

THE EFFECT OF COMMON CURRENCIES ON TRADE

by

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ABSTRACT

The theory of optimum currency areas states that the more two countries trade with each other, the better candidates they are for a currency union. In terms of the endogeneity argument, convergence follows from joining a currency union and the integration process itself turns the countries into optimal currency areas. The potential increase in trade is regarded as one of the most important benefits of a currency union. Indirect evidence from studies on the effect of exchange rate volatility on trade does not support this claim. Rose argues that the common currency effect on trade is separate from the effect of the elimination of exchange rate variability and finds a large positive effect of a currency union on trade. Although his methodology has met with criticism, most studies find a positive estimate. A meta-analysis of the studies confirms that a common currency has a statistically and economically significant trade-creating effect.

Key terms:

Optimum currency area, currency union, dollarization, trade, exchange rate volatility, gravity model, endogeneity, meta-analysis

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CHAPTER ONE

INTRODUCTION

*'I want the whole of Europe to have one currency;
it will make trading much easier.'*

(Napoleon Bonaparte, 1769-1821)

Surprising as it is, these are not the words of a modern day politician who supported the formation of the European Monetary Union. The quote is in fact centuries old and comes from a letter by Napoleon. The idea that a common currency can have a positive impact on international trade is therefore not new. Yet economists have only started to examine the effect of common currencies on trade directly in the last few years. Napoleon suggested that a single European currency would be beneficial to trade among European countries. The purpose of this dissertation is to find an answer to a broader question that asks whether currency unification in general leads to more international trade. If a common currency fosters trade, decision makers around the world contemplating the adoption of a common currency should take this important benefit into account.

1.1 Background and definitions

A range of different currencies characterizes the international monetary system. The majority of these are based on independent states, but there are also many examples of movement toward multinational currencies, the formation of the European Monetary Union and the creation of the euro being the most important. How many currencies should there be in the world? Is a country by definition an optimal currency area? If the optimal number of currencies is less than the number of existing countries, which countries should form currency areas? The branch of economic theory that traditionally attempted to answer these questions is called the theory of optimum currency areas. An overview of the literature on optimum currency area (OCA) theory will be presented in Chapter 2.

OCA theory was first formulated by Robert Mundell (1961:657) who defines a currency area as the 'domain within which exchange rates are fixed'. However, a

currency area cannot be regarded as synonymous with a system of fixed exchange rates. What Mundell means is an absolutely and irrevocably fixed exchange rate system, and not a system with fixed, but adjustable rates, which was the case under the Bretton Woods System (Bofinger 1994:39). According to most economic textbooks, the definition of a currency area or a monetary union is an area within which exchange rates are permanently and irrevocably fixed and there is complete liberation of capital movements (Presley & Dennis 1976:8; Visser 2000:158). This can be achieved either by maintaining national currencies or by introducing a common currency, in which case it is called a currency union, a full monetary union, or a common currency area. In other words, a currency union is a special case of a monetary union, an area where the different currencies of member countries have been replaced by one common currency (Visser 2000:158). For smaller countries, this set-up usually entails the use of another country's currency, such as the US dollar.

While the traditional theory of optimum currency areas covers both incomplete and full monetary unions, it is more useful to think in terms of a currency union. A common currency seems to be a more permanent arrangement than the simple fixing of exchange rates. If there are separate national currencies, no guarantee can be given that exchange rates are irrevocably fixed. The apparent commitment to fixed exchange rates can readily be broken and the various national currencies are not seen as perfect substitutes. Therefore, a monetary union without a common currency may be subject to speculative attacks and instability when doubts about the irrevocability of the exchange rate arise (Visser 2000:160). In addition, it cannot be assumed that a totally rigid exchange rate system yields exactly the same benefits and costs as a single currency area. Some of the benefits will not be realized unless there is a common currency. Therefore, even though the traditional theory of optimum currency areas allows for the use of separate national currencies, any further reference to a currency area or monetary union in this dissertation will mean a common currency area or full monetary union which includes the use of a common currency, in other words a currency union.

The literature on optimum currency areas addresses two main issues, namely the costs and benefits of joining a monetary union and the characteristics that are

desirable for countries to consider monetary integration. Participating in a currency union has its advantages and disadvantages. On the positive side, a common currency eliminates the transaction costs that are incurred when converting currencies. Besides the direct savings on transaction costs there are also indirect benefits in the form of more price transparency and increased competition. A common currency also eliminates the risk arising from the uncertainty about movements of the exchange rate. This can lead to increased trade. The positive impact of common currencies on trade is an important benefit and comprises the main topic of the dissertation.

On the negative side, the adoption of a common currency implies the loss of independent monetary and exchange rate policy, and the loss of real revenues a government acquires by using newly issued money to finance its expenditure. An OCA is a currency area for which the costs of relinquishing the exchange rate as an instrument of adjustment are less than the benefits of adopting a single currency. A nation facing the option of monetary unification should weigh the costs and the benefits and should only surrender its own currency if the benefits outweigh the costs.

The theory of optimum currency areas identifies a number of criteria that are to be fulfilled for a common currency arrangement to be optimal. Mundell (1961) presented the existence of a high degree of labour mobility as the principal criterion, arguing that perfect factor mobility is a substitute stabilizing mechanism for exchange rates. In practice, however, labour mobility is generally low and unlikely to act as a sufficient adjustment mechanism to asymmetric shocks. Given the absence of factor mobility, Kenen (1969) proposes to use the degree of product diversification as a criterion, while McKinnon (1963) points to the significance of the openness of an economy as a requirement for a currency area. Other criteria that have been suggested include the similarity of inflation rates, the similarity of industrial structures, high cyclical covariation in economic activities and fiscal integration. It should be noted, that in reality, historical, cultural and political factors usually play a more important role in the decision about the formation of currency unions than economic arguments.

The traditional theory of optimum currency areas concentrates on the costs of forming a monetary union, neglecting the benefits, and tends to be rather pessimistic about the possibility for countries to have a common currency at a low cost. Furthermore, the different criteria suggested by OCA theory are difficult or impossible to measure and cannot be ranked or weighted against each other. For these reasons, OCA theory did not receive much attention for decades. However, in the 1990s, plans for the formation of the European Monetary Union rekindled interest in OCAs and efforts have been made to formalize the traditional theory by integrating and comparing the various criteria suggested. The general equilibrium models of optimum currency areas that have been developed provide significant new results. In a formal model, the welfare effects of a currency union can be analysed, not only for its members, but also for regions outside the union. It is found that a currency union can raise the welfare of regions within a union, but it always lowers welfare for the rest of the world (Bayoumi 1994). The idea that a currency union may not be beneficial to those left out has not been considered by the traditional theory, since it viewed optimisation from the point of view of a single nation.

Numerous studies attempt to identify empirically which countries form optimum currency areas. In general, most empirical studies find that the cost of a common currency is too high for most regions considered. However, a country's decision to join a monetary area should consider not just the situation that applies under monetary autonomy, it should also allow for the economic effects of a currency union. The various characteristics embodied in the OCA criteria can change over time. Macroeconomic convergence may itself be encouraged by the adoption of a common currency. Two of the relevant OCA criteria are the intensity of trade with other potential members of the currency union and the extent to which domestic business cycles are correlated with those of other countries. Entry into a currency union may increase international trade, and increased trade integration can lead to increased correlation of business cycles. In this way a country could achieve convergence *ex post*, even if it does not meet the criteria of optimality *ex ante*. Frankel and Rose (1997, 1998) call this the endogeneity of OCA criteria, arguing that instead of being exogenous variables, the different criteria suggested by the theory of OCAs are subject to change following the formation of a currency union.

Real integration can follow monetary integration and the causality between the two works in both ways. Therefore simply looking at historical data gives a misleading picture of a country's suitability for entry into a currency union. The endogeneity of the OCA criteria will be discussed in detail in Chapter 3.

From a theoretical viewpoint, the effect of increased trade integration on the cross-country correlation of business cycle activity is ambiguous. The alternative view is that as trade becomes more highly integrated, countries specialize more in production, and this greater specialization will reduce the correlation of incomes, since supply shocks will be less correlated (Bayoumi & Eichengreen 1994; Eichengreen 1992; Krugman 1993). This view, known as the Krugman specialisation hypothesis, leads to the conclusion that a country might fail the optimum currency area criteria *ex post*, even if it passes them *ex ante*.

In terms of the endogeneity hypothesis the adoption of a common currency reduces trade barriers and the resulting higher trade level synchronizes business cycles across countries, turning a currency union into an optimum currency area. However, the whole endogeneity argument hinges on the impact of the currency union on trade. Without a positive impact, the argument falls apart, whether or not trade leads to cycle correlation (Micco *et al* 2003:318). The first link implied by endogeneity, the effect of common currencies on trade is therefore of vital importance and is the main focus of this dissertation.

1.2 The problem

Advocates of currency unions argue that one of the most certain advantages of adopting a common currency is the increase in international trade. The problem is, that until recently there has not been much supporting evidence in favour of this argument. Conclusions about the trade-creating effect of common currencies have been based on studies investigating the impact of exchange rate volatility on trade. This has been done under the assumption that a currency union has the same effect on trade as the complete elimination of exchange rate volatility. The effect of exchange rate volatility on trade will be investigated in Chapter 4.

While most economists believe that exchange rate volatility reduces the volume of trade across countries, there is an ambiguity about the exact nature of the

relationship, even on a theoretical level. Flexible exchange rate systems imply that economic agents involved in international trade are exposed to exchange rate risk. An increase in exchange rate volatility means higher exchange rate risk and reduced level of trade by risk-averse agents. However, in addition to a substitution effect that will depress the level of trade, increased risk also reduces the expected utility, and exporters might trade more to avoid an extreme reduction in their income. If the income effect outweighs the substitution effect, the end result could be more trade (De Grauwe 1988). For a diversified firm, exchange rate risk is not an extra independent risk but a facet of its total risk, and international transactions can provide opportunities for diversifying risks arising from domestic operations rather than increasing total risk. Therefore, exchange rate uncertainty affects the composition of international trade, rather than its overall volume (Willett 1986).

There is an alternative hypothesis that states that exchange rate uncertainty can have a positive effect on trade. In terms of this hypothesis, changes in exchange rates are not simply a source of risk; they also create opportunities to make profits (Broll & Eckwert 1999; Franke 1991). Although it is theoretically possible that increased exchange rate variability will have a positive effect on trade due to higher profit opportunities, this hypothesis is dependent on the firm's ability to vary its output quickly and at a small cost, which is not a very realistic assumption.

Several studies have attempted to quantify the impact of exchange rate volatility on trade and the empirical results are just as controversial as the predictions of the theoretical models. Most studies fail to find a consistent link between exchange rate volatility and trade, some find a negative, but modest effect, and there are some that find that the relationship is actually positive. A general problem with these empirical studies is that the measures of exchange rate volatility are not necessarily good proxies for exchange rate uncertainty. It is not exchange rate variability but rather unanticipated variability that decreases trade volumes. Ex post measures of exchange rate variability do not necessarily correspond to ex-ante perceptions of unforeseen exchange risk (Brada & Mendez 1988:266).

The main empirical findings support the hypothesis that exchange rate variability does not have a significant impact on trade. Even those studies that confirm a statistically significant negative effect of exchange rate volatility on trade generally

find that the magnitude of the effect is small. Thus volatility studies do not support the argument that the adoption of a common currency will encourage trade between members of a currency union. On the other hand, if sharing a common currency is different from reducing exchange rate volatility to zero then it is wrong to draw conclusions about the desirability of common currencies on the basis of studies investigating exchange rate volatility. It is conceivable that a common currency has a much stronger effect on the volume of trade than the complete elimination of exchange rate volatility. One has to study the effect of currency unions on trade directly in order to be able to judge the desirability of common currencies.

1.3 Hypothesis and methodology

The direct study of the trade effect of common currencies has been initiated by Rose (2000) whose model will be explained in detail in Chapter 5. Rose's estimates suggest that those countries that share a common currency trade three times more than those that have separate currencies. This effect is separate from and additional to the positive, but modest effect of the complete elimination of exchange rate variability. An important finding of Rose's study is that the effects of currency union and volatility on trade are economically distinguishable. The impact of a common currency is significantly larger than the effect of reducing exchange rate volatility to zero. The adoption of a common currency implies a serious commitment by government to long-term integration and a much lower probability of reversal in the future. This could encourage the private sector to engage in more trade. Savings on transaction costs and hedging costs also play a role in increased trade but can only explain a fraction of the effect. Rose (2000:32) admits that a proper explanation of the trade effect of common currencies is lacking but argues that the existing evidence of a huge positive impact should suffice to strengthen the case for a currency union.

Rose's argument is taken as a starting point for further investigation in this dissertation. The hypothesis is that a common currency has a significant positive effect on trade between the adopting countries. If the hypothesis is correct, this has important implications. What is the economic significance of the trade effect of common currencies? Whether a currency union is indeed beneficial to trade is of crucial interest, since increased international trade has a positive effect on income,

as explained by the principle of comparative advantage and economies of scale in specialization. Such arguments suggest that higher trade intensity can induce a one-off improvement in output. More modern theories of trade suggest that an increase in trade might raise the rate of economic growth on a long-term basis. It is argued that increased openness implies more competition, more contact with foreigners fosters innovation, more technological and managerial knowledge, higher productivity, and higher economic growth (Frankel & Rose 2002:444; HM Treasury 2003, par.2.24). To predict the effect of currency unions on income, the estimated effect of currency unions on trade and the estimated effect of trade on growth need to be combined. Frankel and Rose (2002) find that the ultimate growth effect depends on who is adopting what currency. Simply belonging to a currency union is not enough to ensure economic growth; the members need to be natural trading partners.

Rose (2000) answers the question whether countries that share a common currency trade more than others that do not. From a policy perspective, one would rather want to know the impact of a currency union on those countries that adopt it; whether countries trade more with each other as a consequence of joining, and whether leaving a currency union reduces their trade levels. Treating exits from and entries into a currency union symmetrically and comparing trade for a pair of countries before and after the regime change, Glick and Rose (2002) estimate that joining a currency union doubles bilateral trade.

The suggested doubling or even tripling effect of common currencies on trade is implausibly large and highly controversial. Many economists following Rose's work have attempted to overturn his result and shrink the currency union effect on trade. The most common criticism is that most currency union countries in Rose's sample are very small, or poor, or both. Therefore, the estimates are not applicable to the monetary integration plans of major economies such as the European Monetary Union.

Several authors criticise Rose on methodological grounds and suggest various improvements in their quest towards a superior estimation of the currency union effect on trade. These will be discussed in Chapter 6. One of the potential problems is non-random selection. The argument is that the probability that two countries will

adopt a common currency is not random and may depend on some of the explanatory variables, such as the size of the country. Another point of criticism is that the results of gravity trade models are subject to simultaneity bias. Besides currency unions creating trade it is also possible that countries decide to form a currency union because they trade a lot with each other, or both currency unions and high levels of trade are jointly caused by some third factor. In these cases currency union membership becomes an endogenous variable and the trade effect will be biased because of the simultaneity between currency union membership and trade. Estimates of the currency union effect on trade may be further biased by the fact that the models that are used explain bilateral trade through measures of absolute trade costs, while in reality it is relative trade barriers that matter. Incorporating relative trade barriers into the analysis reveals that the adoption of a common currency has more impact on trade for larger countries than in the case of small economies. Furthermore, for countries that already trade a lot, the currency union effect on trade is smaller in percentage terms but their welfare benefit from joining a currency union will be greater (Rose & van Wincoop 2001).

The various studies that attempt to improve on Rose's methodology generally find a much smaller effect than the original estimate of tripled trade, but the effect is still significantly positive in most cases. In an effort to improve the ability to estimate the trade effect of common currencies for major, developed economies, some recent research looks for evidence in the past by extending the data set back to the late 19th and early 20th century when much of the world was tied to gold. While pre-EMU contemporary currency unions comprise mainly small, poor countries, observations on currency unions in the extended data set include economically significant nations. Although most studies find that common currency arrangements a century ago were associated with trade creation similar in magnitude to the Rose effect, it is doubtful whether the historical evidence is relevant to monetary unification in the 21st century.

With the formation of the European Monetary Union and data about its early years becoming available it has become possible to study the currency union effect on trade in contemporary, economically large, developed countries. The studies that have appeared so far on the topic arrive at different estimates but the general

consensus is that the impact of the euro on trade is positive, although much smaller than the estimated impact derived from evidence on other currency unions. The starting date of the EMU is January 1999, when the final irreversible convergence rates into the euro basket were announced. Considering that the samples in the studies only cover the first four years of the monetary union and for the first three years the euro was not even in circulation, the trade effect of the euro, which is in the order of 10 percent, is quite impressive. The timing of the euro effect has also received considerable attention. Various authors emphasize that trade among EMU members increased in anticipation of the currency union (Barr *et al* 2003:584; Micco *et al* 2003:333). The possibility of trade diversion has also been examined and results suggest that the creation of the euro did not have a negative impact on trade between members of the EMU and outsiders (Micco *et al* 2003:334). A comparison of the size of the trade effect across the different members suggests that the impact of the euro is fairly widespread but is generally higher for more advanced economies (Micco *et al* 2003:339).

The qualitative conclusion that a currency union promotes trade has survived the European test but the size of the effect has been considerably reduced. Rose (2004a) attempts to summarize the current state of the debate and to arrive at a single representative estimate of the common currency effect on trade by using meta-analysis, a quantitative method of literature review. Meta-analysis entails including all studies on the topic and treating different point estimates of a given coefficient as individual observations and then estimating the underlying coefficient of interest using this vector of estimates. A significant limitation of the meta-analysis is that all studies are weighted equally, while many of them rely on the same dataset and the number of genuinely independent observations is much lower. Equal weighting also ignores the fact that more recent research on more relevant databases using more sophisticated methodologies has typically yielded lower estimates. Keeping these limitations in mind, the results of the quantitative survey indicate that the hypothesis, that there is no effect of currency union on trade, can be rejected when the results from the individual studies are pooled. The pooled effect is not just positive but economically significant, ranging from 30 to 90 percent (Rose 2004a:13). Rose's meta-analysis of the trade effect of common currencies will be presented in Chapter 7. In addition, Rose's main results are confirmed with a

straightforward version of the meta-analysis. The methodology used relies on simple sorting techniques, measures of locations and box-and-whiskers diagrams. It will be shown that while Rose's qualitative conclusion about the positive effect of common currencies on trade is convincing, the overrepresentation of his own studies in the relevant literature lends a significant upward bias to the overall estimate.

CHAPTER TWO

OPTIMUM CURRENCY AREAS

The economic theory of common currencies goes back to the traditional theory of optimum currency areas initiated by Mundell (1961). This chapter provides an overview of optimum currency area (OCA) theory, starting with the examination of the costs and benefits of adopting a common currency. When a nation relinquishes its national currency and adopts the currency of some wider area it gives up its independence regarding monetary policy. Mundell (1961) asks under which circumstances this cost is minimized and argues that perfect factor mobility is a substitute stabilizing mechanism for exchange rates. After analysing how factor mobility works as an adjustment mechanism in theory, the empirical evidence on international labour mobility is assessed. Numerous other criteria that countries should possess if they are to form an optimal currency area have been suggested and these are discussed in turn. With the advance of modeling techniques there have been attempts to formalize the theory of optimum currency areas. Various general equilibrium models have been constructed with the aim to integrate and compare the different criteria suggested by the traditional OCA theory. The most important theoretical models and some representative examples of the applied OCA literature that try to identify which countries form optimum currency areas are selectively reviewed. The chapter concludes with an evaluation of the usefulness of OCA theory.

2.1 The benefits of a common currency

A common currency has important costs and benefits for the adopting countries, which may arise at the micro or macro level. The benefits accrue mostly at the microeconomic level. A common currency leads to gains in economic efficiency emanating from two main sources, the elimination of transaction costs associated with the exchanging of national currencies and the elimination of risk coming from uncertain future movements of the exchange rate (De Grauwe 2003:60).

2.1.1 The elimination of transaction costs

A common currency eliminates the transaction costs that are incurred when converting currencies. The larger the trade and investment flows between the countries, the greater the gain from reduced transaction costs (Inter-American Development Bank 2002:208). Transaction cost savings benefit businesses as well as tourists, and represent the most visible and easily quantifiable gain from a monetary union. The EC Commission has estimated these gains to members of the European Monetary Union and have found that small, open and less developed economies stand to gain the most, around one percent of their GDP. The gains for the larger EMU members have been estimated around 0.2 percent of national GDP (Emerson *et al* 1992:63). It should be noted that conversion costs do not constitute a pure gain in economic efficiency. When a common currency is introduced, the banks and others involved in foreign exchange transactions experience a loss with the disappearance of commission revenue. However, the gain for the public is greater than the loss of the banks and others because the transaction costs involved in exchanging money are a deadweight loss (De Grauwe 2003:61).

The elimination of transaction costs also leads to an indirect gain in the form of more price transparency (De Grauwe 2003:61). Money does not only serve as a medium of exchange, it also serves as a unit of account. In a currency union there is only one unit of account, which facilitates the comparison of prices and wages across borders. The use of a common currency makes markets more transparent and reduces the cost of processing information, such as bookkeeping (Visser 2000:159). A common currency also reduces the scope for price discrimination between national markets. The direct comparability of prices should also increase competition, which will benefit consumers who will face the same lower prices in the end (De Grauwe 2003:61).

2.1.2 Gains from less uncertainty

A common currency also helps to reduce the uncertainty risk regarding exchange rate movements. Within a currency union nominal exchange rate uncertainty disappears, eliminating intra-area exchange rate risk leading to savings in hedging costs (Mongelli 2002:8). This is an important benefit but difficult to quantify.

Reduced exchange rate volatility reduces the risk premium demanded by investors and therefore encourages investment in the entire area of a currency union. A common currency integrates national financial markets, leading to higher efficiency in the allocation of capital in the union. Large transactions are less likely to cause a price shock in a large union market than in a small national market. In addition, financial assets are more liquid in a currency union (Visser 2000:159). In an enlarged foreign exchange market the volatility of prices and the ability of speculators to influence prices and disrupt the conduct of monetary policy decrease (Tavlas 1993:668).

2.1.3 Other benefits

A further advantage of a common currency is that it can reinforce the discipline and credibility of monetary policy. If a monetary union has been known for maintaining low rates of inflation, then it may be advantageous for a single country to join the union in order to increase the credibility of its monetary policy, leading to lower inflationary expectations, lower inflation rates and lower wage demands (Visser 2000:158). However, the success of a currency union depends heavily on the credibility of the anchor country whose currency has been adopted by others. The formation of a currency union in itself does not guarantee a low inflation rate. The choice of a credible anchor is essential.

Another benefit arising from the adoption of a common currency is that there is no need to hold foreign reserves for intra-area transactions. International reserves can be pooled and invested in higher yielding, less liquid assets (Visser 2000:159).

Finally, the use of a common currency can lead to an increase in international trade. The trade-promoting effect of common currencies can be very significant and much larger than one would expect from the reduced transaction costs and the elimination of exchange rate volatility. It is because the trade argument is an important and much debated benefit of common currencies that it constitutes the focus of the present study.

2.2 The costs of a common currency

While the introduction of a common currency brings numerous benefits, it also has its disadvantages that result in certain costs. A currency union should be introduced when the benefits of the union are greater than the costs. Whereas the benefits of a common currency arise mostly at the microeconomic level, the costs are mostly related to the macroeconomic management of the individual members of the currency union.

2.2.1 Loss of monetary independence and exchange rate policy

The main cost of a common currency is the loss of independence over monetary and exchange rate policy. In a full monetary union the national central banks of the individual member countries either stop to exist or have no real power. When a country gives up its national currency and joins a monetary union it loses an instrument of economic policy. A country that belongs to a monetary union cannot use the exchange rate as an instrument for protecting itself from economic shocks by devaluations and revaluations. It cannot determine the quantity of the national money in circulation, or change the short-term interest rate (De Grauwe 2003:5).

The costs of a common currency are less severe in the case of symmetric shocks affecting all the members of the currency union similarly, when a common policy response would be appropriate. If shocks are asymmetric and affect the members differently, the inability to use the exchange rate to make the necessary adjustments could result in greater volatility in output and employment. Mundell (1961) discusses how exchange rate flexibility operates to adjust for disturbances caused by an asymmetric demand shock in a two-country model. This can be illustrated with the following example. Consider two countries, A and B. Assume that country A specializes mainly in the production of raincoats and country B specializes mainly in the production of sunglasses. The model assumes that wages are rigid in both countries. If in a given year the weather is unusually bad, demand for raincoats is high and the demand for sunglasses is low. Bad weather is an asymmetric shock, since its effect on the economy of country A is the opposite of its effect on country B. Given the specialization pattern of the countries, the result of bad weather is a shift in demand from goods produced in country B to goods produced in country A.

This could lead to higher inflation in country A and more unemployment in country B. If the exchange rate is flexible, the currency of country B will depreciate, leading to an increase in its exports, demand and employment, while the currency of A appreciates. This will later cause a decrease in its exports, and thus lower demand and lower inflation.

If country A and country B form a currency union, the automatic stabilizing mechanism of the exchange rate cannot work. With a common currency the two countries must have the same level of interest rate, so they cannot use the interest rate instrument either. If country A tries to fight inflation by raising the interest rate, country B would also have to increase the interest rate, making the unemployment problem even worse. If country B tries to reduce unemployment by decreasing the interest rate, the same interest rate level would increase inflation in country A. Therefore country A is left with inflation and country B is left with unemployment.

The optimum currency area theory assumes that if a country retains the exchange rate as a policy instrument, its currency will only be devalued when economic considerations warrant the action. In practice devaluations are not necessarily done for the right economic reason and happen more often than warranted. Factors such as political instability can greatly increase the likelihood that a country will devalue its currency. Systematic devaluations can lead to more inflation without an increase in output and employment. They can also cause macroeconomic instability, as future devaluations are going to be expected by economic agents. Currency devaluation is not an instrument that can be used any time and without cost. If used too often, it reduces the credibility of monetary policy. In such a situation a further devaluation of the currency will simply lead to spiralling wage inflation and governments may gain nothing from retaining the exchange rate as a policy instrument (Guillaume & Stasavage 2000). However, devaluations can still be beneficial when countries face major macroeconomic shocks, and relinquishing the exchange rate instrument remains an important cost associated with the formation of a monetary union (De Grauwe 2003:54).

2.2.2 Loss of seignorage

Another cost of joining a monetary union is the loss of seignorage. Seignorage represents the real revenues that a government acquires by using newly issued money to finance its expenditure (Obstfeld & Rogoff 1996:527). It is also called inflation tax. Seignorage is a major source of government revenues only for economies suffering high inflation. Otherwise, seignorage revenues typically amount to less than one percent of national GDP (Emerson *et al* 1992:120), so it is not such an important cost of a monetary union.

2.2.3 Conversion costs

A further important cost of currency unions arises when the common currency is introduced. Conversion costs are more readily quantifiable than the costs associated with the loss of the exchange rate policy tool and can be quite high. If a common currency is introduced, new bills and coins have to be made available and old ones have to be taken out of circulation. Consumers and businesses have to convert their bills and coins into new ones, and convert all prices and wages into the new currency. These changes involve costs as banks and businesses need to update computer software for accounting purposes and update price lists. Vending machines, telephone booths, ticket machines and cash dispensers have to be adapted or replaced. Finally, economic agents have to get used to gathering information and making calculations in the new unit of account (Visser 2000:183).

2.3 Optimum currency area criteria

The traditional theory of optimum currency areas stemmed from the debate on the merits of fixed versus flexible exchange rates and concentrates on identifying the characteristics that are relevant for choosing likely candidates for a currency union. A number of different criteria have been proposed which should be fulfilled for a currency union to be a suitable arrangement. Mundell (1961) defines optimality in terms of ability to stabilize national employment and price levels. An economic region is an optimum currency area when it exhibits characteristics that lead to an automatic removal of both unemployment and inflation.

2.3.1 Factor mobility

Mundell (1961) argues that the existence of a high degree of factor mobility is the principal criterion that should determine the optimality of a currency area. If the degree of factor mobility between two countries is high, then they are good candidates for a currency union, because the mobility of factors provides a substitute for exchange rate flexibility in adjusting for asymmetric demand shocks and a flexible exchange system becomes unnecessary (Mundell 1961:664).

