.3679178	**Regress R-Square**	0.9642
Durbin-Watson	1.7318	**Total R-Square**	0.9739
		Observations	15

Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	3.8599	0.0878	43.95	<.0001
FDI	1	0.0344	0.009615	3.57	0.0051
GDP	1	-0.000118	0.000147	-0.81	0.4395
wage	1	-0.009767	0.0103	-0.95	0.3642
AR1	1	-0.1782	0.3637	-0.49	0.6346

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	3.8599	0.0878	43.95	<.0001
FDI	1	0.0344	0.009614	3.57	0.0051
GDP	1	-0.000118	0.000143	-0.83	0.4270
wage	1	-0.009767	0.0101	-0.97	0.3546

Figure D.1 Fit Diagnostics for the Primary Sector of the Chinese Economy, using GDP-FDI Data

The SAS System

The AUTOREG Procedure

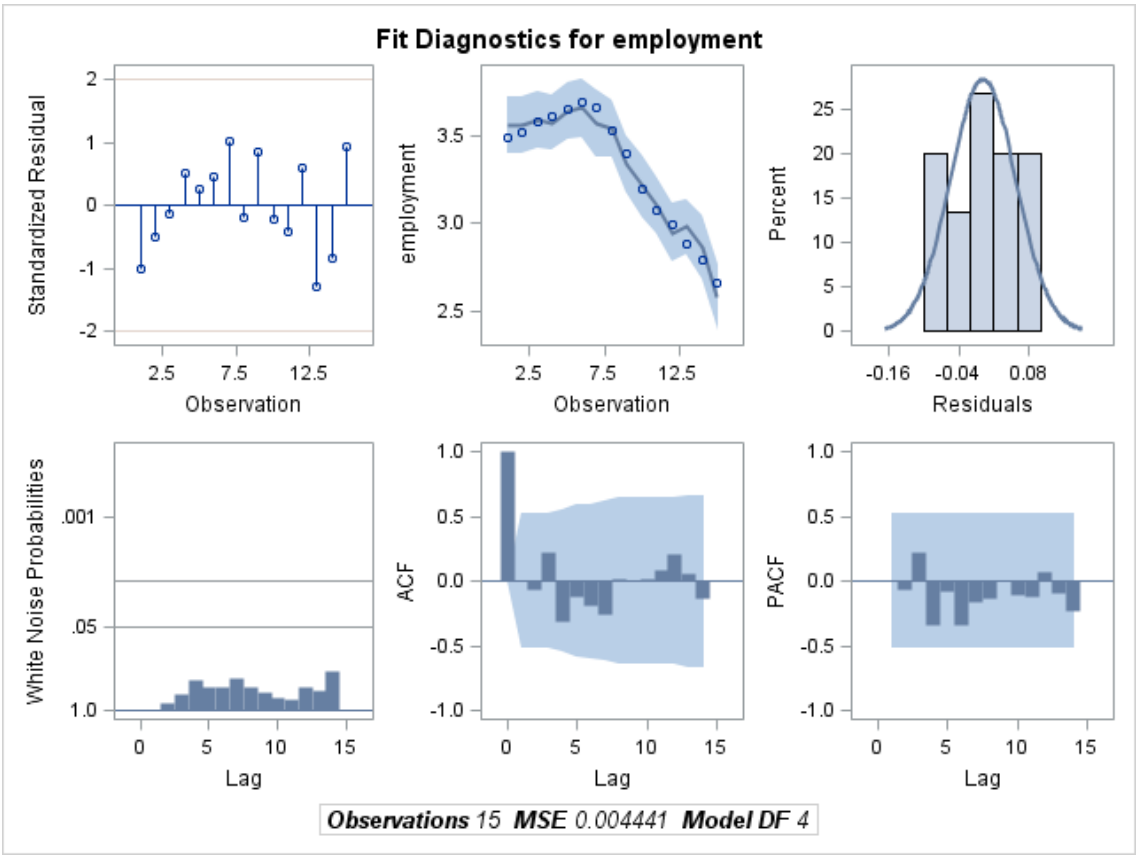


Table D.3 Ordinary Least Squares Results for the Secondary Sector of the Chinese Economy, using GDP-FDI Data