The equilibrating mechanism of perfect labour mobility can be illustrated with the previously used example of country A, specializing in the production of raincoats, and country B, specializing in the production of sunglasses. When workers in the sunglass industry in country B become unemployed because of the lack of demand due to bad weather, they will move to country A where there is an excess demand for labour in the raincoat industry. This will reduce unemployment in country B and the increase in the supply of labour in country A will stop the inflationary pressure on wages in the simple example. The adjustment problem for the two countries will, in principle, disappear automatically if the mobility of labour is sufficiently high.

Although Mundell (1961) suggests factor mobility as the criterion for optimal currency areas, his analysis focuses on labour mobility. As far as capital mobility is concerned, its mitigating effect in the event of payments disequilibria among the members of a monetary union is uncertain. The higher the degree of capital mobility the greater will be the shift in capital flows, but there is no guarantee that these will be of the equilibrating and not of the disequilibrating kind (Fleming 1971:473). On the other hand, the mitigating effect of factor mobility is much more certain in the case of labour mobility. The greater the mobility of labour the greater the extent of the transfer of workers from one country to another and the greater the resulting reduction in unemployment and inflation in the respective countries. However, the transfer of labour from one country to another is likely to be associated with a transfer of workers' expenditure from the countries of emigration to the countries of immigration. This will reduce the stabilizing effect of labour mobility, but it will not eliminate it. Fleming (1971:472) also notes that a transfer of labour caused by a shift in demand is not necessarily justifiable from a structural point of view, and may later have to be reversed. Various authors point out that the migration of labour may

carry high costs (Corden 1972:15; Visser 2000:1167). New homes and infrastructure need to be built in country A, while living conditions deteriorate in country B, which has become depressed. While it is desirable to avoid unemployment, excessive movement of labour out of the country should be avoided.

Numerous empirical studies have been conducted on labour mobility as a possible adjustment mechanism to asymmetric shocks, the majority focusing on Europe and comparing it with the US, assuming that the latter approximates an optimum currency area. Bayoumi and Prasad (1995) investigate the degree of labour market integration for eight US regions and eight EU countries and find that interregional labour mobility appears to be a much more important adjustment mechanism in the United States, which has a more integrated labour market than the EU. De Grauwe and Vanhaverbeke (1993) compare interregional mobility to inter-country mobility across European countries and show that the yearly flow of migrants between countries is less than one tenth of the yearly flow of migrants between regions.

Puhani (1999) estimates the elasticity of migration with respect to changes and unemployment and income for Germany, France and Italy. It is shown that labour mobility is highest in Germany, but even there, the accommodation of a shock to unemployment by migration takes years, therefore labour mobility in Europe is extremely unlikely to act as a sufficient adjustment mechanism to asymmetric shocks. Decressin and Fatás (1995) also find that in Europe migration is only important four years after a shock, and a decline in regional labour demand is met mostly by lower labour-force participation. Buiters (1995) argues that even in the United States inter-state labour mobility does not compensate for the absence of state-level exchange rate flexibility, since it is rather a more permanent or long-term mobility, while the kind of mobility required to compensate fully for the loss of the exchange rate tool is a strictly temporary migration. In general it can be concluded that Western Europe does not meet the OCA criteria of labour mobility, which is hindered by linguistic and cultural differences. However, labour mobility is only one of the possible adjustment mechanisms that can make a currency area optimal.

2.4 Wage and price flexibility

Another automatic equilibrating mechanism in the face of an asymmetric demand shock would be perfect wage and price flexibility. If prices and wages were both entirely flexible, there would be no need for relative exchange rate adjustments in a monetary union. Workers, who become unemployed in the depressed country because of a decrease in demand for the product that they produce, will reduce their wage claims. In the prosperous country where there has been an increase in demand for a product, there will also be an increase in the demand for labour that will push up the equilibrium wage rate. At the same time, this adjustment improves the current account of the depressed country and reduces the current account surplus of the prospering country. However, this is only a theoretical possibility, since in reality wages and prices are not perfectly flexible. Collective bargaining in the labour market and monopoly power in the goods market have significantly reduced the extent to which wages and prices are flexible (Fleming 1971:471).

2.4.1 Openness of the economy

McKinnon (1963) suggests that the most important criterion for the formation of optimum currency areas should be the openness of an economy. He argues that the more open an economy, the greater the need for fixed exchange rates to prevent any price instability caused by exchange rate fluctuations. A corollary of this argument is that a small country will be more inclined to join a currency area, since the smaller the size of the economy, the more open it is likely to be.

The appropriate definition of openness is a major practical problem. McKinnon (1963:717) himself defines openness as the ratio of tradable to non-tradable goods in domestic production and consumption. A tradable good can be either an exportable or importable good. The higher the ratio of tradable goods to non-tradable goods, the more beneficial the formation of a currency area would be. In a relatively open economy flexible exchange rate changes are less effective in curing any trade imbalance. Furthermore, such flexibility is more harmful to domestic price stability in a more open economy. This view has been criticized by Corden (Presley & Dennis 1976:50), who argues that if the cause of price instability emanates from a disturbance abroad, then flexible rates would protect the country from such

disturbances. If this assumption is made, the more open an economy is, the more harmful fixed exchange rates are, which means that McKinnon's argument is turned on its head. If, however, disturbances are assumed to emanate from the domestic economy, McKinnon's argument is valid and openness is a desirable characteristic of an economy wishing to enter a monetary union. The openness criteria will be revisited in Chapter 3 where it is argued that instead of being a precondition, countries become more open as a result of the formation of a currency union, because currency union members tend to trade more.

2.4.2 The degree of product diversification

Kenen (1969) suggests that the suitability of introducing a currency area is a function of the product mix diversity of the economies in question. Highly diversified economies are better candidates for currency areas than less diversified ones. His major argument is that a highly diversified economy can give up exchange rate changes, since it is unlikely to suffer a recession due to a shift in demand away from one product group (Presley & Dennis 1976:60). Although each of its exports may be subject to shocks, the law of large numbers will come into play if the shocks are independent. In a highly diversified economy one can expect both positive and negative shocks and shocks will tend to average out over time. Aggregate exports will be more stable than in an economy less thoroughly diversified.

When an economy experiences a fall in the demand for its principal export, the size of the required change in its real exchange rate depends on the degree of diversification. In a single-product economy, workers who lose their jobs due to a fall in exports will not be able to be absorbed into the economy, and the real exchange rate must change by enough to offset the fall in demand. In a two-product economy, with an export good and an import-competing good, the required change of the exchange rate will be smaller, since depreciation will also stimulate demand for the import-competing good (Kenen 2000:10). Furthermore, the links between external and domestic demand, especially the link between exports and investment, tend to be weaker in a diversified economy. The fall in output and employment caused by a fall in the demand for one of its exports will not be greatly increased by a corresponding fall in total capital formation. Product diversification insulates against a variety of shocks, obviating the need to use the exchange rate.

The problem with the product diversification criterion is that there is no stable solution if applied in practice (Frankel & Rose 1996). If a country is sufficiently diversified to form a currency union with its neighbour, it follows that the larger unit that is created will be even more diversified. This would lead to a further enlargement of the currency union, until the entire world is using one currency. On the other hand, if individual regions are not sufficiently diversified, they should break up into smaller currency units. These smaller units would be even less diversified and would break up into even smaller units, leading to an endless process of dissolution. Therefore no interior solution is an equilibrium.

2.4.3 Similarity of inflation rates

According to Fleming (1971:476) members of optimum currency areas should have roughly similar inflation rates. If the difference in inflation rates between members is substantial for long periods, then fixed exchange rates cannot be maintained. Large differences in inflation rates make a common monetary policy difficult. Circumstances that favour similarity in wage inflation are similar national employment goals, similar rates of productivity growth and similar degree of trade union aggressiveness. Similarity in all of these respects is not necessary; differences in one respect can be offset by differences in another.

Tavlas (1993:673) argues that the time inconsistency issue reverses the ordering between similarity of inflation rates and participation in a currency area, similarity of inflation rate being a desirable outcome and not a precondition of such participation. Since inflation rates are subject to manipulation, they cannot be used as a criterion to decide which countries would make an optimum currency area. Instead, countries wishing to form a monetary union should take measures to reach converging inflation rates. Countries that have the same historical inflation patterns can achieve such convergence relatively easily. In the case of countries with different historical rates of inflation, the convergence of inflation rates can be expected to be more difficult to achieve.

2.4.4 Other criteria

The list of desirable characteristics that prospective currency union members should possess is almost endless. For example, it has been suggested that countries with

similar industrial structures are better candidates for a currency union because they are affected in a similar way by sector specific shocks (Tavlas 1993:667). Furthermore, countries may have different industrial structures, but they will still be good candidates for a currency union if they exhibit high level of business cycle symmetry. High cyclical covariation of economic activities indicates that the countries are likely to experience common economic shocks, and this reduces the significance of exchange rate adjustments (Jonung & Sjöholm 1998:4). Fiscal integration also contributes to the suitability of a common currency arrangement. Fiscal integration between two areas increases their ability to smooth out asymmetric shocks through fiscal transfers from a low unemployment region to a high-unemployment region (Tavlas 1993:667). While it is possible to have a monetary union without political union, fiscal integration usually implies that the members of a currency union also form a political union.

The traditional theory of optimal currency areas defines the ideal economic conditions for monetary integration. In reality, economic conditions are usually not the only factors influencing the decision whether or not a single currency should be introduced. Historical, cultural and political factors also play part in influencing the decision. In fact, Mintz (Jonung & Sjöholm 1998:4) argues that the most important criterion for monetary integration is the political will to integrate. Without a strong political will by the leaders in government and without public support, there would be no real commitment to the currency union, which in turn can lead to the demise of the union. Cohen (2001) verifies the importance of political factors in an empirical study of seven past examples of formal currency unions and finds that political factors dominate over economic ones in successful currency unions. He notes that most work on the theory of OCAs concentrates on economic factors thought to be decisive in a government's selection of an exchange-rate policy at a particular point in time, rather than on conditions that might ensure the durability of a currency union, once made, over time. The evidence suggests that political conditions are most instrumental in determining the durability of commitments to currency unification.

2.5 Formal models of optimum currency areas

The various contributions to the traditional theory of optimum currency areas that have been discussed present verbal arguments for and against monetary integration rather than formal models. The different optimum currency area criteria that have been suggested are difficult or impossible to measure and cannot be formally weighted against each other. In his analysis of the deadlocks in the optimum currency literature, Melitz (1995b:493) emphasized the need for a general equilibrium approach. In the 1990s, plans for the formation of the EMU led to renewed interest in optimum currency areas, and efforts have been made to formalize the basic concepts of the traditional theory and to evaluate their relative importance. Many economists, including Bayoumi (1994), Ricci (1997) and Beine and Docquier (1998) developed general equilibrium models of currency unions, allowing for the various criteria that have been set out in the literature on optimum currency areas to be integrated and compared.

In Bayoumi's (1994) model of optimum currency areas the world is made up of a number of regions, each specializing in a particular good. Each region has a choice between having a separate currency and joining other regions in a currency union. Many of the traditional OCA criteria are incorporated in the model and the choice of a currency union is shown to depend upon the size and correlation of underlying disturbances, labour mobility across regions, the costs of transactions across currencies and the interrelationships between the demand for different goods (Bayoumi 1994:537). The model also provides insight on the welfare effects of currency unions. It is found that a currency union can raise the welfare of regions within a union, but it always lowers welfare for the rest of the world (Bayoumi 1994:552). The reason is that the benefits of the union, in the form of lower transaction costs, are limited to the members of the union, while the costs of the union, in the form of lower output due to the interaction between the common exchange rate and the nominal rigidity, affect both members and non-members. While this result depends on the underlying assumptions of the model, the idea that a currency union may not be beneficial to non-members is an important issue. A further result of the model is that the incentives for a country to join a currency union differ from the incentives to admit a country into a union. New entrants gain

from lower transaction costs on trade with the entire union, whereas members of the existing union only gain on their trade with the new entrants. A small region's incentive to join a union will therefore be greater than the union's incentive to admit the new member. Furthermore, even if a country prefers free-floating exchange rates, it may still have an incentive to join a prospective currency union, because it would be affected by the welfare losses of the union even if it did not join (Bayoumi 1994:552).

Bayoumi's model is an important milestone in the formalization of OCA theory, but it considers only the real aspects of currency areas, such as the correlation of real shocks, labour mobility, openness and diversification. Monetary aspects and their interaction with the real aspects are not analysed in the model. Ricci (1997) attempts the simultaneous analysis of both the real and monetary aspects of the OCA literature and presents a two-country model to investigate the circumstances under which it is beneficial to participate in a currency area. His results are in line with most but not all of the traditional arguments. He finds that the net benefits that a country expects from monetary integration increase with the correlation of real shocks between the two countries, since the exchange rate becomes less useful as an instrument of adjustment. Net benefits also increase with the degree of international labour mobility and the degree of adjustment provided by fiscal transfers, as these substitute for the exchange rate (Ricci 1997:33). Certain factors decrease the net benefits of forming a currency union. One of these is the variability of real shocks, which generate adjustment costs in a currency union. The variability of foreign monetary shocks is another factor that decreases the net benefits, since these can be transmitted to the domestic economy in a currency union. Finally, higher correlation of monetary shocks across countries also decreases the net benefits, since the probability that these shocks neutralize each other is smaller in a currency union (Ricci 1997:33).

The unexpected result of Ricci's study is that the effect of the degree of openness on the net benefits is ambiguous when both monetary and real shocks are accounted for. This is in contrast with the usual argument that more open economies are better candidates for a currency union (McKinnon 1963). According to Ricci's analysis, the effect of the degree of openness on the net benefits differs depending on the

relative importance of the various components of the net benefits (Ricci 1997:32). An increase in openness increases the net benefits arising from the elimination of the deadweight and efficiency losses associated with multiple currencies, since savings on transactions costs are greater in more open economies than in relatively closed ones. On the other hand, an increase in openness also increases the relevance of trade shocks, which reduce the net benefits of a currency union. The larger the adjustment provided by labour mobility and by a fiscal tool, the smaller the negative effect of trade shocks on net benefits. Higher correlation between real shocks across countries also mitigates the negative effect of trade shocks (Ricci 1997:32). Finally, greater openness also increases the relevance of monetary shocks, with uncertain effects. If monetary shocks are negatively correlated across countries, net benefits will increase with greater openness. If monetary shocks are positively correlated across countries, net benefits will only increase if domestic monetary variability is higher than the foreign one, otherwise net benefits will decrease. In other words, the country with higher monetary instability would gain stability from the formation of a currency union, and the more open it is, the more it would gain (Ricci 1997:34).

The important implication of Ricci's (1997) result is that two countries do not necessarily agree on the desirability of creating a given currency union, since their net benefits will tend to differ. It is conceivable therefore that a country intent on forming a currency union with another country will find opposition from the intended partner, if the latter is to gain less from the currency union than its prospective partner. The conditions under which the two countries have the same net benefits are in general too restrictive (Ricci 1997:34).

Both Bayoumi (1994) and Ricci (1997) present a static model of optimum currency areas. This implies that the applicability of the models is limited, since static models cannot analyse changes over time. Beine and Docquier (1998) extend Ricci's model by introducing the intertemporal dimension, thus allowing a more accurate analysis of factor mobility and shock dynamics. If labour mobility is analysed in a dynamic model, then it is possible to account for the time needed to move from one country to another. A dynamic model also makes it possible to distinguish between temporary and permanent shocks. The results of Beine and Docquier's (1998) model are broadly consistent with those obtained by Ricci (1997) but there are some

notable differences. Beine and Docquier (1998:251) find that the cost of a monetary union can increase over time if demand shocks become less symmetric as a result of closer integration. Regarding the effect of the openness of the economy, Beine and Docquier (1998:241) find that it unambiguously increases the desirability of a monetary union. However, their model is a barter one, while Ricci's also includes the monetary aspects, and monetary shocks have been found to have uncertain effects on the net benefits of a monetary union (Ricci 1997:34).

Beine and Docquier (1998) also assess the Mundellian criterion of labour mobility and find that it is an efficient channel of adjustment in the presence of permanent shocks. However, in the presence of temporary random shocks, labour migration is not an efficient adjustment tool. This result stems from the assumption that migrations occur during the period after the decision to migrate is made. The authors conclude that labour mobility is a criterion that can be used to establish whether a geographic zone is close to an OCA, provided that this zone is subject to asymmetric shocks that are permanent and not just temporary (Beine & Docquier 1998:244).

Another notable feature of Beine and Docquier's (1998) model is the estimation of a threshold value for transaction costs above which a currency union becomes desirable. In the presence of fiscal federalism the formation of a monetary union is estimated to be beneficial when transaction costs are higher than 1.2 percent of GDP. On the other hand, without the adjustments provided by the fiscal tool, a monetary union is only desirable if transaction costs exceed 1.6 percent of GDP. The consequences of fiscal federalism are thus found to be highly relevant in the decision concerning the formation of a currency union.

The argument that a currency area may be optimal from the point of view of a single country but may not be optimal from the point of view of its partners, has been taken up by Demopoulos and Yannacopoulos (2001). They criticize the marginalistic approach adopted by Melitz (1995a) that seeks to determine the optimum size of a currency area from the point of view of a single country. The assumption in the marginalistic analysis is that a given country is too small to be an optimal currency area on its own, and it has to be enlarged to reach the optimum size. The optimum size occurs when the welfare function of this particular country

is maximized. The expansion of a given currency area is treated as a continuous variable ranging from zero to one; zero if the currency area does not extend beyond the borders of the country in question, and one if all sources of imports and competition in trade are included in the union (Melitz 1995a:281). The optimal order in which new members are admitted to the union is a central aspect of the problem.

The main drawback of the marginalistic approach is that it cannot be applied in cases where a monetary union results from an agreement of the member parties. The determination of the optimal area of the currency union for the country in question does not necessarily imply that this area is also optimal for its partners. If the partner countries find that the proposed area is not optimal for them, they may refuse to join a currency area in which their benefits are not maximized. In an attempt to account for countries' different benefits, Demopoulos and Yannacopoulos (2001) present an alternative view of an OCA based on cooperative game theory. They start from the assumption that there is a currency area of a given size and try to determine under what conditions this area is optimal. They conclude that a currency area is an OCA if the benefits derived by its members are in the core, meaning that all members are better off with a common currency. It is argued that the existence of the core is independent of the degree of economic similarity of the member countries; therefore the traditional OCA criteria may not constitute a safe policy guide in determining the members of a successful monetary union. It is also found that free factor mobility may strengthen the case for a common currency in the presence of international economies of scale, even if the member countries are structurally dissimilar (Demopoulos & Yannacopoulos 2001:23).

Another recent effort at formalizing the optimum currency area theory is the model by Alesina and Barro (2002) that seeks to determine which countries are most likely to benefit from adopting a foreign currency. They show that the determination of optimal currency areas depends on a number of variables including the sizes of countries, their distances, trading costs and correlations between shocks. It is established that countries with an inability to achieve monetary and price stability on their own stand to benefit from adopting a foreign currency. Monetary integration is also beneficial if the economic disturbances of a country are highly

correlated with those of the potential anchor whose currency is to be adopted. Small countries that are highly dependent on foreign trade or those that are close in distance to potential anchors and therefore could potentially trade a lot with each other could also benefit from a currency union. In summary, the country with the strongest incentive to give up its own currency is a small open economy with a history of high inflation and with a business cycle highly correlated with that of a large, nearby and monetarily stable country with which it is trading heavily. Given these considerations, the most likely currency union will have an anchor country credibly committed to price stability, and this anchor will provide the currency and the monetary policy for the union. The other, client members of the currency union would be small countries close to the anchor, which trade a lot with the anchor (Alesina & Barro 2001:17).

On the basis of this cost-benefit analysis Alesina and Barro try to determine how many currency unions there should be in the world. While they do not mention an exact number, they suggest that as the number of countries increases and their average size decreases, the optimal number of currencies may not only increase less than proportionally, but may even fall. They conclude that the tendency to currency unification is likely to increase as the number of independent countries increases, especially if these new countries are small and heavily dependent on international trade and financial integration. The number of currencies in the world is therefore higher than the optimal number of currency areas (Alesina & Barro 2002: 435).

2.6 Identifying optimum currency areas

The theory of optimum currency areas has often been criticized for having little or no predictive power. The factors that can be used to consider whether or not an area should have a single currency are difficult to measure unambiguously and cannot be formally weighted against each other. Nevertheless, this has not prevented economists from attempting to identify which economies would form optimum currency areas.

Ghosh and Wolf (1994) adopt a continuous approach towards determining optimum currency areas and seek to determine the optimal number of currencies needed for any given country group. They argue that there is no reason to believe that for a

region with n countries the optimal monetary arrangement will be either a single currency or n independent currencies. They find that there is little correlation between geographical proximity and the optimal currency area groupings. If potential monetary unions were restricted to contiguous areas, the cost of adopting a single currency would be prohibitively high for most regions considered. Instead, optimal currency areas in their model are formed by countries that are geographically disconnected.

In contrast to Ghosh and Wolf (1994), Artis, Kohler and Melitz (1998) tend to identify monetary unions more on a geographical basis. They attempt to identify optimum currency areas in the world on the basis of only two of the traditional OCA criteria, high level of bilateral trade and shock symmetry. They disregard labour mobility and fiscal federalism, arguing that “international labour mobility is mainly low, even among close trading partners, and fiscal federalism generally does not exist at all on a supra-national level” (Artis *et al* 1998:539). They also mention the possibility that the trade criterion alone might be sufficient, since the shock symmetry criterion will tend to be met progressively once the monetary union is formed. Based on the trade criterion, they identify four large optimum currency areas. The first is in Western Europe, the second occupies Mesoamerica and part of South America, the third is in the Middle East, and the fourth encompasses the ASEAN area. Adding the criteria of shock symmetry reduces the size of the OCAs considerably, and the results imply, for example, that the European Monetary Union is already too large (Artis *et al* 1998:566). However, if the trade and shock symmetry criteria are endogenous, this judgment could be reversed. The suggested positive correlation between monetary union, bilateral trade intensity and symmetry of output fluctuations will be discussed in more detail in Chapter 3.

Alesina, Barro and Tenreyro (2002) also seek to determine optimum currency areas on a geographical basis. They explore the incentives for different countries to adopt the dollar, the euro or the yen. They find that there appear to be reasonably well-defined, geographically connected dollar and euro areas, but there does not seem to be a yen area. They argue that the differences between their findings and those of Ghosh and Wolf (1994) arise because the latter “do not emphasize the link between currency unions and trade and because they assume a very high cost from imperfect

synchronization of business cycles” (Alesina *et al* 2002: 17). However, a currency union can lead to important trade benefits that can compensate for the loss of monetary autonomy. Since trade costs increase with distance, the trade benefit would be higher in geographically connected currency areas. The potential trade benefit of a currency union is the main focus of this dissertation and its various aspects are investigated in the remaining chapters.

2.7 Conclusion

The traditional theory of optimum currency areas concentrates on identifying those specific characteristics that are relevant for choosing the likely participants in a currency union. These criteria represent a range of economic conditions, among others, the intensity of trade with other potential members of the currency union, and the extent to which domestic business cycles are correlated with those of potential partners. In general, a country’s costs and benefits from joining a currency union depend on how closely integrated its economy is with those of its potential partners. However, most of the criteria are difficult to quantify and cannot be formally weighted against each other. The old theory lacks a formal analysis for the determination of the optimum domain of a currency area. Efforts to formalize the basic concepts of the traditional theory produce general equilibrium models that integrate the various OCA criteria and provide significant results. An important point that emerges is that a currency area may be optimal from the point of view of a single country but may not be optimal from the point of view of its partners. This has important policy implications and cautions against too much optimism regarding the formation of further currency unions in the world. Empirical studies trying to identify optimum currency areas in the world provide inconclusive evidence but are generally pessimistic. The costs of adopting a single currency are too high for most regions. However, the traditional theory of optimum currency areas ignores the possibility that the costs and benefits of participating in a currency union may change over time. If there is a possibility that costs decrease and benefits increase after the formation of a currency union, then instead of asking if a certain area forms an optimum currency area, one should rather ask if a proposed currency union is a feasible currency area. The possibility that OCA criteria are not static but may change over time is discussed in the next chapter.

CHAPTER THREE

THE ENDOGENEITY OF THE OPTIMUM CURRENCY AREA CRITERIA

The causality implied by the traditional theory of optimum currency areas runs from economic integration to monetary integration. The more two countries trade with each other and the more similar their business cycles are, the better candidates they are for a common currency. Empirical studies (see section 2.5) that try to identify optimum currency areas assess the various OCA criteria on the basis of past information. If the analysis of historical data shows that two countries trade little with each other and their business cycles are asymmetric, then they should not form a currency union in terms of OCA theory. The conclusion about the non-optimality of the currency area is based on the assumption that the various OCA criteria are exogenous, unchanging variables. This assumption is challenged by a theoretical development that questions the exogeneity of OCA criteria and the one-way causality between economic integration and monetary union. The emerging argument is that the various characteristics embodied in the OCA criteria can change over time once a currency union has been formed. Trade intensity and business cycle symmetry may increase as a result of the adoption of a common currency. Real integration can follow monetary integration and the relationship between the two is characterized by two-way causality. The purpose of this chapter is to show that the factors by which the optimality of a monetary union is assessed are not static but evolve as a result of the formation of the union.

A naïve examination of historical data gives a misleading picture of a country's suitability for entry into a currency union, since optimum currency area (OCA) criteria are endogenous (Frankel & Rose 1997:754, 1998:1010). Countries that enter a currency union are likely to experience various structural changes. Sharing a common currency may bring countries closer together. Countries that fail the optimality criteria and should not form a currency union in terms of the OCA theory may satisfy the criteria with the passing of time if they go ahead with the formation of the monetary union. The famous Lucas Critique provides the theoretical basis for the argued two-way causality between real and monetary integration (see section

3.1). Most of the endogeneity literature is concerned with two criteria, trade intensity and business cycle correlations. There are two opposing views regarding the exact nature of the endogeneity of these criteria, each supported by relevant empirical studies. The resultant debate together with an attempt to consolidate the seemingly conflicting views is presented in sections 3.2 to 3.5. The possible endogeneity of other OCA criteria is discussed next. Finally, a theoretical model of endogenous optimum currency areas is analysed.

3.1 The Lucas Critique

The argument that the various OCA criteria are endogenous is a straightforward application of the Lucas Critique of inappropriate policy evaluation based on historical evidence only (Lucas 1976:126). The Lucas Critique states that the structure of an economy is endogenous to the economic policies applied to it. Any new economic policy that is introduced will change the rules of the game. If there is a change in economic policy, this will bring structural changes in the economy, change expectations and actual behaviour that govern market supply and demand. Because of these changes it is impossible to forecast the effects of a policy from past evidence.

The Lucas Critique has generally been regarded as ‘a nuisance that plagues all applied empirical research, namely that it has to rely on historical data to predict outcomes in future that fails to obey the *ceteris paribus* clause’ (Schelkle 2001:21). However, the Lucas Critique has considerable relevance for decisions about the formation of new currency unions or the enlargement of present ones. The traditional OCA theory did not distinguish between monetary integration as the fixing of a bilateral exchange rate and the market result of fixing it (Schelkle 2001:21). Policy and policy outcome were regarded as identical, whereas one has to distinguish between the policy, namely the unification of monetary policy, and the outcome of the policy, for example the synchronization of national business cycles. Monetary integration is a fundamental change of the monetary policy regime; therefore it is unwarranted to say that a proposed currency union should not be formed because the area is not an OCA. An important implication of the Lucas Critique is that the listing of OCA criteria to be fulfilled before the formation of a

currency union is pointless (Schelkle 2001:2). The optimality of a currency area can increase as a result of monetary integration.

3.2 The effect of monetary integration on shock symmetry

In Mundell's (1961) classical analysis countries experience an asymmetric demand shock. If these countries are in a currency union, then they cannot use independent monetary and exchange rate policy to deal with such a shock. It follows that the higher the business cycle correlation of two countries the lower the probability of asymmetric demand shocks and the better candidates they are for a currency union. However, in terms of the Lucas Critique, it is reasonable to expect that a currency union will affect the nature and symmetry of shocks that countries face after monetary integration has taken place. Normally it is assumed that the effect of monetary unification on business cycle correlation works via the trade channel. The two main criteria considered in the OCA theory – the extent of trade and the correlation of business cycles are not independent from each other and both are likely to change after monetary integration. Entry into a currency union may increase international trade and increased trade can be expected to affect the nature of national business cycles.

From a theoretical viewpoint, the effect of increased trade integration on the correlation of business cycles across countries is ambiguous. The few economists who have identified the importance of the endogeneity of trade patterns and income correlation are divided on the nature of relationship between the two. There are two opposing views.

The one view is that closer international trade could lead to more symmetric business cycles. The reason is that integration reflects an intensification of intraindustry specialization, which leads to higher diversification of each country's output. As trade links strengthen, income will become more tightly correlated, reducing the impact of industry-specific shocks and thereby increasing the optimality of a monetary union. The other view is that an increase in international trade volumes leads to less symmetric business cycles. Reduced trade barriers can result in increased industrial specialization by country and can lead to more asymmetric business cycles. These two different views are called the endogeneity of

OCA hypothesis and the Krugman specialization hypothesis respectively (Mongelli 2002).

3.3 The endogeneity of OCA hypothesis

The endogeneity of OCA hypothesis is the more generally accepted view about shocks in a monetary union. It is also called ‘The European Commission View’ because it was defended in a report by the Commission (De Grauwe 2003:25). In terms of the endogeneity hypothesis of OCA criteria, stronger trade links and monetary integration synchronize business cycles between countries. Economic integration leads to concentration and agglomeration effects, but with increased market integration national borders become less relevant in influencing the location of economic activities. It becomes more likely that clusters of economic activity overlap borders. Regions may still be affected by asymmetric shocks, but if the region affected transgresses borders, then the countries concerned will be affected in the same way. Therefore the occurrence of asymmetric shocks between countries becomes less likely with economic integration (De Grauwe 2003:25).

The view that business cycles may become more similar across countries when countries trade more and the relevance of this for monetary integration has been highlighted by Frankel and Rose (1997, 1998). They argue that this positive relationship is possible if demand shocks predominate or if intraindustry trade accounts for most trade (Frankel & Rose 1997:754, 1998:1010). The correlation of business cycles is endogenous with respect to trade integration, while trade integration is also affected by monetary integration. Strictly speaking, endogeneity of the optimum currency area criteria could also mean that these criteria change for the worse and render monetary unification less optimal and more costly. However, in all work on the topic endogeneity means that the optimality of the monetary union is increased after its formation, in most cases implying that business cycles become more correlated. This view is known as the endogeneity hypothesis.

Frankel and Rose (1997, 1998) test their more trade – more cycle symmetry hypothesis empirically, using a panel of bilateral trade and business cycle data covering twenty industrialized countries over thirty years. They estimate regressions where the dependent variable is a proxy for the bilateral correlation between real

economic activity in two countries and the explanatory variable is a measure of bilateral trade intensity. The estimates indicate that the effect of greater bilateral trade intensity on the bilateral correlation between real economic activity in a pair of countries is strongly positive and statistically significant (Frankel & Rose 1997:758, 1998:1020).

The evidence that countries with closer trade links have more highly correlated business cycles leads the authors to conclude that a country is more likely to satisfy the criteria for entry into a currency union *ex post*, than *ex ante* (Frankel & Rose 1997:759, 1998:1023). In other words, it is possible that countries that historically do not satisfy the OCA criteria may satisfy the criteria after joining the currency union. The adoption of a common currency encourages trade, which in turn leads to more symmetric business cycles. The cost of giving up independent monetary and exchange rate policy is lower when business cycles are more symmetric. In this way optimality of a currency area can be achieved after its formation.

The endogeneity hypothesis has met with some skepticism. Imbs (1998) questions the findings of Frankel and Rose (1998) and maintains that the claim that more trade leads to more synchronized business cycles needs to be qualified. He argues that the role that foreign trade can play in the synchronization of national business cycles is limited, since both bilateral trade and business cycles may respond simultaneously to omitted, time-invariant factors, which are of a geographic or institutional nature. Even though a fixed exchange rate regime might result in more trade, and thus make a common currency endogenously more desirable, the intensity of bilateral trade will not have any impact on business cycle symmetry. Instead, the main determinants that explain the co-movements of national business cycle indicators are relative economic structures, relative sectoral production patterns and relative total economy incomes (Belke & Heine 2001:8).

In a similar vein, Fidrmuc (2004) re-estimates the specification of Frankel and Rose (1998) using bilateral levels of intraindustry trade between OECD countries in the 1990s. The results suggest that intraindustry trade promotes the convergence of business cycles between trading partners. However, no direct relation between business cycles and trade intensity is found. Although this result seems to confirm the OCA endogeneity hypothesis, since intraindustry trade leads to more business

cycle symmetry, it also highlights the role of structural variables and specialization. It is the particular structure of foreign trade and not the direct effect of bilateral trade that promotes the synchronization of business cycles across countries. Fidrmuc (2004:11) also emphasizes the point that a currency union will only increase cyclical convergence if there is already a sufficient symmetry in the shocks and institutional structure across the countries.

3.3.1 The endogeneity hypothesis and the European Monetary Union

According to Babetski (2003:9), a natural experiment for testing the endogeneity hypothesis would be the case of European Union accession countries (ten of which have in the meantime become members of EU with the view of joining EMU in the near future). In the past decade trade between the EU and the accession countries has significantly increased and many of them have pegged their currencies to the euro. If the endogeneity hypothesis is correct, then levels of shock asymmetries should have decreased between these countries. Babetski (2003) analysis the degree of synchronization of demand and supply shocks between the European Union and the candidate countries and finds that demand shocks have converged, while supply shocks remain asymmetric. Furthermore, an increase in trade intensity is associated with higher symmetry of demand shocks but lower symmetry of supply shocks. Babetski (2003:3, 20) offers the following economic interpretation of his result. The effect of trade on demand shock symmetry is positive, since intraindustry trade accounts for a large share of the trade of candidate countries, while supply shock asymmetry can be viewed as an indication of restructuring, as the process of 'catching up at work'. Productivity gains in accession countries translate into increases in per capita incomes. Higher trade intensity, due to an increase in intraindustry trade, suggests a positive link between trade and restructuring which leads to the observed negative effect of trade on supply shock symmetry. The results also indicate that a decrease in exchange rate volatility is accompanied with higher symmetry of demand shocks. Attempts by some accession countries to fix their currencies to the euro have contributed to the synchronization of demand shocks. The overall results of the study support the endogeneity of OCA criteria hypothesis which states that trade links and monetary integration synchronize business cycles between countries. Babetski (2003:21) concludes that - in terms of

costs associated with shocks asymmetry - entering the EMU would not be so costly for the accession countries.

Some pre-EMU studies also hint at endogeneity, focusing on the change over time in business cycle symmetry across countries. Artis and Zhang (1997) argue that successful fixed exchange rate regimes impose policy disciplines that lead to converging business cycles in participating countries. Looking at the business cycles of countries that participated in the Exchange Rate Mechanism (ERM) of pegging the exchange rates in preparation for full monetary integration and dividing the sample period between a pre- and post-ERM period it is found that ERM members' business cycles have become more similar to the German cycle than to the US cycle since the creation of the ERM. The data clearly indicate the emergence of a European business cycle (Artis & Zhang 1997:14). The nominal exchange rate peg of the ERM agreement and the degree to which these arrangements were credible seem to explain this phenomenon. The authors add an important qualification: the results do not in themselves support an unequivocal causal interpretation. It is also possible that the shift in business cycle affiliation permitted sustained participation in the ERM and not the other way around. They also note that the two interpretations are not mutually exclusive, clearly suggesting the possibility of a two-way relationship between monetary and real integration.

Similar conclusions are reached by Fatás (1997) who uses European regional data on employment to analyse the level of business cycles symmetry within and across countries. By breaking the sample into two sub-periods one can judge the impact of integration and the creation of the European Monetary System. The results show that business cycle correlations across countries tend to increase with the process of integration while there is a clear pattern of decreasing within-border correlations.

The increase in the synchronization of business cycles is usually taken as support for the existence of OCA endogeneity. Darvas and Szapáry (2004) argue that this is not necessarily the case. The authors analyse the evolution of business cycle correlations in the euro zone countries and find clear evidence of increased synchronization in the run-up period to the EMU. At the same time, however, non-EMU countries and even the US and Japan to some extent have also shown greater co-movement with the euro cycle. This result points to the emergence of a world

business cycle. This does not contradict the endogeneity hypothesis, but implies that increased synchronization cannot be unambiguously attributed to monetary integration.

3.3.2 The endogeneity hypothesis and developing countries

A positive link between trade intensity and business cycle correlation would play a crucial role when considering the merits of a currency union between developed countries that do not seem to meet the OCA criteria. However, it is not clear whether the Frankel and Rose (1998) results also apply to developing countries. A study by the Inter-American Development Bank (2002) extends the analysis of Frankel and Rose (1998) to 147 countries in order to analyse the impact of trade integration on business cycle correlation, not only among developed countries, but also among developing countries. The results suggest that the impact of trade integration on business cycle synchronization between two countries is positive and significant for all groups of country pairs, but the effect is much weaker in the case of developing country pairs. More trade does not synchronize the business cycles of developing countries to the extent, that the formation of a currency union would seem warranted if the countries do not pass the optimality criteria *ex ante*.

The weak link between bilateral trade intensity and business cycle correlation in developing countries could be attributed to the fact that trade between these countries is generally of an interindustry nature, as opposed to the largely intraindustry trade between developed countries. The intraindustry trade of developed countries makes cross-country business cycles more similar via the demand channel. The pattern of trade among the countries is therefore important. On the other hand, a monetary union may have an impact on business cycle correlation that bypasses the trade integration channel. A currency union eliminates exchange rate volatility, which in itself can be a determinant of cycle asymmetries (Inter-American Development Bank 2002:228).

Ahumada and Martirena-Mantel (2001) test the endogeneity hypothesis in the context of developing countries in South America. They investigate whether the estimation of the OCA criteria should be considered in isolation by taking into account only historically isolated statistics for the Mercosur regional bloc.

Following Frankel and Rose (1997, 1998) they jointly estimate two traditional OCA criteria, bilateral trade intensity and the degree of business cycle symmetry across countries. The results show weak evidence that more trade fosters more symmetric business cycles, since only for some cases are statistically significant positive estimates found. Furthermore, the effect of higher bilateral trade intensity on the correlation of business cycles is quite different in magnitude across country pairs, which partly explains the lack of highly significant estimates. The exact nature of the endogeneity is uncertain because of the lack of strong evidence, but even the weak evidence allows one to conclude that the OCA criteria are not static but evolve with trade integration. (Ahumada & Martirena-Mantel 2001:16)

3.4 The Krugman specialization hypothesis

There is another way in which the trade-promoting impact of monetary integration could affect the optimality of a currency union. In terms of the alternative view, which is associated with Krugman (1993), it is theoretically possible that as trade becomes more highly integrated, countries specialize more in production, making countries more dissimilar. Greater specialization in goods in which countries have a comparative advantage will reduce the correlation of incomes, since supply shocks will be less correlated.

Krugman (1993:260) argues that the experience of the US suggests that European regions will become increasingly specialized and more susceptible to region-specific shocks, which will be of a predominantly permanent nature. If higher integration leads to regional concentration of industrial activity and more asymmetric shocks, this has important negative implications for the cost of monetary integration. The Krugman specialization hypothesis leads to the conclusion that a country might fail the optimum currency area criteria ex post, even if it passes them ex ante. In other words, a currency union that seems optimal beforehand might become sub-optimal once it is formed (Schelkle 2001:8). There is no guarantee that countries that historically exhibit a high level of business cycle symmetry will not become more dissimilar after they form a currency union.

The problem with Krugman's view is that it implicitly assumes that regional concentration of industrial activity will be confined to separate countries and will

not cross national borders (Horvath & Komarek 2002:16). However, in reality borders are becoming less relevant in influencing the shape of the concentration effects, meaning that asymmetric shocks are not country specific.

There are other authors who investigate the specialization hypothesis, including Bayoumi and Eichengreen (1994:4-5), who maintain that if two economies specialize in sectors that respectively produce and use primary products, the disturbances they experience will be negatively correlated. Eichengreen (1992:14-16) compares the incidence and magnitude of shocks in Europe and the United States and finds that temporary shocks are larger in US regions because of greater regional specialization of manufacturing within the United States. He predicts that regional specialization will increase in Europe with increased integration and this will amplify region-specific shocks, increasing the cost of monetary unification.

The idea that specialization works against monetary unification goes back to Kenen (1969) who emphasized the point that sectoral diversification reduces the cost of a monetary union. In revisiting his original paper, Kenen (2003) cites the empirical evidence of Midelfart-Knarvik, who examined trends in the location of European industries and found that economies are becoming increasingly specialised. Kenen (2003) is of the opinion that the implications of the trade-promoting effects for the size and frequency of industry-specific shocks are at best ambiguous.

3.5 Integrating the endogeneity and the specialization hypothesis

The endogeneity and the specialization hypothesis are at first sight mutually exclusive, since the one claims that more trade will lead to more synchronized business cycles while the other claims that trade integration will reduce the extent of synchronization. It is, however, possible to integrate the two views without negating the validity of either, since they apply to different types of trade.

The effect suggested by Krugman operates via interindustry trade while that proposed by Frankel and Rose applies to intraindustry trade (Kalemli-Ozcan *et al* 2001:109). In their analysis of the economic effects of currency unions, Tenreyro and Barro (2003) find that the effect of currency unions on the degree of output correlation between countries is negative, which is empirical evidence in favour of the specialization hypothesis. The authors argue that the negative effect of currency

unions on the extent of output correlation reflects the positive effect of currency unions on sectoral specialization, which in turn will decrease the extent of correlation. However, they acknowledge that this effect might be different for developed countries forming a currency union. If these countries specialize in the same industries, they will experience similar sectoral shocks and a higher degree of output correlation. In other words, their finding does not invalidate the Frankel and Rose (1998) result, but implies that the endogeneity hypothesis is only relevant to certain countries. The exact effect will depend on whether interindustry or intraindustry trade patterns dominate. If a currency union mainly promotes intraindustry trade, then members' business cycles will become more symmetric and the union can become an OCA endogenously.

Another important point is that trade integration is not the only channel through which specialization patterns can be affected. Kalemli-Ozcan, Sorensen and Yosha (2000) empirically substantiate the claim that economic integration leads to higher specialization in production through better cross-country income insurance facilitated by capital market integration. They also find that higher specialization in production is associated with less symmetry of output fluctuations (Kalemli-Ozcan *et al* 2001:109). The authors emphasize though that there is no contradiction between their empirical findings and those reported by Frankel and Rose (1998), because the mechanism suggested is independent of barriers to trade. If the formation of a monetary union leads to more capital market integration and therefore also to more inter-country risk sharing, then countries will specialize more, which is likely to lead to more asymmetric output shocks (Kalemli-Ozcan *et al* 2000:25). The synchronizing effect of more trade intensity can simultaneously work in the opposite direction and counter-balance the impact of regional specialization.

Kalemli-Ozcan *et al* (2001:130) argue that even the fact that more specialization means more asymmetric output shocks should not be taken as an argument against integration, since it does not imply that income shocks will also be more asymmetric. In fact, these may actually become more symmetric as a consequence of extensive cross-country ownership of productive assets, despite the greater asymmetry of output shocks.

Higher trade intensity increases business cycle symmetry but specialization makes cycles more asymmetric. These opposing effects of economic integration on business cycle symmetry are further integrated by Hoffmann (2003) who suggests that comparative advantage is the driving force for both effects. Comparative advantage drives specialization and increases supply side asymmetry. On the other hand, more specialization also increases international trade, therefore facilitating demand spillovers. In other words, increased specialization will not only decrease the symmetry of the supply component of the business cycles but will also increase the symmetry of demand components. Which of the two effects will dominate and what the net effect on business cycle correlations will be remains an empirical question. Hoffmann provides empirical evidence of this mechanism by analysing forty years' data for OECD countries. He finds that measures of demand side and supply side symmetry are inversely related. Demand side symmetry is positively related to openness whereas supply side symmetry is negatively related to openness (Hoffmann 2003: 18).

3.6 The endogeneity of other OCA criteria

Trade intensity and business cycle correlation occupy a prominent position in the endogeneity literature, but this does not mean that the other OCA criteria are strictly exogenous. On the contrary, virtually all factors that influence the optimality of monetary unification are in turn affected by the existence of such a union.

Based on the original Mundellian theory it is commonly argued that in the absence of interregional fiscal transfer payments the successful stabilization of asymmetric shocks in a monetary union requires either flexible wages or labour mobility, or probably both. However, wages are relatively rigid in reality, and the observed degree of labour mobility is also generally low. Therefore rigid wages and immobile labour stand in the way of successful monetary unions. However, it is conceivable that the degree of labour mobility or wage-price flexibility may respond endogenously to the elimination of currency fluctuations once a monetary union is formed. According to the endogeneity hypothesis, monetary integration could increase the mobility of labour across borders and might lessen the degree of wage rigidity. In the case of the European Monetary Union, increased harmonization of labour regulations could also contribute to this effect (Fukuda 2002:14).

Quirici (2003) has empirically tested the endogeneity of real wage flexibility in a historical context. Specifically, his study investigates whether the onset of monetary union in the US and the Gold Standard in selected countries have made real wages more pro-cyclical. He finds that the Lucas Critique argument applies, so that monetary unions and credibly fixed exchange rate systems might render wages more flexible and substitute for independent monetary policy in macroeconomic adjustments to shocks. Quirici (2003) concludes that the degree of real wage flexibility depends on the nature of the monetary policy regime and that wage formation should not be treated as exogenous.

Another criterion by which to judge the optimality of a prospective currency area is a high level of financial integration. However, the endogeneity hypothesis could also apply to this factor. The formation of a monetary union promotes the integration of capital markets. If financial markets are more integrated, households will diversify their holdings of financial assets to a greater extent and thereby insure themselves against asymmetric shocks (Kenen 2003: 25). This will reduce the cost of monetary unification. It is possible that a currency union that seemed to have too high costs before its formation may become more optimal after the degree of financial integration responded endogenously to the formation of a monetary union.

3.7 A theoretical model of endogenous optimum currency areas

The endogeneity hypothesis is based on the assumption that a monetary union can foster economic convergence and render the union an optimum currency area after it has been formed. Corsetti and Pesenti (2002) take the endogeneity argument even further by suggesting that a monetary union can be self-validating, independent of economic integration. They show that it is still possible for a monetary union to satisfy the optimality criterion ex-post, even if monetary integration fails to boost economic convergence and intraindustry trade.

Corsetti and Pesenti (2002) analyse endogenous optimal monetary unions within a general equilibrium two-country model where national welfare is measured by the utility of each country's representative household. In order to distinguish their theory from the previous trade-related argument for endogenous optimal currency areas, they rule out the possibility of a structural change: each country is perfectly

specialized in the production of one good both before and after the formation of the monetary union.

The model yields two equilibria, which define two self-validating currency regimes. In the first, the private sector chooses pricing strategies that are optimal in a monetary union, presetting prices in consumer currency. Such strategies make a currency area the optimal monetary regime from the policymakers' viewpoint as well, and there is no incentive to pursue independent strategies of national output stabilization. Even if national monetary authorities remained independent they would still choose to implement the same policies. As a result, national outputs become more correlated. The result shows that credible policy commitment to monetary integration may lead to a change in pricing strategies, so that the monetary union becomes the optimal monetary arrangement in a self-validating way. However, the argument for self-validating optimal currency areas could be used in the opposite direction, as an argument for self-validating optimal floating regimes, if the second equilibrium is considered. In this case firms preset prices in domestic currency and let the foreign price adjust according to the law of one price. This implies fully inward-looking monetary policies and low correlation between national outputs, an equilibrium that is inconsistent with fixed exchange rates.

The two corner solutions for exchange rate regimes can be Pareto ranked, the optimal monetary union being inferior in welfare terms. While this is an important result, it is worth emphasizing the main conclusion of Corsetti and Pesenti (2002): the best way to guarantee a credible policy commitment to a monetary union is to have the monetary union itself in place.

3.8 Conclusion

Contrary to the traditional OCA theory that postulates that a high degree of real integration is necessary for a monetary union to be successful, it can be concluded that the causality between economic integration and monetary integration is two-way and mutually reinforcing. The endogeneity argument regarding the optimum currency area criteria states that trade links and monetary integration synchronize business cycles between countries, thus increasing the benefits and reducing the costs of sharing a common currency. The theory of endogeneity has had a

significant impact on OCA theory, as it postulates that countries do not need to meet many of the criteria before integration, convergence will follow from joining and the integration process itself will turn the countries into optimal currency areas. Since it is to be expected that the similarity in a number of the OCA criteria will increase as a consequence of membership in a currency union, the case for common currencies is stronger than previously thought. Although the alternative view that increased trade leads to more asymmetric business cycles cannot be discounted, the empirical evidence is largely but not equivocally in favour of the endogeneity hypothesis that increased trade intensity leads to more symmetric business cycles. However, this issue will not be pursued any further. For the purpose of this dissertation it will be accepted that more trade makes a monetary union more optimal. In the discussion of endogeneity the focus was on the link between trade integration and business cycle synchronization. The rest of the dissertation will explore the first link implied by endogeneity, namely the effect of monetary integration on trade.

CHAPTER FOUR

THE EFFECT OF EXCHANGE RATE VOLATILITY ON TRADE

Proponents of currency unions argue that an increase in trade is one of the few undisputed benefits of adopting a common currency. The problem is that until recently, there has been little evidence supporting this claim. Conclusions regarding the effect of common currencies on trade have been drawn from the literature that examines the effect of exchange rate volatility on trade since it was generally assumed that reducing exchange rate volatility between trading partners to zero was the equivalent of establishing a currency union. Many economists and policymakers firmly believe that exchange rate volatility reduces the volume of international trade. However, empirical studies have not found a consistent link between exchange rate volatility and trade. Such effects have been found to be minimal, at best. Even the predictions of the theoretical models regarding the effect of exchange rate volatility on trade are contradictory. The aim of this chapter is to present a survey of the most important theoretical and empirical contributions to the relevant literature and discuss the most recent findings about the impact of exchange rate volatility on international trade flows.

4.1 Theoretical models of the effect of exchange rate volatility on trade

A flexible exchange rate system implies that economic agents involved in international trade are exposed to exchange risk. Currency or foreign exchange risk concerns the possible impact that fluctuations in exchange rates may have on exporters' income or on importers' commitments payable in foreign currency. When exchange rates show more fluctuation they are said to be volatile. Exchange rate volatility is also often referred to as exchange rate uncertainty, although uncertainty can be high even when volatility is low. Most studies use the terms exchange risk, uncertainty and volatility interchangeably. Intuition and conventional wisdom hold that an increase in exchange rate volatility will reduce the level of trade. However, despite the general belief that exchange risk is an obstacle to international trade, there is a fundamental unresolved ambiguity regarding the effects of volatility in the

theoretical literature. Different models show positive or negative impact depending on the assumptions made.

4.1.1 Risk aversion and risk neutrality

The earliest contributions to the theoretical literature about the impact of exchange rate volatility support the negative hypothesis that volatility dampens trade flows, which is rationalized by the theory of choice under uncertainty. The analysis of the impact of exchange rate uncertainty on trade is based on the assumption that a firm's willingness to engage in international trade depends on its assessment of its long-term profitability. In the simplest trade models, higher exchange risk is expected to increase the uncertainty of profits that can be realized from export sales in foreign currency. Hence, risk-averse exporters will reduce their export supply in the face of increased exchange rate uncertainty.

An early example is provided by Ethier (1973), who develops a model of a risk-averse firm that has to decide how much to import and how much forward exchange cover to take. Assuming perfect advance information about the level of profit at different exchange rates, the volatility of the exchange rate does not influence the volume of trade, only the amount of forward cover obtained. In the absence of such information, however, exchange rate uncertainty will have a negative impact on the level of trade, although the significance of this effect declines the more speculative the firm is.

A similar result is obtained by Clark (1973), who models the decisions of an exporting firm that produces a homogeneous good that is sold entirely abroad. As the variance of exchange rate volatility increases, so does the uncertainty of profitability. When a risk-averse firm faces increasing uncertainty about future exchange rates, it will reduce sales to the level where marginal revenue is actually higher than marginal cost. This is done in order to compensate for the additional risk. Reduced sales lead to a decline in both expected profits and the variance of profits. However, the expected utility of the firm will increase.

The assumption of risk aversion is not sufficient to obtain the result that exchange rate uncertainty reduces trade flows. An increase in risk has both a substitution effect and an income effect. When there is an increase in exchange rate volatility,

the substitution effect will depress the level of trade, since agents will find trading less attractive. Increased risk also reduces the expected utility, and the urge to compensate might lead to an increase in trading activity. De Grauwe (1988) models a competitive producer who must decide between selling in the domestic or foreign market. The producer's reaction to an increase in exchange rate risk will depend on whether the utility function of export income is a convex or concave function of the exchange rate, which in turn depends on the degree of risk aversion. For very risk-averse individuals the income effect might outweigh the substitution effect and they might want to export more to avoid the possibility of a drastic drop in their revenues. The exact impact of exchange rate volatility on trade depends on the properties of the utility function.

It is also possible to produce a model that supports the negative hypothesis without assuming risk-aversion. Demers (1991) assumes risk neutrality for a competitive firm that is uncertain about the demand for its product because of price uncertainty due to exchange rate volatility. Under such uncertainty firms will reduce production levels because of the irreversibility of investment in physical capital, and therefore trade flows will also decrease.

4.1.2 Third country effects and other sources of uncertainty

The simple models that analyse the impact of exchange rate volatility on trade assume that the exchange rate represents the only source of risk to the firm, which is unlikely in practice. For a diversified firm in a multi-country model, exchange rate uncertainty may represent a relatively minor and highly diversifiable risk. Movements in one exchange rate can be offset by movements in other exchange rates or interest rates. Exchange rate risk is not an additional independent risk but a facet of the total risk incurred by the firm. International transactions can provide opportunities for diversifying risks arising from domestic operations rather than increasing total risk. Willett (1986) argues that it is the composition of trade rather than its overall volume that is affected by exchange rate uncertainty. Whether trade flows decrease or not depends on how international risks compare to domestic risks. The similarity of international and domestic risks can be a reason why exchange rate volatility has not been found to have a significant dampening effect on trade.

Perée and Steinherr (1989) suggest that the empirical estimates of the effect of exchange rate volatility on trade may be affected by a third-country effect. When a country has a number of trading partners and exchange rate volatility against the different currencies increases in varying degrees, the increase in the risk of trading is also not the same for all trading partners. Despite the absolute increase in risk, it is possible that the country will divert exports towards the country against which the risk increase is the smallest. In other words, it is not the absolute level of risk that counts, but the relative risk. Perée and Steinherr (1989) suggest that relative risk should be incorporated in the empirical studies.

Similarly, in a multi-country analysis Cushman (1986) shows that differences in bilateral exchange rate risk can lead to trade being deflected away from the countries where exchange rate risk increased the most. Therefore, if only the bilateral exchange rate risk between two countries is taken into account the estimated trade effect can be misleading. Omission of third-country exchange risk is a possible reason why some studies find a positive link between bilateral exchange rate variability and the level of trade.

4.1.3 The role of the invoicing currency

Baron (1976) focuses on how the choice of the invoicing currency affects an exporting firm's production and pricing decisions when exchange rates are volatile and the marketplace is not perfectly competitive. Baron shows that exporting firms will increase prices when the foreign currency is used to invoice goods. When the home currency is used, firms face quantity risk and their response will depend on the properties of the demand curve they face. When demand is linear, the price will decline, thereby increasing demand and decreasing the variance of profits.

The role of the invoicing currency is also investigated by Hooper and Kohlhagen (1978). Their theoretical model of the impact of exchange rate risk on trade prices and volumes takes normal contract leads and payment lags into account, so that variations in future spot exchange rates induce fluctuations in the unhedged profit streams of international traders. They find that if traders are risk averse, an increase in exchange rate risk will unambiguously reduce the volume of trade, regardless of whether the risk is borne by importers or exporters, while the effect on price of

traded goods depends upon who bears the risk. An increase in exchange rate risk will lead to a decrease in trade prices if importers bear the risk, since import demand falls. If exporters bear the risk, the price will rise, as they will charge a higher risk premium.