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	0.02639838	**DFE**	11
MSE	0.00240	**Root MSE**	0.04899
SBC	-41.737184	**AIC**	-44.569385
MAE	0.03570269	**AICC**	-40.569385
MAPE	2.04955226	**HQC**	-44.599554
Durbin-Watson	0.8386	**Regress R-Square**	0.9663
		Total R-Square	0.9663

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	1.6900	0.1108	15.25	<.0001
FDI	1	-0.000601	0.000362	-1.66	0.1253
GDP	1	0.0000588	0.0000126	4.67	0.0007
wage	1	-0.000276	0.0000999	-2.76	0.0187

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.00176	1.000000	|**********|
1	0.000878	0.498961	|********** |

Preliminary MSE 0.00132

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.498961	0.274051	-1.82

Table D.4 Maximum Likelihood Results for the Secondary Sector of the Chinese Economy, using GDP-FDI Data

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.01634521	**DFE**	10
MSE	0.00163	**Root MSE**	0.04043
SBC	-45.613716	**AIC**	-49.153967
MAE	0.02850222	**AICC**	-42.4873
MAPE	1.61528937	**HQC**	-49.191678
Log Likelihood	29.5769833	**Regress R-Square**	0.9043
Durbin-Watson	1.4633	**Total R-Square**	0.9791
		Observations	15

Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	1.6947	0.1231	13.77	<.0001
FDI	1	-0.000520	0.000406	-1.28	0.2292
GDP	1	0.0000461	0.0000140	3.29	0.0081
wage	1	-0.000179	0.0000977	-1.83	0.0973
AR1	1	-0.6741	0.2846	-2.37	0.0394

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	1.6947	0.1122	15.10	<.0001
FDI	1	-0.000520	0.000344	-1.51	0.1611
GDP	1	0.0000461	0.0000117	3.95	0.0027
wage	1	-0.000179	0.0000871	-2.05	0.0673

Figure D.2 Fit Diagnostics for the Secondary Sector of the Chinese Economy, using GDP-FDI Data