4.1.4 Hedging opportunities

The negative hypothesis of no effect of exchange rate volatility on trade is based on the simplifying assumption that there are no hedging possibilities. On the other hand, models that take hedging into account and assume the existence of a perfect forward market conclude that the volume of trade is unaffected by volatile exchange rates. Firms, however, may not be able to completely eliminate exchange rate risk if forward markets are not fully developed or if there is uncertainty about the amount of foreign exchange that needs to be covered (Côté 1994:1). In many developing countries traders lack easy access to forward markets and are unable to hedge against exchange risk (Arize *et al* 2000). Hedging long-term exchange risk can be difficult even in developed countries. Forward markets for the major currencies are well developed for periods up to one year, but at horizons longer than that the availability of hedging instruments is less comprehensive (HM Treasury 2003, par.2.7).

Viaene and de Vries (1992) emphasize that even if there are perfect hedging possibilities, the variability of the exchange rate still has an impact on trade flows because it affects the risk premium in the forward exchange market. The authors show that an increase in exchange rate risk has opposite effects on exports and imports. Which side benefits depends on the size of the trade balance, since the equilibrium forward rate is determined by the total supply and demand for foreign currency. Exporters benefit when the trade balance is negative, and importers benefit when it is positive. The trade balance can reverse sign over time; hence the authors argue that it is not surprising that empirical studies fail to find a significant relationship between volatility and trade.

4.1.5 Profit opportunities

There is another strand in the theoretical literature that challenges the view that exchange rate uncertainty is definitely detrimental to trade. According to this

alternative hypothesis, exchange rate volatility could have a positive effect on trade since it can offer higher profit opportunities for exporting firms (Franke 1991; Sercu & Vanhulle 1992). In the basic traditional models firms have to decide the level of production and exports before the exchange rate is known, and inventories are ignored (Côté 1994:8). When these assumptions are relaxed, changes in exchange rates do not simply represent risk, they also create opportunities to make profits. When the exchange rate becomes more variable, the probability of very favourable exchange rates increases, along with the probability of making high profits. The probability of very unfavourable exchange rates also increases, but this does not lead to offsetting losses, since the firm is free to stop exporting (Emerson *et al* 1992:82).

Broll and Eckwert (1999) consider a model of a price-taking, risk-averse firm that can produce a good for sale in the domestic or the foreign market. All prices except the exchange rate are assumed to be certain. The production decision has to be made under exchange rate uncertainty, but the firm is flexible enough to postpone the choice between selling in the foreign market or the domestic market until the exchange rate uncertainty is resolved. The export strategy is like an option that is exercised in favourable conditions. The value of an option increases with its variability, therefore the more variable the exchange rate, the higher the value of the option and the higher the potential gains from international trade. This positive effect on the firm's utility has to be weighed against the negative effects created by greater uncertainty. The net effect of increased exchange risk on the level of trade depends on the firm's attitude towards risk. Broll and Eckwert (1999:183) show that an increase in exchange rate volatility has a positive effect on the volume of production and international trade in economies with low aversion to risk. Hence it is theoretically possible that increased exchange rate variability will have a positive effect on trade.

The hypothesis that higher exchange rate variability creates the opportunity for higher profits is dependent on firms' ability to vary their output quickly and at a relatively small cost. In practice, this assumption may be unrealistic because firms are often bound by existing contracts. It may not be easy to vary output, especially to reduce it below its average level, since it might be necessary to reduce staff. If

the exchange rate is unfavourable and the option to export cannot be exercised, the firm might go out of business, since it may be difficult to expand its domestic market (HM Treasury 2003). If the exchange rate is favourable, it is difficult to imagine that all firms will be able to increase export at the same time. Overall, the proposition that increased exchange rate volatility can be beneficial to trade goes against economic intuition.

4.2 Empirical studies of the effect of exchange rate volatility on trade

Several studies have attempted to quantify the nature and magnitude of the relationship between exchange rate volatility and trade flows. Empirical tests of the hypothesis that exchange rate variability has a negative effect on the level of international trade provide no less confusing results than the theoretical models. Studies often find that the trade effect is of the wrong sign, statistically insignificant, or very weak. Results of the different studies are difficult to compare due to differences in the sample period, the countries investigated and the methodology employed. Empirical results also depend to a large extent on the measure of risk used; therefore the issue of exchange risk measurement has to be addressed before turning to the discussion of the various empirical studies.

4.2.1 Measures of exchange rate volatility

In order to investigate the effect of exchange rate volatility on trade empirically, volatility has to be measured. However, there is no unique way of measuring exchange risk. Most early studies have measured exchange rate volatility using the sample standard deviation method, either the standard deviation of the exchange rate or the standard deviation of the percentage change in the exchange rate. The disadvantages of this method are that it wrongly assumes that the empirical distribution of exchange rate is normal and it cannot differentiate between predictable and unpredictable elements in the exchange rate process, leading to volatility being overstated (Bah & Amusa 2002:13). In an attempt to measure the unanticipated change, some studies use the difference between actual and predicted forward rate. Others utilize a time-series model for exchange risk to account for trends. McKenzie (1999:100) notes that more recent studies give special attention to the specification of the technique by which exchange rate volatility is measured and

have more success in deriving a statistically significant relationship between volatility and trade.

The problem is that the different measures of exchange rate volatility used in empirical studies are not necessarily good proxies for exchange rate uncertainty. The reason is that it is not exchange rate variability but rather unanticipated variability that depresses trade volumes due to higher risk experienced by traders. For example, traders may predict exchange rate fluctuations caused by diverging inflation rates, in which case there would be no effect on trade. In practice, ex post measures of exchange rate variability may only be roughly related to ex-ante perceptions of unforeseen exchange risk (Brada & Mendez 1988:265). Therefore the different variability measures used are unlikely to be good proxies for the dispersion of economic agents' subjective probability distributions of expected exchange rate changes (Willett 1986:S106). Many empirical studies emphasize that the choice of the best measure of volatility is crucial, yet they neglect to properly define the difference between expected and unexpected volatility (Pickard 2003:10).

Sharp increases in exchange rate volatility since the early 1970s appear to have had few adverse effects on trade volumes. In this period international trade has grown faster than world output, just the opposite of what one would expect if increasing exchange rate volatility had a negative impact on trade (Moreno 2000). However, increasing exchange rate volatility does not necessarily imply increasing uncertainty. Exchange rate uncertainty can be high whether exchange rate volatility is high or low, or whether the currency is pegged or floating. In principle, a fixed exchange rate system should mean the elimination of exchange rate risk, but in practice, fixed regimes are vulnerable to sudden collapse. Obstfeld and Rogoff (1995) find that only six economies with open capital markets, in addition to a number of very small economies, maintained fixed exchange rates for longer than five years. While there is no observed exchange rate variability under fixed rates, there is considerable unanticipated exchange risk because there is uncertainty about the timing of devaluation (Brada & Mendez 1988:266). If uncertainty about the sustainability of a fixed exchange rate is a deterrent to trade, then the complete elimination of exchange rate uncertainty and the irreversibility of exchange rate fixing in currency unions can be expected to promote trade. Direct studies

investigating the trade effect of common currencies will be discussed in detail in the remaining chapters of the dissertation.

4.2.2 Empirical results

The empirical literature about the effect of exchange rate volatility on trade is vast. This section presents a survey of the literature and highlights the degree to which the research results are ambiguous.

One of the earliest empirical studies on the impact of exchange rate volatility on trade was done by Hooper and Kohlhagen (1978) who tested their theoretical model (see section 4.1.3) by analysing US and German trade flows for the period 1965 to 1975. The empirical result confirms the finding of their theoretical model that exchange rate risk has a significantly negative impact on the market price where the importers are likely to bear the risk, and a positive impact in cases where the risk is borne by exporters. However, they find absolutely no significant effect of exchange rate risk on the volume of trade, even after experimenting with alternative risk proxies and alternative functional forms of the quantity equation. In their view, the absence of a significant impact of volatility on trade volumes might be attributable to relatively inelastic export supply in the short run, or to substantial hedging by importers and exporters. The conclusion reached by Hooper and Kohlhagen (1978) is representative of the early empirical literature. Along this line, the IMF produced a survey in 1984 and found that the majority of empirical studies failed to establish a systematically significant relationship between measured exchange rate variability and international trade levels (International Monetary Fund 1984:36).

Studies that do find a statistically significant negative impact of exchange rate volatility on trade include De Grauwe and Verfaillie's (1988) investigation of bilateral trade among fifteen industrial countries for the period 1975 to 1985. Estimates from a cross sectional model show that the level of trade is significantly stronger within the European Monetary System (EMS) than outside the EMS. Volatility is estimated to have reduced the growth rate of exports outside the EMS by approximately 9 percent. Focusing on more recent data, Anderton and Skudelny (2001) estimate euro area import demand functions for the period 1989 to 1999. They use pooled data across imports of the individual euro area countries from their

main trading partners, the US, Japan, Denmark, Sweden, the UK and Switzerland. Importers are assumed to use information from the past as well as the current period to assess exchange risk, therefore various moving-average measures of volatility are used as proxies for exchange risk. The panel estimates imply that extra-euro area exchange rate volatility may have decreased extra-euro imports by approximately 10 percent – up to a maximum of 14 percent in the long run. The authors also provide some limited evidence that differences in extra- and intra-area exchange rate volatility lead to substitution between extra- and intra-area imports.

While the majority of studies find an insignificant or a negative relationship between exchange rate volatility and trade, a number of authors present empirical evidence of the alternative hypothesis that exchange rate volatility might be beneficial to trade. Studies which find positive relations include Daly's analysis of bilateral trade between Japan and seven industrialized countries that shows that volatility has a significant positive effect on seven import and five export flows out of fourteen (Flam & Jansson 2000:7). Asseery and Peel (1991) examine the effect of volatility on multilateral export volumes of five industrial countries and find significantly positive relations for all countries except the United Kingdom. Kroner and Lastrapes (1993) also find that an increase in volatility may be associated with an increase in international trade. They find a negative volatility effect only for the United States and the United Kingdom, for the other countries the effect of volatility on trade is found to be positive. McKenzie and Brooks (1997) find a clearly positive association between US-German trade flows and exchange rate volatility.

The above examples illustrate the ambiguity that characterizes the empirical literature on the trade effect of exchange rate volatility. Some studies find no significant effect of volatility on trade, others find a significant negative effect, and some even find a significant positive effect. However, even when the effect is statistically significant, the magnitude of the effect is generally low.

4.2.3 Volatility and trade in developing countries

Results of the different empirical studies may differ depending on the countries under consideration. There is increasing evidence that the volatility-trade link is

significantly negative in developing countries, in contrast to the ambiguous results obtained for industrial countries.

Sauer and Bohara (2001) investigate the differential effect of exchange rate volatility in developing and industrialized countries and find a significant negative relationship for developing economies. In the South African context, Bah and Amusa (2002) examine the impact of exchange rate volatility on South Africa's exports to the United States during the period 1990 to 2001. Estimates indicate that volatility exerts a significant negative effect on exports in both the long and the short run.

Numerous studies investigating trade flows in developing countries provide similar evidence of a negative relationship between volatility and trade flows. The different studies focus on Malaysia, Pakistan, Nigeria and Zambia and all conclude that exchange rate volatility depresses the export volumes in these countries (Bah & Amusa 2002:9). Arize *et al* (2000) look at the export flows of thirteen developing countries and reach similar conclusions. One possible reason for the consistent negative results is the lack of hedging opportunities in developing countries.

4.2.4 Effect of volatility on different sectors

Most empirical studies are based on aggregate data, even though this imposes the assumption that exchange rate volatility has a uniform effect in different sectors. McKenzie (1999) notes that theoretical models predict that firm characteristics and market conditions determine the effect of exchange rate volatility, therefore disaggregated data should be used. A similar conclusion is reached by Côté (1994:23) who suspects that the absence of strong effects is caused by the use of aggregate data and argues that a sectoral approach would be more appropriate. However, both authors emphasize that the lack of such data constrains research. Broll and Eckwert (1999) argue that the fact that no significant negative impact has been found on the aggregate level allows one to assume that industries do exist in the export sector that are able to take advantage of larger exchange rate fluctuations and increase their production. For these industries the volatility-trade link is positive, but they cannot be identified from aggregate data.

An early example of a sectoral approach is a study by Bini-Smaghi (1991) that tests the effect of exchange risk on intra-EMS manufacturing trading for the period 1976 to 1984. The results support the hypothesis that volatility exerts a negative influence on trade. Klein (1990) disaggregates US bilateral exports to seven major industrialized countries into nine categories of traded goods. For five categories the relationship between volatility and trade is found to be positive and statistically significant. In other words, there are certain sectors that are able to take advantage of the profit opportunities offered by greater exchange rate volatility.

A further example of sectoral analysis with mixed results is the study by Bélanger *et al* (1998) that examines trade in several sectors between the United States and Canada. The authors find a significant negative relationship between exchange rate volatility and trade levels in two sectors; automobiles and industrial supplies. For consumer goods and food the effect is positive but not statistically significant. McKenzie (1998) analyses both aggregate and disaggregate sectoral trade data in the Australian economy. His results suggest that the direction and the magnitude of the impact of exchange rate volatility differ between traded good sectors, depending on the characteristics of the specific market. The nature of the relationship, however, remains difficult to establish.

The relevance of investigating trade by sectors rather than in aggregate is further demonstrated by Rapp and Reddy (2000) who focus on United States sector exports to six major industrialized economies. The mix of positive and negative findings shows that different sectors react differently to exchange rate volatility. The sectoral approach is also used in Wang and Barrett's (2002) study of Taiwan's exports to the United States. No significant relationship between expected exchange rate volatility and trade volumes is found, except for the agricultural sector, where volatility reduces the level of trade. In the agricultural sector production decisions precede contracting decisions. Farmers typically decide about land allocation and planting well before they sell their crop forward, therefore the negative effect of exchange rate volatility on trade conforms to expectations.

In a recent sectoral study Pickard (2003) investigates bilateral trade flows of certain steel products between Canada, Mexico and the United States during the period 1996 to 2002. The results indicate that the effects of exchange rate volatility on

trade flows for this sector are small, but they may differ depending on the presence of a well-developed forward market. For the less-developed U.S.-Mexican forward currency market the results indicate predominantly negative, weak correlation between volatility and trade. For the well-developed U.S.-Canadian forward currency market the model results suggest that the relationship between trade and volatility is positive, because increased expected exchange rate volatility presents profit opportunities for traders who engage in risk-portfolio diversification through hedging.

4.2.5 Modern time-series methods

One of the reasons why empirical studies of the relationship between exchange rate volatility on trade find small or insignificant effects is that most early tests relied on time-series data (Frankel & Rose 2002:439). Because of limited data, it is difficult to estimate the impact of exchange rate uncertainty on trade using a time-series approach. Using data on bilateral aggregate U.S. exports to the other G7 countries, Klaassen (2004) finds that export decisions are affected by the exchange rate about one year later. At such a long horizon, exchange rate risk appears fairly constant over time, with only temporary deviations from average risk. This explains why it is problematic to discover the true effect of exchange rate volatility on trade from the limited time-series data that are typically available.

Early time-series studies fail to consider possible non-stationarity of variables, which might partly explain the ambiguous results. Recent developments in econometric methodology allow one to take the non-stationarity of time-series data into account. Some recent studies on the effect of exchange rate volatility have applied cointegration analysis. The advantage of this approach is that a sharper distinction can be made between the short-run and long-run relationships between exchange rate volatility and trade. When the trend properties of the data are accounted for, results of empirical studies are more clear-cut, and most suggest a significant negative relationship between exchange rate volatility and trade (Flam & Jansson 2000:6)

Strictly speaking, a difference can be made between two types of exchange rate variability. One type concerns frequent and non-persistent fluctuations around the

equilibrium level, which is referred to as volatility. The second type concerns less frequent and more persistent departures from the equilibrium level and is called misalignment. The two types of variability create risk for international traders. Sekkat (1997:5) argues that each type of variability is associated with a different type of uncertainty and exerts a different influence on trade. Most early studies concentrated on the impact of volatility, as opposed to misalignment. Sekkat (1997) analyses the impact of both volatility and misalignment on EU trade, testing data for France, Italy, Germany, the United Kingdom and Belgium. He uses cointegration techniques to account for the time-series properties of the data. The results show that the type of variability that has a significant effect on trade differs from country to country. Volatility is found to have affected trade levels significantly in two cases out of five, while misalignment has had a significant impact in four cases (Sekkat 1997:54). Sekkat concludes that misalignment is a structural determinant of trade variables, while exchange rate volatility has only a temporary effect on trade and cannot be responsible for a long-term disequilibrium in the trade balance.

The various studies using cointegration include Koray and Lastrapes (1989) and Lastrapes and Koray (1990) who find a relatively strong and negative long-run relation between exchange rate uncertainty and bilateral imports for five industrialized countries, and a smaller but still significant and negative short-run relation. Flam and Jansson (2000) estimate the effect of exchange rate volatility on trade between member countries before the start of the EMU and find that the long-run relations are mostly negative and in several cases insignificantly different from zero. Fountas and Aristotelous (1999) find a significant negative short-run relationship between exchange rate volatility and export volumes among Germany, France, Italy and the UK. However, they are unable to identify a significant negative effect in the long run. Sukar and Hassan (2001) find a significant negative long-run relationship between United States exports and exchange rate volatility, but in the short run the effect is insignificant.

Arize (1998a, 1998b) provides more convincing evidence for a long-run negative relationship between real exchange rate volatility and import demand. Applying cointegration analysis to United States import data, the major finding is that exchange rate volatility has a short-run and long-run negative effect on import

demand (Arize 1998a). A similar study focusing on eight European countries yields comparable results. Volatility is found to have a significant negative effect on trade for Belgium, Denmark, Finland, France, the Netherlands and Spain. The estimated long-run elasticity of import demand with respect to exchange rate volatility suggests that total real exchange rate stability would increase imports by a maximum of about 15 percent. While this is an impressive result, the fact remains that in the case of Greece and Sweden the effect of volatility on trade is found to be positive and statistically significant (Arize 1998b). The ambiguity about the nature of the relationship between exchange rate volatility and trade is not convincingly resolved.

4.2.6 Exchange rate volatility and the gravity model of trade

From among the great number of volatility studies one group stands out that has had more success in finding a significant negative relationship between exchange rate volatility and trade. Studies in this group are based on cross-sectional and panel data and the gravity model of bilateral trade. It is worthwhile taking a closer look at the gravity model, since not only is it used in various studies to assess the impact of volatility, but it is also the chosen framework used in the analysis of the direct impact of common currencies on trade, which will be the topic of the next chapter.

The gravity model has been widely used in empirical studies in international economics. It is a simple model that explains the size of international trade between countries and has a remarkably consistent history of success. Newton's theory of gravity asserts that the force exerted by two objects is a function of their respective masses and the square of the distance between them. Analogously to the Newtonian equation, the gravity model of trade explains trade between two countries by the combined economic mass (GDP) of the countries and by their geographical distance. The idea is that the larger the economy the more it trades in absolute terms, and the larger the distance between two countries, the less they trade with each other, since distance represents a proxy for transportation cost, which should discourage trade (Dell'Araccia 1999:317).

The first paper to apply a gravity model to the analysis of the trade effect of exchange rate volatility was Abrams (1980), who found a statistically significant

negative impact. Thursby and Thursby (1987) constructed a gravity model to test the Linder hypothesis which postulates that trade of manufactured goods between two countries is inversely related to the difference in the per capita income. The explanatory variables in his model include the mean annual variance of the spot exchange rate around its predicted trend. This model was tested for 17 countries over the period 1974 to 1982. The results show a significant negative relationship between the measure of variability and bilateral trade for ten countries, for both real and nominal measures of exchange risk.

In another gravity model Brada and Mendez (1988) examine the effect of the exchange rate system on the volume of trade during the period 1973 to 1977 with data on 30 developed and developing countries. The authors test whether flexible exchange rates reduce the volume of international trade more than fixed rates do. The unexpected finding is that bilateral trade flows are higher between countries with floating rates than between countries with fixed rates. The authors are careful not to jump to the conclusion that exchange rate volatility is beneficial to trade though. They argue instead that the link between exchange rate regime and trade may not work exclusively through the volatility channel. The exchange rate regime may have an effect on commercial policy, which in turn will influence the level of trade. Even though exchange rate volatility associated with floating rates has a dampening effect on trade, this effect is smaller than that of the restrictive trade policy measures that are often imposed under a system of fixed exchange rates. In other words, the detrimental effect of restrictive trade policies seems to outweigh the beneficial effect of exchange rate certainty on trade in a fixed exchange rate system.

This proposition is supported by historical evidence in a study by Eichengreen and Irwin (1995) who analyse the extent to which trade blocks and currency arrangements were responsible for the changing patterns of trade in the 1930s. The authors estimate a gravity model and find that trade block membership increased trade, exchange rate volatility slightly reduced trade, while being on the gold standard did not have a conclusive role. Any beneficial effects of exchange rate stability were neutralized by trade restrictions.

Frankel and Wei (1993) also use a gravity model to investigate the possibility that the stabilization of exchange rates during the course of the 1980s significantly contributed to the increase in intraregional trade. They uncover a small negative effect of bilateral exchange rate variability on bilateral trade. Specifically, they find that doubling exchange rate volatility in Europe, as it would if it returned from the 1990 level to the 1980 level, would reduce intraregional trade volume by an estimated 0.7 percent.

De Grauwe and Skudelny (2000) use a gravity trade model to measure the effect of exchange rate variability on trade flows within the EU during the period 1962 to 1995. They find a significant negative coefficient for the proxy of exchange rate variability. They explain this with the fact that hedging possibilities are not available in the long run, only in the short run. They also calculate the potential exports that would have materialized under zero exchange rate variability between all countries. The results suggest that the short-term increase in trade due to the elimination of nominal exchange rate variability is lower than 1 percent, which is to be understood as a minimum short-term result. The long-term results would probably be higher.

In another study based on the gravity model of bilateral trade Dell'Araccia (1999) estimates that total exchange rate stability could have increased trade among Western European countries by about 12 percent in 1994. Potential trade impacts are tested with different measures of exchange rate variability, but the choice between nominal or real exchange rate volatility does not seem to matter, the conclusion is the same in both cases. This estimate of 12 percent could be higher than the true impact, due to different forms of bias. There is a possibility that trade may influence exchange rate volatility through exchange rate policy. After controlling for this simultaneity bias, the estimated impact falls to 10 percent. Dell'Araccia also attempts to control for bias due to omitted variables that may determine trade between particular country pairs. Allowing for these country specific fixed effects, the estimated impact of exchange rate volatility falls below 5 percent, but this is still statistically significant.

Pugh (2002) examines the impact of long-term exchange rate variability on bilateral trade between 14 major Western European economies during the period 1984 to

1990 using a gravity model. The sample period was chosen to give the clearest contrast between members and non-members of the Exchange Rate Mechanism of the European Monetary System, with half of the countries under investigation belonging to the ERM. The major finding is that a reduction in exchange rate variability over long periods exerts a positive effect on trade flows. The results suggest that non-ERM countries could have achieved an increase of between 6 and 11 percent in their bilateral trade by shifting to ERM conditions.

4.3 Conclusion

The relationship between exchange rate volatility and levels of international trade is both theoretically and empirically ambiguous. In theory, increased exchange rate volatility might be beneficial to trade if firms are able to take advantage of the increased profit opportunities. However, the majority of the theoretical literature is in favour of the hypothesis that exchange rate volatility is a deterrent to trade. On an empirical level, most studies fail to find a consistent link between exchange rate volatility and trade. Although some find a modest negative effect and others even find a positive effect, the main empirical findings support the hypothesis that exchange rate variability does not have a significant impact on trade. This is bad news for the proponents of currency unions, since their arguments are weakened by this result. The literature does not provide compelling evidence that exchange rate volatility is an obstacle to trade, and by implication, on the basis of volatility studies it cannot be convincingly argued that a single currency will promote trade. However, this conclusion is based on the assumption that the adoption of a common currency is equivalent to the reduction of exchange rate volatility to zero. If this assumption is incorrect, then the true effect of common currencies might be underestimated. The effect of common currencies on trade has to be studied directly in order to be able to judge the desirability of a currency union. The direct study of the currency union effect on trade will be discussed in the remaining chapters.

CHAPTER FIVE

THE ROSE MODEL OF THE COMMON CURRENCY EFFECT ON TRADE

The direct analysis of the effect of common currencies on trade started with the pioneering study by Rose (2000) who found that countries that share a common currency trade three times more than those that do not. This result is known as the Rose effect. In this chapter Rose's model will be discussed in detail, not only because it is the first attempt at a direct analysis of the currency union effect on trade, or for the huge and controversial estimate found, but also because the method used by Rose has become the standard model used by other researchers in this field. Rose (2000) is the standard reference and general point of departure in this recent strand of literature on the currency union effect on trade. After the discussion of Rose's original model the chapter presents attempts to provide a theoretical explanation for the Rose effect (see section 5.2). Next, the border effect in international trade is explained and compared to the Rose effect in section 5.3. The significance of increased trade for economic growth is discussed in section 5.4. Finally, the impact of the dissolution of a currency union on members' trade is investigated.

5.1 Understanding Rose's original model

As it has been shown in Chapter 4, empirical studies have not been able to find major effects of exchange rate volatility on trade. This has led to the general consensus that there is not much trade benefit to be expected from the adoption of common currencies. However, it is possible that the common currency effect on trade is different from the effect that complete exchange rate stability has on trade. If that is the case, conclusions drawn about the desirability of currency unions on the basis of exchange rate volatility studies are misleading. To determine the effect that the adoption of a common currency has on international trade, the direct study of the currency union effect on trade is necessary.

The first paper to tackle the issue of the trade effect of common currencies directly was Rose (2000). In a groundbreaking study, he challenged the view that the gains

to trade through membership of a currency union are modest. He sought to isolate the effects of exchange rate volatility and currency unions on trade and in the process showed that two countries sharing a common currency trade 3.35 times more than they would with different currencies. This 235 percent trade-creating effect of a common currency is additional to the trade-raising effect due to the reduction of exchange-rate variability to zero, which is an obvious result of the use of common currencies.

Rose (2000) exploits a panel of cross-country data drawn from the *World Trade Data Bank* covering bilateral trade between 186 different trading partners at five-year intervals between 1970 and 1990. In this data set, there are over one hundred pairings and three hundred observations, where both countries use the same currency. The word 'country' is not used here in the strictest sense of the word, as trading partners include dependencies, territories, overseas departments and colonies for which there is international trade data.

Rose (2000) uses an augmented gravity model to estimate the effect of currency unions and exchange rate volatility on trade. The gravity model of bilateral trade is based on Newton's theory of gravity and was originally developed by Pöyhönen (1963). In a standard gravity model the dependent variable of the equation is the natural logarithm of the sum of the trade flows between country pairs. The explanatory variables include the natural logarithm of the product of the gross domestic products of the country pair in question and the distance between them. The natural logarithm of the product of their gross domestic products per capita is also included to better represent the combined economic mass.

Rose (2000) augments the standard gravity model by adding several dummy variables to capture trading partners' cultural and historical links that might have an effect on trade levels. The theory behind Rose's augmented gravity model can be formulated as follows. The greater the combined national income of two countries and the smaller the distance between them, the more they will tend to trade with each other. In addition, two countries can be expected to have a higher level of bilateral trade if they share a common land border, if they share a common official language, if they belong to the same free trade area, if they are part of the same nation or share a common colonial past.

The various dummy variables added by Rose are defined as follows. The contiguity dummy is equal to one if two countries have a common land border and zero otherwise. Sharing a border is obviously expected to have a positive effect on trade. The language dummy is equal to one if the trading partners share a common official language, and zero otherwise. The inclusion of this variable represents the fact that language is an important barrier to trade and sharing a common official language accounts for higher trade levels than between otherwise similar country pairs. The importance of trade policy is accounted for by including a dummy that is equal to one if the trading partners in the pair belong to the same free trade area, which would clearly explain part of the trade flows. The same nation dummy is equal to one if two trading partners are part of the same nation, if one is a dependency or political subdivision of the other, or both are dependencies or subdivisions of the same third country. All of these trading units are expected to have higher bilateral trade levels for institutional reasons. There is also a same colonizer dummy, equal to one if both countries were colonies of the same third country after 1945, and a colonial relationship dummy, equal to one if one country colonized the other. In both cases higher trade flows might be found for historical reasons.

Besides adding dummy variables to account for cultural and historical links, Rose (2000) goes one step further and probes the question whether monetary variables might also affect bilateral trade intensity. The key feature of his model is the inclusion of two monetary variables. One is a measure of the volatility of the exchange rate between trading partners, specifically the standard deviation of the first-difference of the monthly natural logarithm of the bilateral nominal exchange rate in the five years preceding the observation. The hypothesis is that exchange rate volatility is a barrier to trade; therefore the coefficient on this variable is expected to be negative. In other words, it is assumed that the more stable the exchange rate between the currencies of the two countries is, the higher their bilateral trade level will be.

The inclusion of a measure of volatility is not radically new, gravity models analyzing the effect of volatility on trade discussed in Chapter 4 also included such measures. The real novelty of Rose's model is the second monetary variable, which is a currency union dummy. The value of this dummy is equal to one if trading

partners share the same currency, and is zero if both have their own separate currencies. If sharing a common currency is not equivalent to zero exchange rate volatility, and a currency union has a trade-creating effect, then the coefficient on this variable is expected to be positive. This is the main hypothesis that Rose tests, whether two countries sharing a common currency tend to trade more than otherwise similar country pairs.

The estimates of Rose's augmented gravity equation are statistically significant and have the expected signs. As far as the standard components of the gravity equation are concerned, both higher GDP and higher GDP per capita increase trade, while greater distance between countries is associated with lower trade levels. The magnitude of these gravity effects is similar to existing estimates. The contiguity, language, free trade area, same nation, same colonizer and colonial relationship dummies all have statistically and economically significant positive coefficients, consistent with intuition.

Rose's main result, however, concerns the statistical significance and large economic size of the coefficient for the currency union dummy, which is around 1.21. In order to obtain the trade effect of currency union, the coefficient needs to be transformed, since bilateral trade is measured in logs. Since $\exp(1.21) = 3.35$, this implies that two countries that share a common currency trade over three times as much as do otherwise similar countries with different currencies (Rose 2000:17). Rose performed extensive sensitivity checks. He found that his results are robust to changes in sample of countries, the definition of a common currency, the measure of exchange rate volatility, the measure of distance, plus inclusion of possibly omitted variables and the use of different estimation techniques. Still, the estimated 235 percent trade-creating effect seems implausibly large, and even Rose (2000:32) warns that it should not be taken too literally. Since many of the countries in Rose's sample are small, poor, or both, any extrapolation of the results to EMU may be inappropriate (Rose 2000:15). Nevertheless, Rose's result is compelling evidence that a currency union has a strong effect on trade.

In contrast to the large value obtained for the coefficient for the currency union dummy, the estimated coefficient on the exchange rate volatility variable is small, although statistically significant. The estimate shows that hypothetically reducing

exchange rate volatility to zero percent would increase trade by 13 percent only. Rose (2000:17) concludes that in contrast with most of the existing literature that presumes that a common currency is equivalent to reducing exchange rate volatility to zero, it is clearly not the case. This conclusion is important since it implies that the volatility studies discussed in Chapter 4 underestimate the trade effect of common currencies. The effects of currency union and volatility are economically distinguishable. Sharing a common currency has an impact on trade that is over an order of magnitude larger than the effect of reducing exchange rate volatility to zero.

Parsley and Wei (2001) reach similar conclusions about the differential effect of reduced exchange rate volatility and a common currency. In their study of the effect of currency volatility on goods market integration, they make a conceptual distinction between an instrumental versus institutional stabilization of the exchange rate. Instrumental stabilisation refers to reducing volatility through intervention in the foreign exchange market or via monetary policies. Institutional stabilization refers to reducing volatility through establishing a currency board, dollarization or adopting a common currency. The authors find that reducing nominal exchange rate variability reduces relative price variability. Goods market integration increases over time and is inversely related to exchange rate variability. If the method used to reduce variability is of an institutional type, then the stimulus to goods market integration is much greater than in the case of instrumental stabilization. In other words, the impact of a common currency goes far beyond the impact of merely reducing exchange rate volatility to zero.

5.2 Theoretical foundations of the Rose effect

The studies of Rose (2000) and Parsley and Wei (2001) confirm that drawing conclusions about the effect of common currencies based on studies on the effect of exchange rate volatility is unwarranted. Rose's empirical results indicate that there is good reason to believe that common currencies can provide greater stimulus to international trade than merely reducing exchange rate volatility to zero via an instrumental stabilization. Having accepted that a common currency encourages trade, one needs to ask why.

Three mechanisms are usually suggested by which the adoption of a single currency might be expected to increase bilateral trade among the members: reduced exchange rate uncertainty, reduced transaction costs and heightened competition through increased price and cost transparency (HM Treasury 2003, par.2.3) In terms of Rose's (2000) model, reduced exchange rate uncertainty falls away as a candidate to explain the Rose effect, since the very essence of the study was to separate the exchange rate effect from the common currency effect. The effect of reduced exchange rate uncertainty is additional to the Rose effect. Reduced transaction costs definitely play a role in increased trade, however, the estimated potential savings in transaction costs through elimination of national currencies have been estimated at less than 1 percent of GDP (Emerson *et al* 1992:21). Savings like that could not possibly account for the huge increase in trade suggested. Finally, the significance of increased price and cost transparency is also uncertain.

Although Rose does not provide a specific reason, why sharing a common currency has such a big effect on trade, he does mention some possibilities in the way of a tentative explanation (Rose 2000:32). First, a common currency represents a serious commitment by government to long-term integration. The adoption of a common currency implies a greater degree of commitment and a much lower probability of reversal in the future. This could encourage the private sector to engage in more international trade. Second, sharing a common currency provides the obvious benefit of foregoing the cost of hedging exchange rate risk. Although the cost of hedging seems to be low, it is possible that hedging exchange rate risk is not as simple as commonly believed. Third, a common currency could lead to greater financial integration, which would in turn stimulate international trade in goods and services. More generally, as recognized by Mundell (1961:662), the more widely a currency is used the greater its usefulness and the more it facilitates trade. While all these factors may play a role, according to Rose (2000:32) it is wisest to conclude that we simply do not know why a common currency encourages trade. The evidence that it does so, and that the impact is huge, should suffice to strengthen the case for a common currency.

Rose's controversial result gave rise to a whole new strand of economic literature, with numerous economists investigating the trade effect of common currencies. The

majority of the currency union literature has an empirical focus and is not explicitly grounded in theory (Smith 2002:3). A notable exception is the study by Baldwin and Taglioni (2004) who attempt to provide a theoretical explanation of the Rose effect. The authors argue that the Rose effect is nothing more than a convex relation between volatility and trade. Rose (2000) finds that the volatility term is negative and the currency union dummy is positive in his model. This implies a simple form of convexity. Reduced volatility increases trade in a log-linear fashion right up to zero volatility and an extra increase in trade only appears when the volatility reaches zero. In other words, the linear volatility term predicts a steady increase in the log volume of trade and the currency union dummy predicts a jump in trade just as volatility reaches zero. Baldwin and Taglioni (2004) suggest that there are two sources of this convexity. First, a reduction in volatility induces existing firms to export more since exporting becomes a less risky business. Second, a reduction in volatility induces more firms to begin exporting. Volatility is a greater hindrance to exports for small firms than large firms, so reduced volatility especially promotes small firms' exports. Given that most firms are small, the extra exports induced by a marginal reduction in volatility may increase as the level of volatility falls. This can account for the convexity of the trade-volatility link implied by the Rose effect.

5.3 Border effect versus Rose effect

Rose's (2000) results suggest that the existence of separate national currencies is a significant barrier to trade. At the same time, a number of studies have shown that there is a clear tendency to trade much more within countries rather than across borders because national borders inhibit economic integration. This phenomenon is referred to as the border effect or the home bias in trade. The home bias has received much attention because it cannot be easily explained by geographic, linguistic or trade policy variables. The question that arises is whether the Rose effect could explain the home bias, since one of the possible explanations for the large border effect is the existence of separate national currencies. Therefore it is worthwhile to take a closer look at the home bias puzzle in the context of an investigation of the trade effect of common currencies. If Rose (2000) is right, and the impact of common currencies on trade is indeed large, then a large part of the home bias in trade is explained by his results.

The first study to report a strong border effect on trade was McCallum (1995). He investigated the trading patterns of US states and Canadian provinces using a gravity model of bilateral trade and data for 1988. He specified a particularly simple equation with the log of bilateral trade as the dependent variable and only three regressors: log GDP of the trading regions, the log of the distance between them and a dummy variable indicating whether the trade flows were interprovincial or between a US state and a Canadian province. He found that Canadian provinces trade more than twenty times more with other provinces than with US states of comparable economic size and distance (McCallum 1995:616). The magnitude of this result is far above expectations.

Nitsch (2000) applies a similar methodology in his analysis of the border effect in Europe. According to his estimates, an average EU country purchases seven times more from domestic producers than from equally distant foreign ones. He finds significant regional variations in the size of the home bias, ranging between 1.8 for the Netherlands and 68 for Portugal. Another study by Head and Mayer (2000) estimates the border effect for EU countries as 14 on average.

Anderson and van Wincoop (2001) provide a critique of the methodology used in the above studies. They argue that trade between two regions depends on their bilateral trade barrier relative to the average barrier of the two regions to trade with all their partners. Anderson and van Wincoop (2001) call this average barrier the multilateral trade resistance. McCallum (1995) and other subsequent studies based on the same methodology did not include multilateral resistance variables and this imparts a significant upward bias in the estimate of the size of the border effect. The inclusion of multilateral resistance terms causes the estimate of the home bias for Canada to fall under 11, but even that is surprisingly large. The other reason why McCallum's estimate of the home bias is so large is that the Canadian economy is relatively small. Any barrier between Canada and the US means a considerable reduction in the relative cost of trade between regions within Canada, because average trade costs are higher for nearly all other trading partners. Because of the larger size of the US economy, the same barrier has less impact on its multilateral resistance and trade between states is less affected. In fact, re-estimating McCallum's regression with US data, it is found that trade between US states is

only 1.5 times greater than trade between US and Canada. Applying their approach to 1993 data, Anderson and van Wincoop (2001) find that national borders reduce trade between the US and Canada by 44 percent, while reducing trade among other industrialized countries by 29 percent.

Although the estimates show large variation, it is clear that the border effect is large. The general consensus is that internal trade is disproportionately large compared to international trade. Explanations are not easily found, in fact, Obstfeld and Rogoff (2000) pose the huge home bias as one of their six puzzles of open economy macroeconomics. The existence of different legal frameworks across countries and advertising tools operating primarily at a national level have been offered as probable explanations why integration is so much higher between provinces of a country than between countries (HM Treasury 2003, par.5.5). The more obvious explanation is the fact that provinces share a common currency while trade across international borders usually involves trade between different currencies. To see how much of the home bias is due to separate currencies, the impact of a currency union needs to be estimated directly.

Rose and Engel (2002) test the hypothesis that the large size of the border effect is mostly the consequence of having different national currencies. Specifically, the authors ask whether countries that make up a currency union are as integrated as regions within nations. They follow Rose (2000) in the specification of the gravity equation and estimate it using 1995 data from the *World Trade Data Bank*. The results are similar to that of Rose (2000), and suggest that trade is three times as intense for members of a currency union than for countries with their own currencies. While this estimate seems provocatively high, the authors point out that it is small compared with the size of the home bias in international trade discussed above. Similar conclusions are reached by de Sousa and Lochard (2003) based on evidence from the CFA Franc zone in West and Central Africa. They find a positive impact of currency unions on trade, but the border effect remains large even after controlling for the currency union effect. Other factors, including tariff and non-tariff barriers to trade, heterogeneous levels of development or informal institutions seem to matter much more in explaining the extent of trade. This is taken as

evidence for the desirability of promoting economic integration before the adoption of a single currency.

Rose and Engel (2002) and de Sousa and Lochard (2003) find that members of common currency areas trade less among each other than regions of individual countries. Although membership in a common currency area does increase trade, it does not increase it nearly enough for common currency areas to resemble countries. In other words, the border effect is much larger than the currency union effect and there is a sharp distinction between the regions of a single country and nations forming a monetary union. It seems that external constraint disappears completely between regions but might survive between nations forming a monetary union, despite the use of a common currency. Flandreau and Maurel (2001) note, that ironically, the survival of barriers to integration would be a reason why monetary unions could be more stable: because of the relatively moderate integration specialization will not be extreme and therefore the countries are more likely to stay together. In conclusion, members of currency unions are more integrated than countries with their own currencies, but less integrated than regions within a country. The common currency effect on trade therefore provides only a partial explanation of the home bias in international trade.

5.4 Economic growth and the Rose effect

The Rose effect implies that the adoption of a common currency dramatically increases the volume of trade. If Rose's (2000) estimates are correct, this has important implications for the potential welfare of countries contemplating monetary unification, since increased international trade has a positive effect on the level of real income. The proposition that more trade leads to more income derives from the principle of comparative advantage of classical trade theory origin. Furthermore, new trade theories emphasize the role of economies of scale in specialization and the promotion of intraindustry trade. Such arguments suggest that higher trade intensity can induce a one-off improvement in output but do not imply continuous improvement in economic growth. However, there are a number of other channels through which an increase in trade might raise the rate of economic growth on a long-term basis. For example, increased openness implies increased competition, which can lead to more economic activity. Intensive interaction with

foreigners also encourages innovation and the adoption of new ideas, resulting in more technological and managerial knowledge, higher productivity, and ultimately higher economic growth (Frankel & Rose 2002:444; HM Treasury 2003, par.2.24).

Numerous empirical studies have attempted to quantify the relationship between trade and income and most of them confirm a positive statistical association between trade and the performance of the economy in the long run, even after holding constant for other important determinants of economic growth (Rodrik 1993).

Frankel and Rose (2002) provide evidence for the argument that currency unions improve income and maintain that the resulting economic growth is due to increased trade among the currency union members. Trade is good for growth, both in theory and according to statistical evidence, and this is also true for trade due to the use of common currencies. The authors quantify the implications of currency unions for trade and income on the basis of a panel data set including observations at five-year intervals from 1970 through 1990, in other words, the study is based on the combined data set of Rose (2000) and Rose and Engel (2002).

In the first stage of their analysis Frankel and Rose (2002) estimate the effect of common currencies on bilateral trade using the gravity model of trade. The specification of their equation differs only slightly from Rose's (2000) original model in that they define two separate dummy variables to correspond to different types of common currency arrangements; a currency union dummy and a currency board dummy. The estimates of the currency union and currency board coefficients are positive, statistically significant and large. Although there is no undeniable theoretical reason why the effect of currency boards should be exactly the same as that of currency union, the coefficients of the two variables are also similar in size and imply a threefold trade-enhancing effect. This should not come as a surprise, given the fact that this study is not independent from Rose's original study. Frankel and Rose (2002) also examine the possibility that the use of a common currency is more beneficial to bilateral trade in very small countries than in larger ones by dropping very small countries from the sample but they find no evidence that the currency union effect varies with country size.

In the next stage of their analysis Frankel and Rose (2002) investigate the effect of increased trade on economic growth. Their estimates suggest that every one percent increase in total trade (relative to GDP) raises income per capita by at least one-third of a percent over a twenty-year period (Frankel & Rose 2002:461).

In the final stage of their analysis Frankel and Rose (2002) combine the estimated effect of currency unions on trade and the estimated effect of trade on growth in order to predict the effect of common currencies on output. The predictions are based on the estimate that a currency union triples trade among its members, and the ultimate growth effect depends on who is adopting what currency. The adoption of the dollar should raise an average country's income by about four percent over twenty years, but the effect could be as much as twenty percent in the case of small countries relatively close to the United States. Similar effects can be expected in the case of small Eastern European countries that adopt the euro. The authors test and find no support for the common argument that currency unions improve income through other channels such as central bank credibility. The effect appears to come via trade. However, simply belonging to a currency union in itself has no effect on a country's growth. Members of a currency union need to be natural trading partners for the growth effect to materialize (Frankel & Rose 2002:438). The conclusion is therefore that geography is an important factor that should be considered in a country's choice of an anchor. The benefits of adopting the currency of a large neighbour are generally greater than the benefits of adopting the currency of a small, distant country.

Frankel and Rose (2002:458) add some important qualifications to their results. First, given the fact that theirs is primarily a cross-sectional study, it is impossible to tell if the beneficial effects of currency unions on trade come quickly or only with very long lags. Second, the decision to adopt a common currency could be endogenous, meaning that the observed correlation between currency unions and trade could be the result of a third, unknown factor. Finally, most currency unions are either formed by very small or very poor countries or by very poor countries (dependencies) adopting the currencies of larger ones. Hence the estimates may not be applicable to larger countries. The inapplicability of the results to major economies is the most common criticism directed against Rose's work, yet he did

caution against extrapolating his general result to the EMU countries in his original paper (Rose 2000). This is an important point that needs to be reiterated; estimates based on the available sample cannot be used to make inferences about the effects of a currency union on trade and growth among developed countries.

5.5 The effect of common currencies on non-members

The evidence discussed so far indicates that currency union membership has a considerable impact on trade between members. An important question that arises is what the implications would be for countries outside a currency union. Trade diversion away from non-members is an intuitively probable consequence that might be expected as a result of the formation of a currency union. Frankel and Rose (2002) investigate whether the stimulus to trade between members of a currency union might come at the expense of trade with non-members. Interestingly, no evidence is found that membership of a common currency union diverts trade away from non-member countries; on the contrary, the evidence points towards trade creation.

In order to test the sensitivity of the results to the specification of their model, Frankel and Rose (2002) add a dummy variable that is equal to one if two countries do not share a common currency, but at least one of them is in a currency union with a third country. The coefficient on this variable is positive, suggesting that currency unions raise members' trade with non-members, rather than diverting trade away from non-members. In other words, members of a currency union have higher overall openness. A similar conclusion is reached by Melitz (2001), who notes that the creation of a common currency lowers trade barriers in general, not only for the members of the currency union.

The effect of the formation of a currency union on trade between members and non-members is a central issue for countries that are reluctant to join such a union. A typical example would be the United Kingdom; a country that might experience a decrease in its trade, should the expanded trade within the EMU come at the expense of non-members. Micco, Stein and Ordoñez (2003) estimate in a cross sectional study that while EMU promotes trade among members, there is no diversion away from the UK. In his investigation of the UK decision regarding

EMU, Frankel (2003) is also of the opinion that there is no evidence that Britain would be worse off remaining outside the union than it would be if EMU had never happened. The lack of trade diversion implies that non-members have nothing to fear from the formation of currency unions, but it also lowers the incentives for non-members to join existing currency unions, if they are to enjoy the benefits anyway. With no trade diversion, free-riding for countries that stay out of a monetary union becomes a possibility. Free riders will share the benefits but not the costs of a common currency.

5.6 The effect of currency union dissolutions on trade

The studies discussed so far are based on cross-sectional analysis of trade data at a given point in time. They answer the question whether countries that share a common currency trade more than others that are not members of a currency union. From a policy perspective it is not the right question to ask. What one would really want to know is the impact of a currency union on those countries that adopt the common currency; whether countries trade more with each other if they form a currency union, and whether leaving a currency union reduces the volume of trade between ex-partners. When the question of a causal link between the adoption of a common currency and increased trade is considered, an obvious approach is to examine a bilateral trade time series that includes both pre- and post-union observations. Rose (2000) found that this was not feasible when using the *World Trade Data Bank* because there is such little time-series variation in currency union membership after 1970. Persson (2001) is also of the opinion that the effect of a common currency on trade must be identified from the cross-sectional variations since there are very few regime changes.

In spite of these difficulties, Pakko and Wall (2001) stress the importance of relying on time-series rather than cross-sectional variation and attempt to exploit the little time-series variation there is in the data used by Rose – only eight cases when countries either joined or left a currency union. In order to capture the dynamic link between common currencies and trade Pakko and Wall (2001) add pair-specific

fixed effects to Rose's model, that is they introduce a comprehensive set of dummy variables – one for each pairing of countries.

The fixed effects approach assumes that, for each pair of countries, there is likely to be a unique set of reasons for trade volume to differ from the average. According to Pakko and Wall (2001) the main benefit of this approach is that it avoids the estimation bias that can arise because of misspecified or omitted time-invariant factors that are correlated with bilateral trade volume and with other explanatory variables. This is achieved by controlling for all factors that are fixed over the sample period, not only those included in the estimation. The fixed effects approach has the additional benefit of not relying on distance as a measure of relative trading costs. Pakko and Wall (2001:40) list a number of reasons why distance is a poor indicator of such costs. Distance across land and distance across an ocean will not have the same cost implications, neither will distance across undeveloped countries and distance across developed countries. Furthermore, distance between single points within two countries is not the same as distance between points spread across the countries.

When Pakko and Wall (2001) use the fixed effects approach to estimate the effect of currency union membership on trade, they find that the estimated coefficient on the common currency dummy is negative. Their estimate indicates that two countries that share the same currency trade only 69 percent of what they would if they had different currencies. In other words, the formation of a currency union decreases members' trade by 31 percent. This result is dramatically different from Rose's estimate, however, it is not significantly different from zero statistically. The negative result could stem from attempting to estimate a coefficient from too few observations. Pakko and Wall (2001:40) admit that their approach is not ideal because of the small number of observations, but they feel it is sufficient to demonstrate the fragility of Rose's result. In their view their empirical estimates suggest that a common currency may lead to significant reductions in trade and therefore they conclude that Rose's results are not robust with respect to a general specification of time-invariant determinants of trade volume.

As a result of the above criticism, Glick and Rose (2002) use the fixed effects estimator proposed by Pakko and Wall (2001) on a much larger data set to estimate

the effect of currency unions on trade. They use the IMF *Direction of Trade* data set, which has enough time-series variation to make the use of a fixed effect estimator feasible, namely 146 switches in currency union status. However, most of these switches are currency union dissolutions. Because of the lack of observations on currency union entries, Glick and Rose (2002) are forced to treat exits from and entries into currency unions symmetrically. By comparing trade for a pair of countries before and after the regime change and assuming symmetry, the authors estimate that joining a currency union causes bilateral trade to rise by about 90 percent, in other words trade almost doubles. In their sensitivity analysis of the estimates Glick and Rose (2002) separate currency union exits from entries and find that the exit effect on trade is bigger than the entry effect. They argue that this difference is caused by the fact that exits from currency unions tended to take place early in the sample while entries into currency unions occurred late, so the effect of lags might bias the effect of entry downwards compared to the effect of exits.

Even if currency union exits and entries are accepted as symmetrical, the time-series evidence about the doubling effect of common currencies on trade is much weaker than the tripling effect suggested by Rose's (2000) original cross-sectional study. One reason for this difference could be that the different approaches used in the studies ask different questions from the data. Rose's (2000) original cross-sectional study asks how much more two countries trade if they use the same currency, while the time-series approach asks what happens to trade when a currency union dissolves or is created. Glick and Rose (2002) answer the latter, relevant policy question and find that adopting a common currency nearly doubles trade.

Table 5.1 provides a summary of the main questions and findings of the studies by Rose and co-authors discussed in this chapter. A comparison of the estimates clearly shows that including time-series data in the analysis has considerably reduced the estimated trade effect. The near-doubling effect of common currencies suggested by the time-series analysis is not as implausible as the tripling effect, but is still very large.

Table 5.1 Summary of findings of Rose and co-authors

Study	Data	CU effect	Research question and answer	Comments
Rose (2000)	cross-sectional	235 %	Do two countries sharing a common currency trade more? Yes. 3 times more.	A currency union is not the same as a fixed rate regime and has a much stronger effect on trade.
Rose & Engel (2002)	cross-sectional	235 %	Is the border effect the consequence of having different national currencies? Only partly.	Currency unions triple trade. The border effect is much larger than the currency union effect.
Frankel & Rose (2002)	cross-sectional	290 %	Does a common currency mean more trade and higher economic growth? Yes.	Effect of currency boards and currency unions similar. No evidence of trade diversion. A currency union should raise members' income by 4-20 % over twenty years.
Glick & Rose (2002)	panel	92 %	Do two countries that adopt a common currency trade more? Yes. Trade doubles.	Result is conditional on assuming symmetry between entering and leaving a currency union.

5.6.1 Currency union dissolution versus decolonization

Although entry into and exit from a currency union cannot be expected to have a symmetrical effect on trade, the extension of the analysis to currency union dissolutions does have the advantage of making time-series studies feasible. However, Bomberger (2002) criticizes Glick and Rose (2002) for not distinguishing between currency union dissolution and decolonization. He argues that exchange rate regime transitions are highly concentrated in a group of former colonies that attained independence. Compared with the rest of the sample, trade declined heavily

for all countries in this group including those that never had a currency union or never abandoned one. Hence the large estimates of the currency union effect are in fact the consequence of the disintegration of trade after decolonization, and have been misinterpreted by Glick and Rose (2002). Exits from a currency union often correspond to the breakup of a colonial relationship, and the adoption of more self-reliant, inward-looking policies in the wake of colonialism (Honohan 2001:458). Trade can be expected to decline under such circumstances. Pain (2002) also notes that in many cases the dissolution of a currency union has coincided with other economic or political events that would have had a considerable effect on trade, for example the civil wars in the wake of the decolonisation of Angola and Mozambique, where one would not ascribe the subsequent decline in trade with Portugal to the adoption of separate currencies. In view of the above criticism, the time-series evidence based on changes in currency union status is highly contestable. If leaving a currency union is found to have a negative effect of a certain size on a country's trade, it cannot be simply assumed that joining a currency union will have a trade enhancing effect of the same size.

The relationship between the adoption of different currencies, political disintegration and trade has been further investigated by Fidrmuc and Fidrmuc (2003). They assess the impact of disintegration on trade among the former constituent republics of the Soviet Union, Yugoslavia and Czechoslovakia using a gravity trade model. They find evidence of a strong home bias in the former federations. Trade between the constituent parts of Czechoslovakia and between republics of the Soviet Union was approximately 43 times greater than trade with otherwise similar countries at the time of disintegration. At a factor of about 24, the home bias was lower in Slovenia and Croatia. Fidrmuc and Fidrmuc (2003) find that disintegration was followed by a sharp deterioration of bilateral trade intensity in all former federations, but the legacy of common past remains strong. In 1998 trade flows among the former constituent republics were still between two to thirty times greater than normal trade. The authors point out that their results are broadly consistent with earlier findings on currency unions. They find that bilateral trade intensity declines by about factor three in the first years of existence of the new independent states. However, they also emphasize that the effect of adopting

different currencies cannot be separated from the effect of political disintegration, as both effects happened concurrently.

5.6.2 The Irish experience

Thom and Walsh (2002) criticize Glick and Rose (2002) for a different reason. They argue that generalizations based on broad panel studies are irrelevant to EMU because of the different characteristics of the countries involved. Thom and Walsh (2002) suggest that the break-up of the long-standing currency union between the Irish pound and sterling in 1978 is a unique opportunity to estimate the effects of a currency union on trade and that the result of their case study would be much more relevant to EMU. A further advantage of studying the Irish case is that the dissolution of the currency union was an exogenous event, whereas other changes in exchange rate pegs were brought about by changes in trade patterns.

Thom and Walsh (2002) estimate a model of Anglo-Irish trade over the period 1950 to 1998 and test for evidence of a structural break in the relationship between income and trade after 1978. They also use a panel regression of Irish trade with the main trading partners to estimate the effect of the sterling link on the pattern of Irish trade. However, none of the tests provided firm evidence that the dissolution of the sterling link significantly lowered bilateral trade. While they caution that findings based on the collapse of a currency union cannot be extrapolated to predict the effects of the creation of a new one, they feel confident that their result raises doubt about how much trade will result from the adoption of the euro. However, the conclusions of Thom and Walsh (2002) cannot be reasonably generalized. The case of Ireland-UK seems atypical in not showing the decline in trade that is generally observed. Glick and Rose (2002) maintain that it is the use of a broad data set with many currency union transitions that accounts for the differences between the results of the two studies. They also emphasize that at the time of the dissolution of the currency union Ireland was also small and poor, so the case study is no more relevant to economically large modern countries than the Rose (2000) large panel study. On the other hand, Melitz (2003) is of the opinion that the Irish case study of exit from a monetary union provides one of the most significant empirical results inconsistent with those of Rose and co-authors.