The SAS System

The AUTOREG Procedure

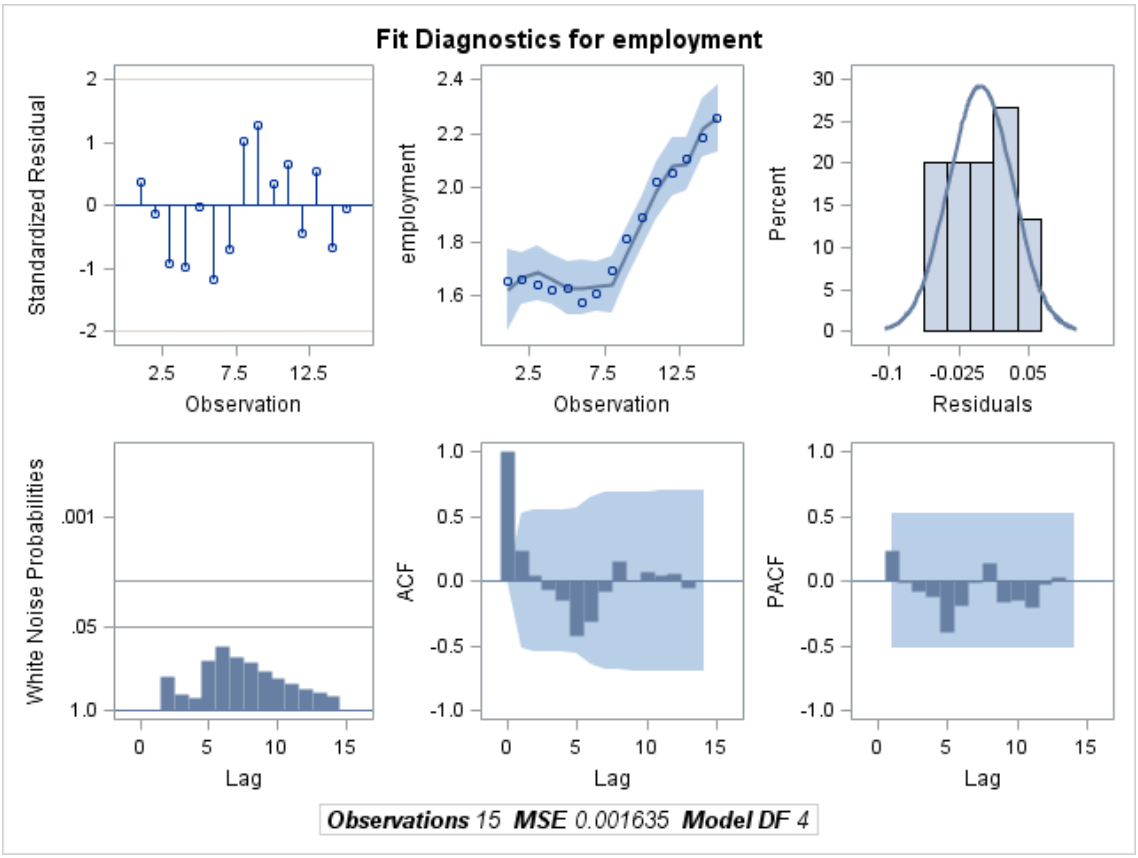


Table D.5 Ordinary Least Squares Results for the Tertiary Sector of the Chinese Economy, using GDP-FDI Data

The AUTOREG Procedure

Dependent Variable employment

The SAS System

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	0.0575544	**DFE**	11
MSE	0.00523	**Root MSE**	0.07233
SBC	-30.045767	**AIC**	-32.877968
MAE	0.05335451	**AICC**	-28.877968
MAPE	2.43408024	**HQC**	-32.908137
Durbin-Watson	0.6232	**Regress R-Square**	0.9516
		Total R-Square	0.9516

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Intercept	1	1.9794	0.0434	45.56	<.0001
FDI	1	-0.003477	0.000792	-4.39	0.0011
GDP	1	0.000312	0.0000879	3.55	0.0046
wage	1	-0.001326	0.000517	-2.56	0.0264

Estimates of Autocorrelations

Lag	Covariance	Correlation	-1 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 1
0	0.00384	1.000000	|**********|
1	0.00241	0.627673	|********** |

Preliminary MSE 0.00233

Estimates of Autoregressive Parameters

Lag	Coefficient	Standard Error	t Value
1	-0.627673	0.246176	-2.55

Table D.6 Maximum Likelihood Results for the Tertiary Sector of the Chinese Economy, using GDP-FDI Data

The SAS System

The AUTOREG Procedure

Maximum Likelihood Estimates			
SSE	0.02062503	**DFE**	10
MSE	0.00206	**Root MSE**	0.04541
SBC	-41.002483	**AIC**	-44.542734
MAE	0.02808998	**AICC**	-37.876067
MAPE	1.28657311	**HQC**	-44.580445
Log Likelihood	27.2713669	**Regress R-Square**	0.7989
Durbin-Watson	0.8079	**Total R-Square**	0.9827
		Observations	15

Parameter Estimates					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	2.0011	0.1522	13.15	<.0001
FDI	1	-0.001925	0.000734	-2.62	0.0256
GDP	1	0.000170	0.0000804	2.11	0.0606
wage	1	-0.000676	0.000421	-1.61	0.1395
AR1	1	-0.9069	0.1899	-4.78	0.0008

Autoregressive parameters assumed given					
Variable	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Intercept	1	2.0011	0.1033	19.38	<.0001
FDI	1	-0.001925	0.000730	-2.64	0.0249
GDP	1	0.000170	0.0000803	2.12	0.0604
wage	1	-0.000676	0.000421	-1.61	0.1395

Figure D.3 Fit Diagnostics for the Tertiary Sector of the Chinese Economy, using GDP-FDI Data

The SAS System

The AUTOREG Procedure