5.7 Conclusion

The study of the effect of common currencies on trade has been initiated by Rose and together with his co-authors he reached some important results. Rose estimated that exchange rate volatility has a small negative effect on trade that is largely consistent with findings of the extensive literature on the topic. More importantly, he separated the currency union effect on trade from the effect of exchange rate stability and showed that the impact of common currencies on trade is huge. Therefore a fixed rate regime is not the same as a currency union. The adoption of a common currency can reduce some of the barriers to trade, but the exact reason behind the currency union effect on trade is unclear. Even though the mechanism at work is not properly understood, the impact of common currencies deserves serious attention, since increased trade intensity can foster higher economic growth.

However, the study of the trade effect of common currencies is impeded by the fact that there are very few examples of currency union formations. One line of research therefore attempted to draw conclusions about the currency union effect on trade on the basis of the effect of currency union dissolutions, but the effect of joining or leaving a currency union cannot simply be considered to be symmetrical. Furthermore, the evidence is based mostly on the experience of small, poor, developing countries, therefore it has no relevance to the monetary unification plans of major, developed economies. Attempts to solve these difficulties will be discussed in the following chapter.

CHAPTER SIX

TOWARDS A SUPERIOR ESTIMATION OF THE ROSE EFFECT

According to Rose's initial research, currency union membership doubles or even triples trade. This controversial result stimulated a great number of economists to carry out similar studies. To date there are more than thirty studies on the currency union effect on trade. Several authors have attempted to overturn Rose's result and shrink the currency union effect on trade, leading a full-scale attack on the general methodology applied in his studies. Section 6.1 discusses important points of criticisms that have been raised and various methodological improvements that have been suggested. Section 6.2 provides historical evidence of the Rose effect based on the gold standard era, while section 6.3 investigates the most recent evidence of the trade effect of common currencies in the context of the European Monetary Union.

6.1 Criticism of Rose's methodology

Critics raised a number of concerns about Rose's methodology. Potential problems include non-random selection, simultaneity and aggregation bias. A large part of the literature on the currency union effect on trade represents an attempt to solve these problems. This section examines whether correcting for the different sources of potential bias reduces the estimated trade effect.

6.1.1 Non-random selection

One of the main points of criticism is that the conclusions of gravity-based models of currency unions and trade are probably affected by selection bias. Persson (2001:436) notes that the estimates might be seriously biased if the members of existing currency unions are non-randomly selected and explains his concern in medical terms. If one regards a currency union as a treatment, then one would want to test its effect on two groups of patients who were similar in all respects, except that one received the treatment while the other did not. However, if the two groups differ systematically in some other respect, then one cannot tell whether any

observed difference in the health of the two groups is really the result of the treatment.

As far as the trade effect of currency unions is concerned, a selection bias arises if the characteristics of countries adopting a common currency appear to be systematically different from the characteristics of countries outside the union. Persson (2001) argues that the likelihood that two countries will adopt a common currency is not random, and may depend on some of the explanatory variables, such as the size of the country. The bias resulting from non-random selection can be aggravated by the non-linearity of some of the explanatory variables. While size, for example, may affect bilateral trade, it is possible that the effect of size on trade is different at different sizes. The combination of non-random selection and non-linearities can result in seriously biased estimates of the currency union effect.

Persson (2001) proposes a novel methodology to solve the problem of non-random selection. As a first step, he compares the characteristics of currency union countries with the characteristics of countries that have their own separate currency. He uses Rose's original dataset, and compares the mean averages of various variables for the two different country groups. A clear contrast can be seen between the two groups. Countries that are members of a currency union are more likely to be economically small, poor and in geographical proximity to each other. They also tend to share a border and a common language, belong to a free trade area, be part of the same nation and have the same colonizer or have a colonial relationship. Since the differences are statistically significant, it is safe to conclude that there is a systematic difference between the characteristics of currency union countries and those of other countries.

Next, Persson (2001:439) uses a matching approach to compare the bilateral trade of the currency union country pairs and the bilateral trade of similar country pairs that are not in a currency union. He treats two country pairs as being similar, if in the absence of the currency union, the currency union pair would have the same amount of bilateral trade as the other country pair. Persson (2001) estimates the probability that a particular country pair will have a common currency, using nine of the regressors that appear in Rose's gravity equation as explanatory variables. The estimated probability that a particular country pair will have a common currency is

the so-called propensity score of the country pair. Then, currency union pairs are ranked by their propensity scores and divided into subgroup, using the stratification method. The non-currency union country pairs are sorted into those same subgroups on the basis of their propensity score. These other pairs are treated as the comparison group. The comparison of the two groups shows that the currency union effect on trade is only 13 percent, and this result is not statistically significant.

In a slightly different method, Persson (2001) twins each currency union pair with the non-currency union pair that has the propensity score closest to that of the currency union pair. Those closest country pairs become the comparison group. This method, known as the nearest matching method, yields a trade enhancing effect of 66 percent. Persson (2001) concludes that the currency union effect on trade is considerably less dramatic than Rose's (2000) early result suggested.

However, Persson's attempt to improve Rose's methodology has been criticized. Kenen (2002:5) has two objections to the Persson methodology. The first objection is that the regressors include GDP and GDP per capita, which may not directly influence trading costs per se, they appear in the standard gravity equation for quite different reasons. The second objection is that the propensity scores provided are estimates of the probability that a particular country pair will share a common currency. Because propensity scores attach to country pairs, it is implicitly assumed that the measured characteristics of the two countries comprising a country pair jointly and symmetrically determine the probability of having a common currency. However, in the case of unilateral currency unions the decision whether to dollarize or not has more to do with the characteristics of the country intent on dollarization than with the characteristics of the chosen anchor country.

In order to account for the different country characteristics, Kenen (2002) proposes a country-based, asymmetrical approach. He estimates the probability that a particular country will deliberately adopt some other country's currency or join a multilateral currency union. For this purpose, the currency-union dummy needs to be redefined, since now it does not refer to a country pair but to a single country. For example, the currency union dummy is equal to one for a country such as Panama, which uses the US dollar, but is zero for the United States. In the case of a multilateral currency-union, the currency-union dummy is one for every member

country. A set of single-country regressors, such as output, population, ex-colony and island are also defined. Some of the dummies used in Rose's gravity equation, such as common language or distance, do not have an analogue in the single-country approach. The distribution of the propensity scores obtained shows that currency-union countries in general have a high propensity score, while other countries normally score low. This difference between the distributions of the two country groups highlights the usual criticism directed against Rose's results. Currency union countries are indeed atypical, and the Rose (2000) regression results cannot be used to predict the trade-creating effect of common currencies for other groups of countries. Members of EMU in particular all have propensity scores lower than five percent.

Once the propensity scores are obtained, Kenen (2002) uses a simple analogue to Persson's (2001) stratification method in order to form a comparison group of country pairs that are similar to the currency-union pairs. Computing and comparing the means of the logs of trade flows for the two groups, he obtains results similar to those of Persson. The mean of the trade flows between currency-union pairs is not significantly different from the mean of the trade flows between the country pairs that form Kenen's comparison group. However, when Kenen re-estimates Rose's gravity equation using the subset of country pairs comprising his currency-union pairs and his comparison group, he obtains a significant, though smaller trade-raising effect than in Rose (Kenen 2002:10). In other words, he confirms both Persson's and Rose's results. He explains this anomaly by the use of different data sets. Another reason is the different strategy used. Persson's trade based strategy yields the same group currency union country pairs as Kenen's country based strategy, but the resulting comparison groups are obviously different. Furthermore, Persson (2001) obtains his gravity equation using the country pairs selected by the nearest-matching method and not the stratification method, and Persson himself suggests that this may explain why his currency union coefficient is not statistically significant. Persson prefers the nearest-matching method and feels that it provides a better-balanced data set, because the number of countries in the currency union group and in the comparison group is similar and the comparison group does not dominate the re-estimation of the gravity equation. On the other hand, Kenen (2002) argues, that the comparison group becomes too small if the nearest-matching

method is used. Rose (2001) suggests that the matching method discards much of the relevant information and that is the reason why it fails to find a significant currency-union effect.

Another author concerned about selection bias in Rose's specification is Melitz (2001). He argues that countries will only form a currency union if they have close economic or political ties with one another. If Melitz is correct, then the estimated high coefficient of the currency union dummy may be due to correlation with other variables, such as membership in regional trade agreements or colonial relationship. This could well be the case since the coefficient of Rose's currency union dummy is higher than those for political union or free trade area, while it is unlikely that removing the frictions of separate currencies could promote trade more than removing protective trade barriers or entering into a political union.

In order to test the hypothesis that membership in currency unions, free trade areas and political unions tends to overlap, Melitz (2001) separates common currency pairs into two groups. The first group is labelled as Strict Currency Unions and consists of country pairs that are not members of a political union or a free trade area and do not have an ex-colonial relationship. The rest belong to the second group labelled Combined Currency Unions. If Rose's interpretation of the coefficient of Currency Union is correct, one would expect the coefficient of Combined Currency Union to be much higher than that of Strict Currency Union, since it should reflect the combined effect of currency union and political union or free trade area. But this is not the case. The difference between the two coefficients is much smaller than expected. In a further test Strict Currency Union is even more narrowly interpreted and country pairs with a past common colonizer are also excluded, with little change in the results. The coefficient of Combined Currency Union is not high enough to admit the additional effect of political union and free trade agreement. This, however, should not be interpreted as a confirmation that currency union does not raise trade at all, it only means that the extent of the impact is not as huge as Rose's original estimate. Melitz (2001) compares the different coefficients and concludes that the use of a common currency doubles trade, a result that is similar to the findings of Glick and Rose (2002).

6.1.2 Simultaneity bias

Another point of criticism directed against the gravity model of trade deals with the likelihood of simultaneity bias. Simultaneity bias means that the dependent variable is not simply a function of the explanatory variables in an equation, but some of the explanatory variables are a function of the dependent variable or of each other at the same time. In such cases where the estimation ignores the possibility of a two-way causality between the dependent variable and one or more of its explanatory variables, simultaneity bias occurs. Regarding the relationship between trade and common currencies, in terms of causality, there are two other possibilities besides currency unions creating trade. It is possible that countries decide to form a currency union because they trade a lot with each other (the traditional optimum currency area argument), or both currency unions and high levels of trade are jointly caused by some third factor (Yetman 2002). In the latter two cases, currency union membership becomes an endogenous variable and estimates of the impact it has on trade will be biased because of the existing simultaneity between trade and currency union membership.

The problem of endogenous selection into a currency union has been stressed by Tenreyro (2001). She attempted to correct for this source of bias by identifying the factors that play a role in the decision to form a currency union, but do not have an independent impact on bilateral trade. Compatibility in legal systems, cultural links, sharing a common language, geographic proximity, better infrastructure and tied bilateral transfers are given as examples of factors that may increase the propensity to form a currency union as well as increase bilateral trade. This correlation could lead to a positive bias of the estimates. Other variables, such as market concentration, may lead to a negative bias. Higher levels of monopoly distortion in the economy could cause higher inflation rates and thereby increase the need to join a currency union in an effort to reduce inflation. By contrast, higher mark-ups tend to discourage trade (Tenreyro 2001:4). From the analysis of these factors the probability that two countries will adopt a common currency is estimated. The effect that such a union will have on the bilateral trade of the country-pair is then estimated simultaneously with the estimation of probabilities.

Rose (2000) dismissed the possible endogeneity of the currency union dummy as purely hypothetical, arguing that trade considerations have been almost irrelevant to a country's decision to join or leave a currency union. It is, however, possible, that the simultaneity problem is more relevant in a historical context. There appears to be evidence, that countries may have joined the gold standard as a result of their trade dependence on other countries that changed to gold (Estevadeordal *et al* 2003:376).

6.1.3 The treatment of zero trade flows

Tenreyro (2001) raises a further economic concern that is a possible source of bias in Rose (2000) and other simple OLS estimates of the trade impact of currency unions, namely the treatment of zero trade flows. Databases on bilateral trade include many economically small countries that traded in some years and not in others. In a gravity model of trade, such as Rose (2000), (log)trade is normally the dependent variable. Zero-valued trade flow entries present a problem for econometric estimation, because the log-linear specification does not allow for them. The common practice has been simply to exclude country pairs with no trade. Countries in currency unions tend to be economically smaller and exhibit a more irregular pattern of trade than the average, therefore ignoring zero-valued observations results in an upward bias in the estimated effect of currency unions on trade.

Tenreyro (2001) addresses the issue of zero-valued entries by averaging trade flows over five-year periods. The results suggest that incorporating the information in zero-valued trade has a huge impact on the size of the estimate, lowering the impact of common currencies on trade from approximately 200 percent to 100 percent. Correcting for both simultaneity and zero observations shrinks the effect on trade to about 60 percent, and the estimates are not significantly different from zero. Tenreyro concludes that the lack of statistical significance implies that the trade effect of common currencies might not be as large and robust as previously reported.

6.1.4 Multilateral trade resistance

A further criticism directed against the methodology of the gravity-based studies is that their estimates may be biased because gravity models do not correspond to the underlying trade theory. Gravity models explain trade between two countries through measures of absolute trade costs, while in reality it is relative trade barriers that determine the level of trade (HM Treasury 2003, par.5.21). Rose and van Wincoop (2001) attempt to control for this bias by using a model in which bilateral trade depends on the trade barrier between pairs of countries relative to the multilateral, or average trade barrier against all other countries. They apply the gravity equation of Anderson and van Wincoop (2001) and add country-specific fixed effects that are assumed to represent a country's multilateral trade resistance, while the existing factors such as common language or membership of a free trade area indicate whether there is reduced bilateral trade resistance. With this model it is possible to estimate the currency union effect on trade even for countries that have never been in one. It also provides an estimate of the tariff-equivalent of the national money barrier.

The inclusion of relative trade barriers leads to some important results. One insight is that any reduction in barriers to trade through the adoption of common currencies will have more impact on larger countries than on smaller countries. This is because relative trade resistance is reduced more in the case of large countries than for smaller countries. In the case of small countries, changes in bilateral barriers have a proportionately larger effect on multilateral resistance. Another conclusion of the model is that for countries that already trade a lot, formation of a currency union may lead to a smaller percentage increase in trade. The reason is that the reduction of bilateral trade barriers also reduces multilateral resistance; therefore relative trade barriers do not fall by much, so trade does not increase by a large amount. Finally, it is also claimed that welfare is inversely related to multilateral trade resistance. This implies that even though countries that already trade heavily will experience a smaller increase in trade, their welfare benefit from joining a currency union will be greater. When a common currency is adopted, the more firms take part in international trade, the greater the benefit from reduced transaction costs associated with the use of separate currencies.

Rose and van Wincoop (2001) estimate the model using 1980 and 1990 data for a set of 143 countries. The results suggest that trade barriers associated with national borders are halved when countries join a currency union, significantly raising trade and welfare. National money indeed appears to be a barrier to international trade. Giving up national money and adopting a common currency may lead to a 50 percent increase in trade. While still impressive, this result is much smaller than those suggested by previous studies. It appears that the inclusion of a multilateral resistance term reduces the size of the currency union effect and previous estimates may have been biased because of omitting this key variable.

6.1.5 Industrial versus developing countries

Another source of possible bias in the estimation of the currency union effect on trade is the lack of differentiation. Rose (2000) does not distinguish between developed and developing countries, or between small and large countries in his analysis. However, it is conceivable that the effect of adopting a common currency will be different for industrial countries and developing countries because the latter are rarely able to invoice their trade in their own currency, mainly because of the low credibility of their currency, little bargaining power and uncompetitive products (Saiki 2002:2).

Saiki (2002) investigates the increase in trade resulting from the adoption of a common currency in the case of developing countries that previously practiced local currency pricing, in other words, exporters set their prices in importers' currency. Local currency pricing is common when developing countries export to industrial countries, because their products are hardly differentiated and they are in competition with other developing countries. These countries have an incentive to devalue their currency to remain competitive. When exporters engage in local currency pricing in order to expand their market share, exchange rate volatility is not an issue for importers, since prices are set in their currency. If the developing country in question adopts the importing country's currency, the trade effect is much smaller than in the case of similar country pairs where exports used to be invoiced in exporters' currency. In addition, it is imports from, rather than exports to the anchoring country that get a positive effect from a common currency. Saiki (2002) runs separate regressions for exports and imports and finds that the effect on

the anchoring country's imports is very small or even negative. A negative effect is found in the case of countries exporting to the US, 80 percent of whose imports are denominated in the US dollar. The negative trade effect is possibly the result of the overvaluation of the currency and devaluation of export competitors' currencies. If a currency union promotes imports from but discourages exports to the anchoring country, then the joining country will suffer from a current account deficit and thus its currency will be overvalued, eroding the country's competitiveness. Saiki (2002:16) calls this the self-fulfilling overvaluation of the exchange rate.

A further conclusion drawn by Saiki (2002:16) is that adopting a common currency will only have a positive effect on trade if there are appropriate institutional arrangements. He finds a clear difference between countries under currency union arrangements with the United States and France, the common currency effect on French trade being stronger. Saiki ascribes this to the historical and institutional relationship of CFA countries with France. Such a relationship is generally lacking between the United States and those countries that adopted the dollar. Appropriate institutional arrangements are therefore needed in order for the dollarization of the developing countries to be successful.

6.1.6 Unilateral versus multilateral currency unions

Country pairs that share a common currency cover a large number of different experiences of monetary integration. Some of them are small, poor, distant dependencies, typically islands that use the currency of their former colonizer or present home country. Others are countries that unilaterally declare the adoption of the currency of a larger country. Finally, there are multilateral currency unions among regional neighbours. There is no reason to believe that the trade effect is the same for the different groups (Nitsch 2002a). It is debatable, whether the experience of overseas territories, where the use of a common currency is due to historical accident and is not the result of independent choice provides any valuable lesson for current monetary integration schemes.

In the standard gravity trade model in the literature, in other words Rose's (2000) model, multilateral currency union members, unilaterally dollarized countries and overseas territories with the same currency are grouped together. The underlying

assumption is that the common currency dummy specifically reflects the effect that a common currency has on trade and not the nature of the overall link between countries, which is captured by a host of other variables. However, various authors have raised their concern that the grouping together of different currency union arrangements can lead to aggregation bias. Levy-Yeyati (2001), Nitsch (2002a) and Klein (2002) attempt to control for this aggregation bias by disaggregating the data in various ways. They estimate the trade effect of different types of currency unions and find considerable variation.

Levy-Yeyati (2001) proposes separating multilateral currency unions from unilateral currency unions in order to correct for aggregation bias. Members of a multilateral currency union are in a symmetric relationship, while in a unilateral currency union a distinction can be made between a 'parent' – the large country whose currency is adopted by smaller countries, and the 'siblings' – the small countries that unilaterally adopt the currency of a larger country. If one can find significant difference in the estimated effect of a common currency on trade between multilateral currency union and parent-sibling (or sibling-sibling) pairs, this would imply that the common currency dummy might in part reflect omitted variables that are correlated with bilateral trade flows and not fully captured by the other dummies.

There are several reasons why such a differential effect might be expected. The creation of a multilateral currency union involves not only monetary but other institutional policies that might augment the common currency effect, and one could expect currency union members to trade more with each other than unilaterally dollarized countries. On the other hand, most siblings are sub-national entities with strong political and institutional links with the parent country, and one could expect them to trade more with each other, since their relationship is somewhat like that existing between provinces of the same country.

Levy-Yeyati (2001) empirically tests the sensitivity of the reported common currency effect to the way in which a common currency is introduced. He extends Rose's (2000) specification by adding country effects and decomposing common currency pairs into two groups, namely pairs of countries within a multilateral currency union and other common currency pairs. The results imply that the

common currency effect on trade differs appreciably between country pairs that belong to a multilateral currency union and other common currency pairs. The common currency effect for the latter group is similar to Rose's (2000) original estimates, but in the case of multilateral currency union members it is considerably smaller, the implied trade enhancing effect is 65 percent. Levy-Yeyati (2001) further decomposed the non-multilateral currency union pairs into two subgroups: parent-sibling and sibling-sibling pairs, but failed to find any significant difference between the magnitude of the coefficients. However, the fact that the size of the coefficient is significantly lower for the multilateral currency union group suggests that using the estimates of the standard Rose model to assess the trade-promoting effect of a common currency could lead to a substantial overestimation of the actual effect.

Another author concerned about the possibility of aggregation bias is Klein (2002) who investigates the effect of dollarization on trade and argues that the results from wide samples used by Rose and his co-authors may not give an accurate assessment of the dollarization effect, just as they might not give reliable estimates of the EMU effect. A currency union and dollarization are theoretically different. A currency union entails the establishment of a new central bank, while dollarization involves the adoption of the currency of another country, typically the US dollar. Klein therefore chooses to work with a smaller sample, focusing on bilateral trade between country pairs in which one country is the United States or in which one country adopted the US dollar. Klein investigates the post Bretton Wood era from 1974 to 1997, since the effect of dollarization on trade is expected to be stronger when the rest of the world is not on a dollar-based exchange rate standard.

According to Klein (2002) one might expect to find larger estimates of the currency union effect on trade in the sub-samples concentrating on the United States than in wider samples covering all common currency agreements, since countries in sustained dollar currency unions are presumed to benefit most from membership. The regression results indicate just the opposite. Following the methodology applied by Glick and Rose (2002), the coefficient on Klein's currency union dummy is only about one-third as large using the United States sample than in the full sample. If an even smaller sub-sample is taken, considering only country pairs in which one is the

United States and the other is a Western Hemisphere country, reflecting current and potential candidates for dollarization, the currency union coefficient is only one-fifth of its full sample value, and loses much of its statistical significance. The bottom line is that there is little robust evidence that dollarization promotes greater trade with the United States for the adopting countries. These results are in contrast with those of Rose and his co-authors. The source of the difference is that Klein focuses on samples that may better represent the behaviour of potential candidates for dollarization.

In a further test Klein (2002) examines whether there is a distinct difference between the trade effect of dollarization and of having a fixed exchange rate, since only a few countries dollarized, but a significant number of nations pegged their currencies to the US dollar at some time during the post Bretton Woods era. Klein augments his regression specification by a separate dummy variable denoting the presence of a sustained fixed exchange rate that is not a currency union. However, no significant evidence is found that the effects of dollarization on trade are different from that of a sustained fixed exchange rate. This result contrasts with the evidence presented by Rose (2000), namely that a common currency is a much more serious commitment than a fixed rate.

The main conclusion of Klein's study, that adopting the US dollar has no significant effect on trade with the United States, seems to be in contrast with the conclusion reached by Levy-Yeyati (2001), who confirms the strong trade effect of common currencies in the case of non-multilateral currency unions, that is for parent-sibling pairs and sibling-sibling pairs. However, the adoption of the US dollar and the use of the currency of the home country or former colonizer by a dependency fall both under the parent-sibling category. The large trade effect associated with this group might be attributable to the experience of the overseas territories, and not to that of dollarized countries, in which case the two results can be compatible.

The only industrial country other than the United States that had sustainable currency unions with more than one country in the post Bretton Woods area is Australia. The estimates of gravity trade regressions for Australia suggest that a non-industrial country that adopts the Australian dollar experiences a tenfold increase in its trade with Australia (Klein 2002:15). Naturally, this result should not

be applied to other countries, since it is based on the experience of three small island nations, namely Tonga, Kiribati and the Solomon Islands.

Klein's (2002) results are consistent with those of Nitsch (2002b) who corrected a number of data errors in Rose's (2000) data set and found that the trade-multiplying effect varies across different currencies, ranging from no effect for countries which have adopted the US dollar to extremely high estimates for countries adopting the Australian dollar. Nitsch (2002a) argues that because of these huge differences it is advisable to examine the effect of the various currency unions separately. Nitsch (2002a) investigates the effect of multilateral currency unions on trade by focusing on two existing multilateral currency unions, the CFA franc zone and the Eastern Caribbean Currency Union and estimates their effect on intraregional trade. Focusing on intraregional trade allows a direct comparison of a country's trade with a currency union member and an otherwise similar country using a different currency. The CFA franc zone has fourteen members. The CFA franc is issued separately by two sub-zones, in West and Central Africa respectively, it is exchangeable one-for-one against each other and collectively pegged to the euro. The Eastern Caribbean Currency Union (ECCU) comprises eight small island territories and the currency is linked to the US dollar. In both groups members trade relatively little among themselves. They produce mainly primary goods and trade with industrial countries. Given these country characteristics, the intra-union trade benefit of monetary integration seems limited, but the percentage change in trade, in other words the common currency effect, can still be significant.

Nitsch (2002a) uses the augmented gravity model of Rose (2000) and runs separate regressions for the two regions. The results imply that CFA franc countries trade about 55 percent more with each other than with a typical non-union country in West and Central Africa. The estimate for the ECCU is smaller and statistically not significantly different from zero. The conclusion is that multilateral currency unions have, on average, a positive effect on intraregional trade, but the magnitude of the effect is considerably lower than Rose's estimate of factor three, confirming other estimates of positive but moderate effect of common currencies on trade. A further conclusion drawn from the investigation of the extent to which the currency union effect differs across country pairs is that economically large countries seem to

benefit more from a common currency. A possible reason for this finding could be that large economies tend to have a diversified production structure and may function as suppliers for the region.

A summary of the methodological contributions and the preferred estimates of the currency union effect on trade of the different studies discussed above are provided in table 6.1. Although the various studies arrive at highly divergent estimates depending on the methodologies used and the countries considered, the estimates are generally much lower than the original Rose result.

Table 6.1. Summary of representative currency union studies

Study	Trade effect	Comments
Persson (2001)	13 % - 66%	Corrects for non-random selection and non-linearities with matching technique.
Kenen (2002)	239 %	Uses a country-based strategy to estimate the probability of joining a currency union.
Melitz (2001)	100 %	Separates pure currency union effect from the impact of political ties or free trade areas.
Tenreyro (2001)	60 %	Corrects for endogeneity by estimating the probability that two countries will adopt a common currency simultaneously with the effect of such a union on trade. Solves the problem of zero trade by averaging trade flows over five years.
Rose & van Wincoop (2001)	50 %	Incorporate relative trade barriers. More impact on larger countries. Effect smaller for countries that already trade a lot, but their welfare benefit will be greater.
Saiki (2002)	75 %	Local currency pricing reduces the effect. It is imports from rather than exports to the anchoring country that increase. Appropriate institutional arrangements are needed for positive effect.
Levy-Yeyati (2001)	65 %	Trade effect for multilateral currency unions is smaller than in the case of unilaterally dollarized countries.
Klein (2002)	65 %	Effect of dollarization not distinct from the effect of a fixed dollar exchange rate.
Nitsch (2002a)	55 %	The effect differs across country pairs. Economically larger countries benefit more.

6.2 Historical evidence: the gold standard era

One of the major criticism of Rose's study was that his sample is dominated by small, poor, developing countries, therefore it has no relevance to the monetary unification plans of major, developed economies. The reason for this is that in the contemporary, post-war data there is a shortage of observations of monetary regime changes. To overcome this difficulty some recent research (Estevadeordal *et al* 2003; Flandreau & Maurel 2001; López-Córdova & Meissner 2003; Ritschl & Wolf 2003) sought answers in the historical experience by extending the data set back to the late 19th and early 20th century, when much of the world was tied to gold. This line of research is motivated by the belief that the historical experience of economically large, developed countries could be more relevant to present-day monetary integration among developed countries than the contemporary experience of small, poor countries.

Flandreau and Maurel (2001) examine the late 19th century European experience. In this period a variety of monetary arrangements were in place that can be ranked according to the different degrees of monetary integration they implied. The Habsburg Empire was a full monetary union between Austria and Hungary. The gold standard represented a lesser degree of monetary integration, best compared to contemporary currency bands or target zones. Within the gold standard group, the Latin and Scandinavian Unions gave legal tender to the gold coins issued by member states but were not full monetary unions. Flandreau and Maurel (2001) apply the gravity model of trade and use separate dummies to indicate membership in the Habsburg Empire, the gold standard, the Latin Union and the Scandinavian Union to capture the trade effect of different monetary arrangements. Annual panel data are used for sixteen countries for the period 1880 to 1913. Their results indicate that the Austro-Hungarian monetary union improved trade between member states by a factor of 3.2. The gold standard was associated by a much smaller but still significant increase in trade of factor 1.36. The Scandinavian Union also impacted trade favourably. Together with the effect of the gold standard its members experienced a trade increase of factor 2.61. The Latin Union, however, did not

improve trade between its members, since exchange rate fluctuations were not eliminated.

Flandreau and Maurel (2001) conclude that tight monetary integration one century ago had the same surprisingly high impact on the volume of international trade that Rose (2000) found in the contemporary context. They also offer an economic interpretation of their finding. They argue that monetary integration fosters capital market integration in general and portfolio diversification in particular. It also promotes macroeconomic coordination by assigning to participating regions common rules and targets, which in turn increase business cycle symmetry. When two countries have similar cycles, booming domestic demand will be matched with booming foreign demand, and bilateral imports and exports move in pace. This means that the constraint on the current account is weakened, the financing of imports via exports is facilitated, and bilateral trade increases as a result.

Another study by Estevadeordal, Frantz and Taylor (2003) investigates the rise and fall of global trade from 1870 to 1939. During the great trade boom from 1870 to 1913 a great number of countries joined the gold standard. The authors test the hypothesis that a large part of the change in trade volumes previously attributed to the dramatic changes in transportation costs and commercial policy was due to changes in payment frictions, that is the gold standard effect.

In order to test their hypothesis, Estevadeordal *et al* (2003) augment the traditional gravity equation with a gold dummy which is equal to one if both members in a country pair are on the gold standard, and zero if one or both are on a float. An average bilateral tariff level is included as a measurement of policy frictions. Gravity equations are estimated for 1913, when the gold standard was widespread, for 1928, when it was partially rebuilt, and for 1938, when it was virtually dead. The preferred estimates of the gold standard impact are obtained by pooling the data. This ensures time variation in the data and a more reliable estimation of the effect of going on and off the gold standard. The authors find that the gold standard had a statistically and quantitatively significant effect on bilateral trade volumes. The results indicate that country pairs which jointly tied their currencies to gold traded almost twice as much - 72 percent more - than country pairs in which at least one member was not on the gold standard (Estevadeordal *et al* 2003:375). This estimate

is lower than the illustrious threefold increase found by Rose (2000), but it must be kept in mind that the gold standard represents a lower level of monetary integration than a currency union. The authors also compare the gold standard effect with the impact of tariffs and transport costs. They conclude that in the 19th century the effect of the gold standard was just as important as the decrease of transport costs and significantly more important than tariff policy in boosting trade (Estevadeordal *et al* 2003:394-395).

Another recent study examining the classical gold standard era from 1870 to 1910 makes use of four regressors to differentiate between various monetary standards (López-Córdova & Meissner 2003). In addition to the gold dummy there is a silver dummy, equal to one if both countries used a silver standard, a bimetal dummy to indicate a bimetallic standard, and a monetary union dummy, equal to one if a common currency was legal tender in both countries. Positive and statistically significant coefficients are found on 'gold', 'silver' and 'monetary union'. The estimates indicate that countries on the gold standard traded about 60 percent more than with partners not on the gold standard. The silver standard had a doubling effect on trade, however, the number of countries on silver was very small. Bimetallism did not seem to be a significant factor encouraging trade, either because there are only a few observations or because of its inherent instability. Countries in a monetary union, controlling for all other effects, traded more than two times more with each other than with other countries. Combining the gold standard effect with the monetary union effect appears to have increased trade by 200 percent (López-Córdova & Meissner 2003:348).

Given the similarity of these results and the estimates of Rose (2000), there seems to be an astonishing long-run stability in the effects of monetary integration. López-Córdova and Meissner (2003) consider the possibility that unobserved country-pair or country characteristics are responsible for the high estimates. In an alternative, country-pair fixed effects specification, the trade-creating effect of the gold standard falls to about 30 percent. However, combined with the impact of a monetary union there is still evidence that there is a very large association between trade and monetary regime coordination. Based on their findings, López-Córdova and Meissner (2003:351) estimate the contribution of the gold standard to global

integration and find that global trade could have been about twenty percent lower during the period examined if no country had joined the gold standard.

A further study seems to confirm the results of the other historically based studies. Ritschl and Wolf (2003) examine the era after the Great Depression of 1929, when the gold standard collapsed and only five countries remained on gold until 1935/6. As a substitute, several regional currency and trade blocks were formed, such as the sterling block and the reichsmark block. These currency areas are not currency unions in the strict sense, nevertheless a similar augmented gravity model as in Estevadeordal *et al* (2003) seemingly reproduces the standard, very high trade-promoting effect among their members, ranging from factor 3.16 for the Reichsmark block to 3.49 for the Sterling block (Ritschl & Wolf 2003:14).

However, the authors warn that it would be wrong to conclude from their result that regional currency unions and trade blocks in operation in the 1920s and 1930s had a major trade-creating effect. Ritschl and Wolf (2003) examine the behaviour of the different currency arrangement dummies over time in order to isolate the treatment effect of actually introducing the currency arrangements. They define two dummy variables for each currency area. The first dummy is equal to one while the formal currency arrangement is operative. The second is equal to one for the whole sample period for the same country group, capturing any trade increase before the formation of a currency block. The results reveal that there is strong evidence of endogeneity. Already in the 1920s, trade among member states of the later currency blocks formed in the 1930s was sometimes two to three times higher than a gravity model would predict. In most cases, the formal establishment of these blocks had only insignificant effects on the coefficients. According to Ritschl and Wolf (2003:21), even the post-war currency arrangements are visible in the inter-war data.

It seems that not only do currency areas create trade, but trade also creates currency areas, which is in line with the theory of optimum currency areas (see Chapter 2). Ritschl and Wolf (2003:23) conclude that the Rose effect suffers from endogeneity bias. They argue that optimum currency unions are formed, not to increase trade, but because trade is already high. Therefore they caution against too much optimism in generating trade through establishing currency unions.

An illustrative summary of the main research results of historical studies is provided in table 6.2. The size of the estimated trade effect in these studies indicates that extending the data set back to the late 19th and early 20th century has provided more evidence on the strong correlation between currency arrangements and trade intensity. At the same time, the possibility of a strong endogeneity bias has been emphasized, questioning yet again the direction of causation between trade and common currencies. While it is certainly remarkable that common currency arrangements a century ago were associated with trade creation similar in magnitude to the Rose effect, there is no guarantee that this historical evidence would be applicable to contemporary monetary integration.

Table 6.2 Summary of trade effects of monetary integration in historical studies

Study	Years covered	Countries in sample	Trade effect	Comments
Flandreau & Maurel (2001)	1880-1913	16 European countries	from 36 % (gold standard) to 220 % (Habsburg union)	Monetary integration weakens the current account constraint by fostering business cycle co-movements.
Estevadeordal, Frantz & Taylor (2003)	1870-1939	40 countries	72 % (gold standard)	Gold standard much more important than tariff policy and just as important as decreasing transport costs in promoting trade.
López-Córdova & Meissner (2003)	1870-1910	23 countries	from 30 % (gold standard) to 200% (monetary union)	Twenty percent of increase in world trade during this period was due to the gold standard.
Ritschl & Wolf (2003)	1928-1938	29 countries	216 % (Reichsmark) 248% (Sterling)	Strong evidence of endogeneity: trade creates currency areas.

6.3 Recent evidence: the European Monetary Union

The most often mentioned economic benefit of the European Monetary Union (EMU) is that it enhances trade between the participating countries. Rose's (2000) initial study and the ensuing literature were motivated by the aspiration to estimate the impact that the euro will have on trade. The time has come when it is not necessary to extrapolate from evidence on other currency unions any more. It became possible to estimate the effects of the euro on trade directly when data for the early years of the European Monetary Union became available. The physical introduction of the euro happened only in January 2002, but one may use the period after the announcement of the final irreversible convergence rates into the euro basket of the eleven original participating members as the starting date of the European currency union, that is from January 1999. By focusing on the experience of the EU countries, a growing number of recent studies provide evidence on the common currency effect on trade in economically large, developed nations that decided to participate in a currency union by a deliberate policy choice, and not by historical accident.

One of the most notable attempts to provide some answers about the euro effect on trade is the study by Micco, Stein and Ordoñez (2003). The authors use the most recent IMF *Direction of Trade* data on annual bilateral trade for 22 developed countries from 1992 to 2002 and form two different samples of industrial countries in their analysis. One sample includes all industrial countries in the data set while the other is restricted to countries that are members of the European Union. While the first sample is larger, countries in the second one are more homogeneous, geographically close and all belong to the same single market. Since countries in the second sample tend to share similar experiences, there is less danger that the results will be biased because of omitted variables that would have a differential effect on trade for certain country pairs.

The estimates obtained for the euro's impact on trade range between 4 and 16 percent, depending on the sample and the various methodologies used (Micco *et al* 2003:343). This effect is not nearly as impressive as the early Rose (2000) estimates, but it is still statistically significant and economically important, particularly if one considers that the sample only covers the first four years of the

monetary union, and the fact that for the first three years the euro was not even in circulation. However, Viaene (2003:346) is skeptical whether the positive trade effects will be maintained in the long run. She argues that during the last part of the sample there was strong economic growth worldwide and the euro was depreciating with respect to the US dollar and other currencies, and both of these factors tend to encourage more trade with the rest of the world.

Micco *et al* (2003) go further than simply establishing that the euro boosts bilateral trade. They are particularly interested in the timing of the euro's impact. To achieve this the EMU dummy is defined so that it takes the value of one when the two countries in the pair belong to the EMU, even for the years before the formal creation of the EMU. The aim is to follow the trade performance of the countries that joined the EMU over time by looking at the changing value of the coefficient for the EMU dummy. If the EMU has an effect on trade the coefficient should be higher after the creation of the monetary union (Micco *et al* 2003:331). The results show that EMU countries were already trading more amongst themselves than with other countries before the creation of the EMU. As expected, the trade effect increases in 1999 with the formal creation of the currency union, but the real jump in the value of the coefficient is observed in 1998. The question is why trade among EMU countries started to increase before 1999. One reason is that it was in anticipation of the formation of the EMU. The elimination of capital controls and the intensification of policy and central bank coordination gave stimulus to trade. The authors ascribe the jump in 1998 to the fact that it was a crucial year in the process of monetary unification. It was then that EMU became an absolute certainty with the official creation of the European Central Bank (Micco *et al* 2003:333).

Another question that arises is whether the impact of EMU applies to all members, or whether the results are due to the experiences of just a few of them. Micco *et al* (2003:339) find that the results are very robust to the exclusion of one country at a time, but significant differences arise from the exclusion of certain groups of countries. If relatively less developed EMU countries are excluded, the estimated trade effect increases. On the other hand, if the original six EU members are excluded from the sample, the size of the EMU coefficient becomes smaller. These

results imply that while the impact of EMU is fairly widespread, it is generally higher in the case of the more advanced economies.

Another question is, whether the increase in trade comes at the expense of other countries. To check for possible trade diversion, Micco *et al* (2003:334) add a new EMU dummy to the specification, defined as equal to one when only one of the countries in the pair uses the euro. If the adoption of the euro is similar to preferential trade liberalization in leading to trade diversion away from non-members of the currency union, than the coefficient on this dummy should be negative. However, just the opposite is found. The authors conclude that the formation of the EMU does not cause trade diversion but instead increases members' trade with the rest of the world. However, this result is based on the analysis of 22 industrialized countries. The impact of EMU on member countries' trade with developing countries cannot be addressed with such a data set, although it is of great political relevance (Midelfart 2003:344).

Another EMU study by Bun and Klaassen (2002) follows a slightly different approach. Theirs is a dynamic model that explains annual bilateral exports from the domestic to the foreign country from lagged exports, GDP, the real exchange rate, its volatility, an EMU dummy and several trade integration dummies. The inclusion of lagged exports allows for the existence of persistent trade flows and improves on the usual model specifications.

Another difference is, that while Micco *et al* (2003) concentrate on the total impact of the euro, Bun and Klaassen (2002) separately identify the impact of exchange rate volatility on trade. The euro effect can come through two channels, the first channel is the real exchange rate volatility, the second is the pure common currency effect representing other changes, such as the perfect credibility of the nominal exchange rate fix, the reduction of transaction costs and capital market integration. These effects are represented by the change in the EMU dummy from zero to one.

Based on a sample that includes yearly data from 1965 to 2001 for all EU countries, Canada, Japan and the US, Bun and Klaassen (2002) find that the trade-enhancing effect of the reduction of the real exchange rate volatility is statistically insignificant

and economically minor. This could be explained by the fact that volatility between current EMU members had already been low before EMU (Bun & Klaassen 2002:14). In contrast, the coefficient for the EMU dummy indicates that other changes induced by EMU, such as perfect credibility of the nominal exchange rate fix, the reduction of transaction costs and capital market integration have a statistically and economically significant effect on trade. This result confirms the findings of Rose (2000), namely that the introduction of a common currency is qualitatively different from a mere reduction of exchange rate volatility to zero (see section 5.1).

Bun and Klaassen (2002:14) find that the total euro effect on trade was 4 percent in the first year of the EMU. The long run effect is estimated to accumulate to about 40 percent, half of which will be achieved by 2006. The results are in line with earlier studies regarding the significance of the currency union effect. The substantially lower size of the estimate is most probably caused by the different types of currency union countries analysed: EMU versus currency unions involving developing countries. While the estimates are significant, their standard errors are economically substantial. This estimation uncertainty is due to the short period of the sample, and the authors suggest that the estimates should be updated when more EMU data become available in time.

Yet another estimation of the trade gains arising from the creation of the EMU was done by de Souza (2002), who uses a very simple gravity equation to capture the effect of the variables that are of interest. The results from the estimations based on the 15 EU countries for the period 1980 to 2001 indicate the lack of a consistent relationship between EMU and trade. De Souza (2002:14) provides various explanations. One hypothesis is that the period corresponding to the fixing of the exchange rates is not an adequate proxy for the introduction of the monetary union. Another hypothesis is that forward-looking agents anticipated and discounted the increase in trade associated with EMU membership. EU integration is a long, phased-in process, and all the trade gains from monetary union could have been realized before EMU entry. To test these two hypotheses formally, the regressions are re-run, this time treating EMU not as a single event but as part of a long-term

integration process. This is represented by a series of continuous cross-country interest rate differentials. To account for the anticipation effects of monetary integration, this continuous variable was calculated for the whole sample. The assumption is that the gradual emergence of the monetary union can be approximated by a reduction in the interest rate differentials to zero. The results show that regardless of EMU participation, a reduction in differentials is associated with an increase in trade (De Souza 2002:20). The conclusion drawn is that while treating EMU as part of a long-term integration process shows a stronger evidence of trade effect, the increase in trade does not seem to be caused by a specific exchange rate arrangement, but by the credibility of the arrangement. A credible exchange rate mechanism can therefore substitute for an institutionalized monetary union. De Souza (2002:21) cautions policy makers, neither to underestimate the timeframe, nor to overestimate the potential economic benefits from any single component of a regional integration process.

Another recent study by Barr, Breedon and Miles (2003) estimates the impact of the euro on trade among EMU members with a standard gravity model on a panel consisting of 17 European countries and data from 1978 to the first quarter of 2002. The authors are particularly concerned about the endogeneity issue: do EMU members trade more as a result of the adoption of the euro, or did they form a monetary union as a result of intensive trade links? If countries that expect a considerable increase in their trade in any event are more likely to form a currency union, then the estimated relationship between trade and currency unions cannot be interpreted as a currency union effect (Barr *et al* 2003:580). Even the use of fixed effects does not solve the endogeneity problem if the omitted variable predicts both the decision to join a currency union and higher trade. Barr *et al* (2003) argue that this can only be solved by an instrumental variable, something that predicts entry into a currency union, but cannot have been influenced by the potential trade increase. When they apply the original Rose (2000) specification to their data, the common currency effect on trade is estimated at 29 percent. Similar results are obtained with the instrumental variable approach, using co-movements of output and prices as indicators of the propensity to form a currency union. The results suggest that it is membership of EMU that is responsible for almost all the increase

in trade within EMU and not the other way around. However, this does not mean that all trade creating is the direct effect of entering EMU. It is possible that the countries that expected to join the currency union altered their policies in a way that stimulated trade, so that a part of the trade effect is indirectly the result of EMU. The use of time dummies reveals that EMU had an effect on trade well before it happened, suggesting that the policy preparations for the single currency have encouraged trade as well (Barr *et al* 2003:584).

Barr *et al* (2003) note that their model only estimated the trade impact with EMU countries, and that it is theoretically possible that the trade impact is due to trade diversion away from countries outside EMU with comparative advantage similar to that of EMU countries. However, they give some reassurance that this is not the case. Assuming that EMU has no effect on trade between non-EMU members, if there were trade diversion, trade between EMU members and non-members would decrease after the creation of the EMU relative to trade between non-members. The authors re-estimate the model with a separate dummy variable for trade between members and non-members of EMU but do not find a significant negative effect (Barr *et al* 2003:585). However, the lack of trade diversion does not mean that countries could not have done even better by joining the monetary union. The authors estimate the trade impact of staying out of EMU for Denmark, Sweden and the United Kingdom. While they find a much smaller estimate than implied by the Rose estimate, it is still dramatic, especially for the UK. The 29 percent pure currency union effect combined with a 43 percent exchange rate volatility effect indicates that British trade could have increased by 72 percent if the UK had not opted to stay out of the monetary union (Barr *et al* 2003:585).

A more recent study on the effect of the euro on trade covers four years with the new common currency (Flam & Nordström 2003). The authors estimate a gravity equation with country-pair fixed effect dummies to capture all factors that are particular to the pair. The novelty in their specification is the use of unilateral trade instead of bilateral trade as the dependent variable. The use of exports as the dependent variable makes it possible to separate euro effects on exports from euro to non-euro countries on the one hand, and exports from non-euro to euro countries

on the other hand. Flam and Nordström (2003) use a panel of 20 developed countries and yearly data from 1989 to 2002. Trade between the three EU countries that did not adopt the euro (Denmark, Sweden and the United Kingdom), and between them and seven non-EU developed countries serve as the benchmark against which trade patterns of EMU members are compared. Estimates of the model indicate that the introduction of the euro has increased trade between euro countries by 15 percent on average for the period 1998 to 2002 compared to the benchmark for the period 1989 to 2002. The euro effect on trade between members and non-members of the currency union is found to be 8 percent. Estimating the euro effect by year-dummies shows that there is a clear increasing trend starting in 1998, and later years show a significantly greater increase in trade volumes than early years of the euro period. Flam and Nordström (2003:19) maintain that the rising trend indicates that the effects are indeed caused by the introduction of the euro. Common currency effects are realized gradually, since producers need time to adjust production and supply patterns to the currency union. Flam and Nordström (2003) further argue that increasing vertical specialization could be the reason for the relatively large increase estimated for trade between EMU members and countries outside the union. Vertical specialization is less costly with a single currency and makes goods produced inside the euro area more competitive.

Another innovation of Flam and Nordström (2003) is that besides the aggregate estimates they also estimate euro effects on different sector exports in order to see whether the effects are present in certain sectors and absent in others. The sector estimates show wider distribution and less significance than the aggregate estimates. Significant euro effects are found for beverages and tobacco, chemical products and manufactured goods. Products in these sectors are either differentiated or require relatively much processing. It is argued that the concentration of significant euro effect to these sectors is not random but indicates that the trade effect is caused by increasing vertical specialization across countries in the case of manufacturing and by relatively high investments in marketing and distribution for differentiated products.

Finally, Flam and Nordström (2003:18) calculate what would happen to trade if Denmark, Sweden and the United Kingdom joined the European currency union.

They predict that the level of trade would be about 8 percent higher on average in the first five years after the adoption of the euro and about 10 percent higher in the fifth year. Of this increase only one percent is due to the elimination of nominal exchange rate volatility, the rest is attributed to the common currency.

De Nardis and Vicarelli (2003) also examine the impact of EMU on trade. They consider 11 exporter countries (members of EMU) and 32 importer countries (EMU 11 plus 21 other countries) during the period 1980 to 2000. They find that the adoption of the euro has had a positive but modest impact on bilateral trade between European countries. Their estimate of about 9 percent is much lower than previous estimates in the literature on a larger and more heterogeneous set of countries. Theirs is a short-run estimate, and they suggest that the long-run effect could accumulate to 16 percent, which is still much lower than the estimates of pre-EMU studies. According to the authors one reason for this divergence is that the euro was adopted after a long-term process of European integration and trade links were already very close because of cultural and neighbourhood factors. EMU countries shared several policy decisions before they gave up their own national currencies. The creation of the European Monetary System at the end of the 1970s and the institution of the Single Market in the 1980s and the macroeconomic convergence path to the euro adoption during the 1990s all contributed to the increase in trade relations among EMU members (de Nardis & Vicarelli 2003).

Table 6.3 provides a summary of the main results of the EMU studies discussed above. While the estimates vary, the general consensus seems to be that the euro's trade impact is positive but modest in size compared to the estimated impact derived from evidence on other currency unions.

Table 6.3 Summary of currency union trade effects from EMU studies

Study	Years covered	Countries in sample	Trade effect	Comments
Bun and Klaassen (2002)	1965-2001	EU 15 US, Japan, Canada	4 % - 40 %	Effects accumulate in the long term. Exchange rate volatility already low before EMU, effect comes via other channels: credibility, transaction costs savings, capital market integration.
De Souza (2002)	1980-2001	EU 15	none	No effect if EMU viewed as single event. More proof if EMU viewed as process. More trade conditional on credibility, not on specific exchange rate arrangement.
Barr, Breedon and Miles (2003)	1978-2002Q1	11 EMU ins 6 EMU outs	29 %	Trade increases in anticipation of EMU. No evidence of trade diversion, but EMU outs (UK, Denmark, Sweden) could have traded more, had they also joined.
De Nardis and Vicarelli (2003)	1980-2000	32 countries	9 %	Impact limited because trade links were already very close due to a long process of integration. In the long run, effect may be higher.
Flam and Nordström (2003)	1989-2002	20 developed countries	15 %	Exports from euro to non-euro countries and exports from non-euro to euro countries both increase. Increasing vertical specialization.
Micco, Stein and Ordoñez (2003)	1992-2002	22 developed countries / EU 15	4 % - 16 %	No evidence of trade diversion. Trade increases in anticipation of EMU. Effect higher for more developed countries.

6.4 Conclusion

Rose's methodology has been criticized on various points. Numerous authors embarked on a mission to shrink the trade effect of currency unions by attempting to correct for different methodological problems, such as non-random selection, non-linearities, simultaneity and aggregation bias. Although the resulting estimates of the trade effect of common currencies are highly divergent, they are generally much lower than Rose's original estimate. As noted by Smith (2002:22), the nature of the criticism is such that one's prejudices will largely determine whether one believes currency union has a significant effect on trade. One cannot ignore however, that even those studies that claim to have succeeded in shrinking the currency union effect, generally find a positive estimate. While Rose's original estimate of factor three is highly improbable, if in reality the impact is just a small fraction of that, it can still have a material effect on trade and growth. It would be foolish to claim that the results lead to the policy implication that countries should form currency unions to increase their trade and economic growth. However, it is clear, that trade implications are a factor that should be considered in a country's decision to join a currency union, together with other factors. How much weight should be attached to this specific factor, is debatable, and will depend on the characteristics of the specific countries involved.

In order to seek a better answer to the impact of common currencies on international trade one strand of the literature investigated the gold standard era. The noteworthy finding of most of these studies is that monetary integration a century ago had a trade-promoting effect similar in magnitude to the Rose effect. The gold standard proved to be more important than tariff policy and just as important as decreasing transport costs in fostering trade. It seems that the gold standard was responsible for about twenty percent of the global trade boom in the early 20th century. However, there is also evidence that the various currency areas of the era were formed because of existing strong trade links, and not the other way around. The strong correlation between currency arrangements and trade intensity has survived the historical test, but the direction of causation is uncertain. There is also no assurance that the historical evidence would be applicable to contemporary monetary integration, since so much has changed in a century.

Undoubtedly, the most exciting strand of literature on this topic is the one that extends the data set to the most recent years and which focuses on the European Monetary Union. From the various EMU studies the general consensus emerges that the euro's trade impact is positive but modest in size compared to the estimated impact derived from evidence on other currency unions. It remains to be seen whether the effect is low because there is not much data yet. It is possible that more trade will be created in the long run. However, it is also possible that EMU is a special case and the bulk of the trade-creating effect had been realized before the adoption of the euro, in anticipation of EMU.

From the present survey of the different studies that have estimated the effect of common currencies on trade it is apparent that although the range of the estimates is extremely wide, the size of the estimates seems to be getting smaller. The Rose effect appears to have passed both the historical and the most recent euro test. While there is no agreement on the exact size of the trade effect, the qualitative conclusion that a currency union promotes trade still stands. Attempts to arrive at a single representative estimate of the Rose effect will be discussed in the following chapter.

CHAPTER SEVEN

META-ANALYSIS OF THE EFFECT OF COMMON CURRENCIES ON TRADE

As discussed in the previous two chapters, a substantial number of papers have provided estimates of the effect of common currencies on trade. The question to be addressed in this chapter is how to evaluate the various research results in a formal and objective way and whether it is possible to arrive at a single representative estimate of the Rose effect. One answer lies in meta-analysis, a quantitative method of literature review, which is discussed in section 7.1. Examples of the application of meta-analysis in the field of economics are given in section 7.2. Section 7.3 presents Rose's different versions of the meta-analysis of the effect of common currencies on trade. In section 7.4 an attempt is made to confirm the results of Rose's meta-analysis using simple sorting techniques, measures of location and graphical representations of the estimates. Section 7.5 discusses the limitations of meta-analysis, such as publication bias and variable quality of the primary studies. Section 7.6 sums up the results of the meta-analysis of the Rose effect.

7.1 The techniques of meta-analysis

Meta-analysis uses various quantitative techniques to evaluate and combine empirical results from different studies. It is best seen as a statistical approach towards literature review (Florax *et al* 2002). The idea behind meta-analysis is that if a number of independent studies have been conducted on a particular subject, using different data sets and methods, then combining their results can provide more insight than simply listing individual results. Meta-analysis entails including all studies on the topic, published or not. In this way the potential bias introduced by any non-random selection of studies is reduced. The different point estimates of a given coefficient are treated as individual observations. One can use this vector of estimates to estimate the underlying coefficient of interest, to test the hypothesis that the coefficient is zero and to link estimates to features of the underlying studies. Meta-regression, in particular, is a form of meta-analysis especially designed to investigate empirical research in economics. In meta-regression analysis, the dependent variable is a summary statistic drawn from each study, while the explanatory variables include characteristics of the method and data used in these

studies (Stanley 2001:131-132). In other words, the estimates are regressed on the characteristics of the studies from which they were drawn. Thus, meta-regression analysis can explain to what extent different methods and data sets influence the results of individual studies.

7.2 Meta-analysis in economics

As a research method, meta-analysis has been widely applied in psychology, education and medical research. In the field of economics, the use of meta-analysis is a relatively new phenomenon, and not so widespread. However, it is gaining popularity. It was first used in environmental economics in the 1980s. The first study is a survey of property value studies estimating the impact of airport noise, and the meta-analytic innovation consists in merely providing an average Noise Depreciation Index over studies (Florax *et al* 2002: 9). Van den Bergh *et al* (1997) discuss a number of different applications of meta-analysis in environmental economics, the topics ranging from tourism multipliers to transport externality and policy issues. Although meta-analysis is most prevalent in environmental economics, it has also been applied in other areas, such as labour economics. For example, Weichselbaumer and Winter-Ebmer (2003) use meta-analysis to estimate the international gender wage gap. Regarding the analysis of international trade, meta-analysis has been used to assess the effect of environmental regulation on competitiveness and international trade flows (Mulatu *et al* 2001).

7.3 Rose and the meta-analysis of the trade effect of common currencies

In a quest to summarize and evaluate the various research results in a formal and objective way, and to arrive at a single representative estimate of the common currency effect on bilateral trade in general, Rose turned to meta-analysis for a solution. He performed various versions of the meta-analysis, necessitated by the continuously increasing number of studies on the topic. His meta-analysis of 19, 24 and 34 studies respectively (Rose2002a, 2002b, 2004a) are discussed in turn.

7.3.1 Rose's original meta-analysis of 19 studies

In his first meta-analysis Rose (2002a) synthesizes the estimates of the trade-creating effect of currency unions contained in 19 different studies. For each study the most preferred or most representative estimate of the effect of currency union on

bilateral trade is chosen. Pooling these estimates and their standard errors across studies, the null hypothesis, that there is no effect of currency union on trade, is tested. Rose (2002a) finds that the null hypothesis can be rejected at standard significance levels. The pooled effect is not just positive but economically significant, and is consistent with the hypothesis that currency union raises trade by an economically significant amount. The combined estimate implies that a currency union approximately doubles trade among its members. It is also shown that the conclusions remain the same if the six studies written or co-authored by Rose are dropped from the meta-analysis. The sensitivity of the meta-analysis to individual studies is tested by omitting studies from the meta-analysis one by one, and no single study is found to be especially influential in driving the results.

Ideally, variations in the point estimates of the different studies could be explained using multivariate meta-regressions with the different study characteristics as explanatory variables, but this is not feasible when there are only 19 studies. In an attempt to link estimates to features of the individual studies Rose (2002a) performs a series of single-independent-variable meta-regressions where the dependent variable is the set of 19 estimates from the different studies and the independent variable is a single feature of the underlying study. The independent variables in the different regressions include those study characteristics that are thought to be consequential, such as the number of observations in different data sets, the number of countries and the number of years investigated, and the standard error of the estimated coefficient. Dummy variables are used to indicate whether the study is contemporary or based on data before World War Two, whether it is based on cross-sectional or panel data and whether Rose is the author. The meta-regressions yield three results. First, there is no positive relationship between the number of observations and the estimated trade effect of currency unions. The lack of a positive relationship between sample size and the estimates is worrying, since it casts doubt on the authenticity of the underlying empirical phenomenon (Rose 2002a:8). Second, studies co-authored by Rose have consistently higher point estimates. Finally, there is no strong relationship between characteristics of studies, such as time span or nature of the data set, and point estimates. This is a disappointing result, since the meta-analysis failed to discover a consistent link between features of the studies and the estimates. The estimates are heterogeneous, in other words, effect size estimates vary between studies to a greater extent than

expected on the basis of chance alone. However, the reason for the heterogeneity of the estimates remains a mystery.

7.3.2 Rose's second meta-analysis of 24 studies

As more studies on the trade effect of common currencies appeared, Rose (2002b) repeated his meta-analysis, this time with 24 studies on the topic. The five new studies that have been added to the original sample of 19 studies display heterogeneous estimates of the trade-creating effect of common currencies, ranging from 8 percent (Bomberger 2002) to 376 percent (Alesina *et al* 2002). The total range of all estimates has therefore increased, but the inclusion of the five new studies did not have any effect on the results of the original meta-analysis (Rose 2002a). The null hypothesis that there is no effect of currency union on trade can still be rejected at standard significance levels and no consistent link between study characteristics and estimates is found. Even the combined estimate remains unchanged and implies that a currency union has a doubling effect on bilateral trade among its members (Rose 2002b).

7.3.3 Rose's third meta-analysis of 34 studies

The most recent meta-analysis of the trade effect of currency unions provides a summary about the current state of the debate on the basis of 34 studies (Rose 2004a). The various single-independent-variable regressions used in the first meta-analysis (Rose 2002a) are applied to the larger set of studies and two new regressions are added, necessitated by the different characteristics of the 10 new studies, many of which investigate the trade effect of the euro directly. The two additional features under scrutiny are whether the focus of a study is on EMU observations and whether the focus is on the short run. Rose (2004a) then combines the most statistically significant independent variables in a multivariate meta-regression. Focus on EMU observations, short-run focus, Rose as author and cross-sectional versus panel data are the four study characteristics used as explanatory variables in the multivariate regression. Compared to the two earlier versions of the meta-analysis (Rose 2002a, 2002b), the new finding of the meta-regression is that studies with an EMU focus consistently find a lower effect of currency union on trade, either because there is little data yet on the EMU era or because the effect is

indeed small (Rose 2004a:9). Given the consistently lower estimates of the euro studies, it is impossible to arrive at a single representative estimate of the common currency effect on bilateral trade in general. It might well be the case that the trade-creating effect differs across the different currency unions. Rose (2004a:13) concludes that the combined estimate implies that a currency union increases trade by between 30 percent and 90 percent.

7.4 A simple version of the meta-analysis of 34 studies

Rose (2002a, 2002b, 2004a) used regressions and complex statistical tests in his different versions of the meta-analysis of the trade effect of common currencies. It is interesting to examine whether elementary statistical techniques lead to the same or different conclusions. In this section a simple meta-analysis is presented, using sorting techniques, measures of location and box-and-whisker plots to represent the data graphically (Steffens 1991). As a first step, the 34 studies that provide estimates about the effect of common currencies on bilateral trade are tabulated along with the most representative estimates of the coefficient of interest - as chosen by Rose (2004a) - in table 7.1. Since the studies measure bilateral trade in logs, the trade effect is not obvious from simply looking at the estimates. In order to make the data more meaningful, the exponential of the estimate is shown in the next column. For example, if the estimate of the coefficient is 1.1, $\exp(1.1)=3$, which implies that currency unions triple trade.

For ease of reference the trade multiplying factors are further converted into percentage values in the next column, shown in bold. Factor 3 therefore becomes 200 percent, indicating that if two countries form a currency union their bilateral trade will increase by 200 percent. This is the estimated trade-creating effect of common currencies, and studies have been arranged on the basis of this percentage value in descending order. This results in a ranking of estimates from highest to lowest. It can be seen that the highest estimate is 376 percent (Alesina *et al* 2002) while the lowest estimate is minus 31 percent. Both are extreme estimates, therefore the range, the difference between the largest and smallest estimate value, does not say much about the remaining estimates. The highest estimate is extreme in the sense that its distance from the second highest estimate is greater than any distance between two consecutive estimates. The lowest estimate is extreme in the sense that

it is the only one with a negative sign. All the other estimates indicate a positive relationship between the adoption of a common currency and the level of bilateral trade.

Table 7.1 Studies ranked according to the size of the estimated trade effect

Rank	Author	Year	Estimate	exp (estimate)	Estimated trade effect (%)	Rose euro
1	Alesina, Barro & Tenreyro	2002	1.56	4.759	376	
2	Melitz	2002	1.38	3.975	297	
3	Frankel & Rose	2002	1.36	3.896	290	√
4	Kenen	2002	1.2219	3.394	239	
5	de Sousa & Lochard	2003	1.21	3.353	235	
6	Rose	2000	1.21	3.353	235	√
7	Rose & Engel	2002	1.21	3.353	235	√
8	Flandreau & Maurel	2001	1.16	3.190	219	
9	Rose	2004b	1.12	3.065	206	√
10	Honohan	2001	0.921	2.512	151	
11	Rose & van Wincoop	2001	0.91	2.484	148	√
12	Nitsch	2002b	0.82	2.270	127	
13	Rose	2001	0.74	2.096	110	√
14	Subramanian & Wei	2003	0.732	2.079	108	
15	López-Córdova & Meissner	2003	0.716	2.046	105	
16	Melitz	2001	0.7	2.014	101	
17	Glick & Rose	2002	0.65	1.916	92	√
18	Nitsch	2002a	0.62	1.859	86	
19	Saiki	2002	0.56	1.751	75	
20	Persson	2001	0.506	1.659	66	
21	Klein	2002	0.5	1.649	65	
22	Levy Yeyati	2003	0.5	1.649	65	
23	Tenreyro	2001	0.471	1.602	60	
24	Smith	2002	0.38	1.462	46	
25	Bun & Klaassen	2002	0.33	1.391	39	√
26	Estevadeordal, Frantz & Taylor	2003	0.293	1.340	34	
27	Barr, Breedon & Miles	2003	0.25	1.284	28	√
28	de Souza	2002	0.17	1.185	19	√
29	Flam & Nordström	2003	0.139	1.149	15	√
30	Tom & Walsh	2002	0.098	1.103	10	
31	Micco, Stein & Ordoñez	2003	0.089	1.093	9	√
32	Bomberger	2002	0.08	1.083	8	
33	de Nardis & Vicarelli	2003	0.061	1.063	6	√
34	Pakko & Wall	2001	-0.378	0.685	-31	
	Mean				114	
	Median				89	
	Third quartile			First quartile	34	
				Interquartile range	172	

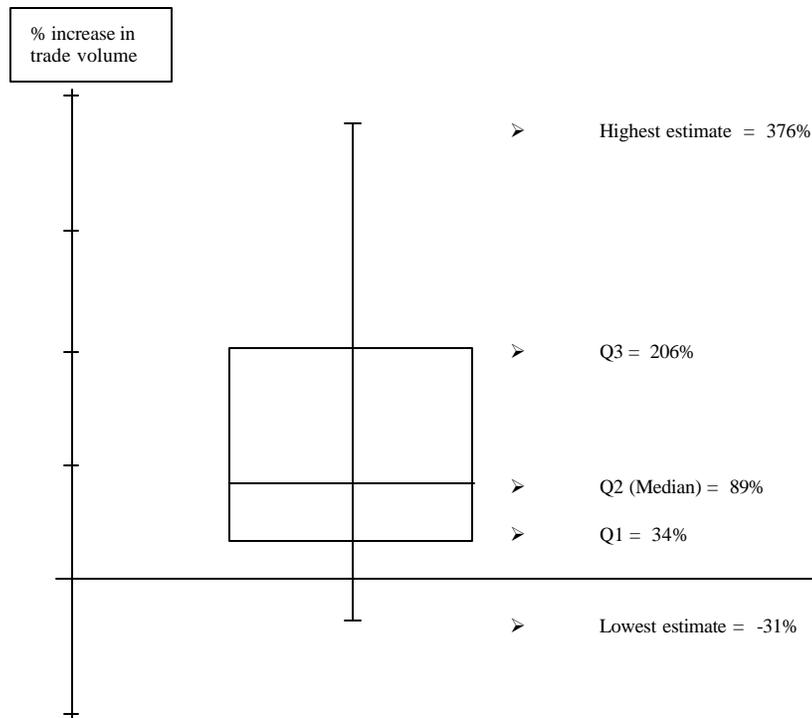
Simply adding together all the percentage estimates and dividing this total by the number of studies gives the mean estimate, which implies a 114 percent increase in trade associated with the adoption of a common currency. Another measure of location, the median, divides the estimates into two equal parts. Half of the estimates are larger than the median and half of them are smaller. Since the number of studies in the meta-analysis is even, the median is taken as the average of the two middle values (92 percent estimated by the Glick and Rose (2002) study ranked 17th and 86 percent estimated by Nitsch (2002a) ranked 18th) and is therefore 89 percent. In a symmetric distribution the mean and the median are equal. In this case the mean is larger than the median, indicating that the distribution is skewed upwards, and that some of the extremely high estimates are outliers. Given the skewed distribution of the estimates, the median is a better choice than the mean, provided one insists on arriving at a single estimate. In fact, the median value of 89 percent is very close to the upper value of the estimated trade effect of currency unions that Rose (2004a) arrived at in his meta-analysis, namely that a currency union increases trade by between 30 percent and 90 percent.

In order to get more information about the distribution of the estimates, the sample of studies is further divided into four equal parts. The values that subdivide the estimates are called quartiles. The first quartile (Q1) is the 9th lowest estimate, which is 34 percent, arrived at by Estevadeordal *et al* (2003). The second quartile (Q2) is equal to the median and is therefore 89 percent. The third quartile (Q3) is the 9th highest estimate of 206 percent by Rose (2004b). The interquartile range, in other words the values for the middle 50 percent of the estimates from Q1 to Q3, range from 34 percent to 206 percent. The interquartile range excludes the top 25 percent and bottom 25 percent of the values and is therefore unaffected by extreme estimates (Steffens 1991: 86).

The quartiles discussed above are displayed graphically in a box-and-whisker plot in figure 7.1. The vertical axis covers the range of estimates. The 'box' displays the three quartiles, with a horizontal line across it at the median. The 'whisker' from the box out to the extremes depicts the distances from the two outer quartiles to the lowest and highest estimates.

Figure 7.1

Box-and-whisker plot of the estimates of the trade effect of common currencies



The plot reveals a number of interesting characteristics about the distribution of the estimates. The upper whisker (Q3 to the highest estimate of 376 %) is longer than the lower whisker (Q1 to the lowest estimate of -31%). This confirms that the distribution is skew. Similarly, the position of the median line is not in the middle of the box and indicates an asymmetric distribution. Half the studies find that the trade-creating effect is larger than 89 percent and the highest estimate is more than four times greater than the median value. In spite of this wide range, basically all studies in the top half say the same, that the trade effect of a currency union is huge. Whether it is a tripling or a quadrupling effect does not seem to make that much difference, although the former estimate would be in the box and the latter quite high up on the upper whisker. Estimates from the bottom half of the studies seem to be more homogenous at first glance, because the range is smaller. However, the economic interpretation of the estimates reveals that this is not the case. While the values are numerically closer to each other, some estimates in the bottom half of the whisker would be interpreted as a significant effect while others would be seen as a modest effect. Estimates along the lower whisker range from modest to no effect at

all. It must be noted, that although Pakko and Wall (2001) (at the bottom of the whisker) arrived at a negative estimate of -31%, they did not actually conclude from this that a common currency decreases the volume of bilateral trade, but that it simply has no effect on trade levels.

7.4.1 Searching for links between estimates and study characteristics

One of the purposes of meta-analysis is to try and link estimates to study characteristics. In terms of the box-and-whisker plot it means that one looks for reasons why some estimates are in the box while others are on the whisker. In table 7.1 - alongside the estimates - it is shown for each study whether Rose is the author and whether the focus is on the euro. It is evident from the table that all Rose studies are in the top half of the ranked studies, four of them in the upper part of the box and two of them on the upper whisker. Since all Rose studies find higher estimates than the median, it can be concluded that studies co-authored by Rose have consistently higher estimates. Regarding the EMU studies it is interesting to note that all of them are among the lower ranked studies. Five of the six studies investigating the trade effect of the euro are located along the lower whisker and the sixth is in the bottom half of the box. It is therefore safe to say that studies with an EMU focus consistently find a lower effect of currency union on trade. These findings are therefore in accordance with the results of Rose's meta-analysis.

It would be interesting to find more links between study characteristics and the size of the estimated trade effect. Rose (2002a, 2002b, 2004a) has tried his best but failed to do so, therefore it should not come as a surprise that a simple ranking of estimates and a box-and-whisker plot cannot reveal further relationships. As a tentative effort, studies have been ranked in ascending order according to the standard error of the estimate (see table 7.2). An inspection of the ranking reveals that the two studies which have the highest standard error of the estimated coefficient, at the bottom of the list, happen to be the ones with the highest and the lowest estimate respectively (compare table 7.1). It appears that the most extreme estimates come from the studies with the worst fit and least precision. Hence there is good reason to consider them as outliers that can seriously distort the picture and they should rather be ignored. In the case of the lowest estimate (Pakko & Wall 2001) the reason for the large standard error and the negative estimate could be that

the authors tried to do time-series analysis on the basis of just a few observations. In the case of the study by Alesina *et al* (2002) it is not clear why the standard error and the estimated currency union effect are so large. It can be further seen that euro studies in general display relatively low standard errors of the estimate, probably because European countries are relatively homogenous and can be expected to experience reasonably similar trade effects from the adoption of the euro.

Table 7.2 Studies ranked according to the size of the standard error of the estimate

Rank	Author	Year	Estimate	standard error	% increase in trade	Rose author Euro
1	Flam & Nordström	2003	0.139	0.02	15	√
2	Micco, Stein & Ordoñez	2003	0.089	0.025	9	√
3	de Nardis & Vicarelli	2003	0.061	0.027	6	√
4	Barr, Breedon & Miles	2003	0.25	0.033	28	√
5	Bomberger	2002	0.08	0.05	8	
6	Glick & Rose	2002	0.65	0.05	92	√
7	Rose	2001	0.74	0.05	110	√
8	Flandreau & Maurel	2001	1.16	0.07	219	
9	Subramanian & Wei	2003	0.732	0.08	108	
10	Bun & Klaassen	2002	0.33	0.1	39	√
11	Smith	2002	0.38	0.1	46	
12	de Sousa & Lochard	2003	1.21	0.12	235	
13	Rose	2004b	1.12	0.12	206	√
14	Rose	2000	1.21	0.14	235	√
15	Estevadeordal, Frantz & Taylor	2003	0.293	0.145	34	
16	Melitz	2002	1.38	0.16	297	
17	Saiki	2002	0.56	0.16	75	
18	Nitsch	2002a	0.62	0.17	86	
19	Frankel & Rose	2002	1.36	0.18	290	√
20	Rose & van Wincoop	2001	0.91	0.18	148	√
21	López-Córdova & Meissner	2003	0.716	0.186	105	
22	Tom & Walsh	2002	0.098	0.2	10	
23	Melitz	2001	0.7	0.23	101	
24	de Souza	2002	0.17	0.24	19	√
25	Levy Yeyati	2003	0.5	0.25	65	
26	Persson	2001	0.506	0.257	66	
27	Klein	2002	0.5	0.27	65	
28	Nitsch	2002b	0.82	0.27	127	
29	Kenen	2002	1.2219	0.305	239	
30	Tenreyro	2001	0.471	0.316	60	
31	Rose & Engel	2002	1.21	0.37	235	
32	Honohan	2001	0.921	0.4	151	
33	Alesina, Barro & Tenreyro	2002	1.56	0.44	376	
34	Pakko & Wall	2001	-0.378	0.529	-31	

7.4.2 The size of the typical estimate

As far as the exact size of the trade effect of common currencies goes, it is not possible to say for certain that the typical value is somewhere in the box of the box-and-whisker plot, since most euro studies are on the lower whisker, outside the box. The first quartile of 34 percent is very close to the lower value of the estimated trade effect of currency unions that Rose (2004a) arrived at in his meta-analysis, which is 30 percent. However, this estimate disregards almost all the euro studies. It is almost certain that as time goes by more studies will appear estimating the trade effect of the euro, and it is reasonable to assume that these estimates will also be below the median. This will cause the box to slide down along the whisker. While the 90 percent upper limit of the currency union effect on trade suggested by Rose (2004a) seems reasonable, putting the minimum effect at 30 percent seems a bit too optimistic.

If the meta-analysis of the original 19 studies and that of the currently available 34 studies are compared the tendency of decreasing estimates is not that obvious. Table 7.3 shows the ranking of the estimates of the original 19 studies with the different quartile values. When the box-and-whisker plots of the original and the extended group of studies are displayed next to each other (see figure 7.2), one can see that the upper whisker got longer and even the box has become bigger, indicating a larger interquartile range. This implies that there is even less agreement about the size of the effect of a currency union on trade than earlier. This is in contrast to the emerging conclusion from the qualitative survey of the literature that points towards a more modest effect of currency union on trade. One reason for this could be that in the qualitative survey the focus was on the criticism of the Rose effect (see Chapter 6).

Another interesting point arising from the comparison of the two versions of the meta-analysis is that the mean value of the estimates is 114 percent, whether all 34 or only the 19 original studies are considered. However, the median estimate has fallen from 101 percent to 89 percent with the addition of the 15 recent studies. While the whole box has not slid down, its midline (indicating the median) and its bottom (showing the first quartile) are positioned significantly lower on the whisker (see figure 7.2). This might give some indication that the typical size of the

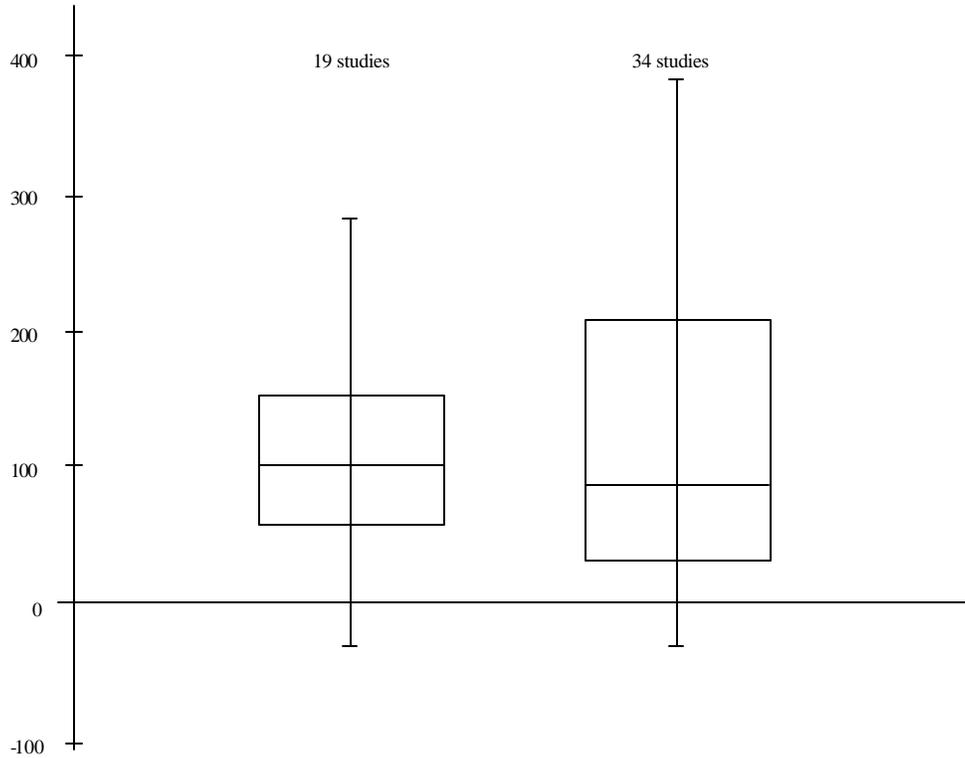
estimated effect of a currency union on trade has indeed decreased with more studies available on the topic.

Table 7.3 Ranking of the estimates of the 19 original studies

Rank	Author	Year	Estimated increase in trade (%)
1	Frankel & Rose	2002	290
2	Rose	2000	235
3	Rose & Engel	2002	235
4	Flandreau & Maurel	2001	219
5	Honohan	2001	151
6	Rose & van Wincoop	2001	148
7	Nitsch	2002b	127
8	Rose	2001	110
9	López-Córdova & Meissner	2003	105
10	Melitz	2001	101
11	Glick & Rose	2002	92
12	Nitsch	2002a	86
13	Persson	2001	66
14	Klein	2002	65
15	Levy Yeyati	2003	65
16	Tenreyro	2001	60
17	Estevadeordal, Frantz & Taylor	2003	34
18	Tom & Walsh	2002	10
19	Pakko & Wall	2001	-31
	mean value		114
	median value		101
	third quartile		151
	first quartile		65
	interquartile range		86

Figure 7.2

Box-and-whisker plots of the estimates of the trade effect of common currencies



7.4.3 Rose's influence on the typical estimate

In order to investigate Rose's influence on the value of the most typical estimate of the trade effect of common currencies, a subset of studies is formed that excludes the ones by Rose. These studies are tabulated and ranked according to the size of the estimates in table 7.4. The vital quartile values are calculated and on the basis of this information a box-and-whisker plot is drawn. Figure 7.3 compares the box-and-whisker plots of the full set of 34 studies and the subset that excludes Rose's studies. It is clear from this graphical representation of the estimates that Rose's studies have a significant influence on the typical size of the estimated effect that a currency union has on the level of international trade.

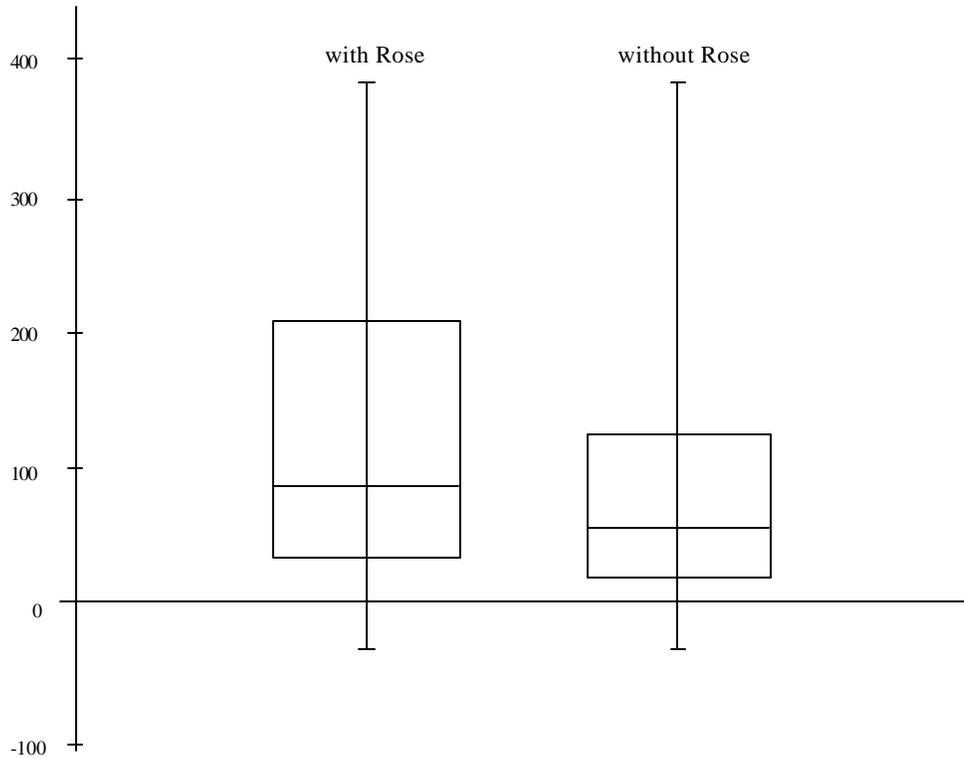
Table 7.4 Non-Rose studies ranked according to the size of the estimate

Rank	Author	Year	Estimated increase in trade (%)
1	Alesina, Barro & Tenreyro	2002	376
2	Melitz	2002	297
3	Kenen	2002	239
4	de Sousa & Lochard	2003	235
5	Flandreau & Maurel	2001	219
6	Honohan	2001	151
7	Nitsch	2002b	127
8	Subramanian & Wei	2003	108
9	López-Córdova & Meissner	2003	105
10	Melitz	2001	101
11	Nitsch	2002a	86
12	Saiki	2002	75
13	Persson	2001	66
14	Klein	2002	65
15	Levy Yeyati	2003	65
16	Tenreyro	2001	60
17	Smith	2002	46
18	Bun & Klaassen	2002	39
19	Estevadeordal, Frantz & Taylor	2003	34
20	Barr, Breedon & Miles	2003	28
21	de Souza	2002	19
22	Flam & Nordström	2003	15
23	Tom & Walsh	2002	10
24	Micco, Stein & Ordoñez	2003	9
25	Bomberger	2002	8
26	de Nardis & Vicarelli	2003	6
27	Pakko & Wall	2001	-31
	mean value		95
	median value		65
	third quartile		127
	first quartile		19
	interquartile range		109

If Rose's studies are not taken into consideration, the box slides down along the whisker. This indicates that the more representative half of the non-Rose studies typically finds a lower estimate than the middle 50 percent of the studies including Rose. The median estimate (Q2) falls from 89 percent to 65 percent, the typical high estimate (Q3) falls from 206 percent to 127 percent, and the typical modest estimate (Q1) falls from 34 percent to 19 percent.

Figure 7.3

Box-and-whisker plots of trade effect estimates with and without Rose



Since every fifth study on the topic is associated with Rose, it might be wise to try and arrive at a combined estimate on the basis of the subset of studies excluding Rose. The aim is not to disregard his research, but his overrepresentation in the sample is just too high. The without-Rose interquartile range is from 19 percent to 127 percent. Since many of the studies date back to the pre-EMU era and therefore disregard important recent evidence, it seems reasonable to take the without-Rose median of 65 percent as the upper value for the trade effect. The tentative conclusion from this simple meta-analysis is therefore that a currency union is typically associated with a significant increase in trade, ranging from about 20 percent up to about 60 percent.

7.5 The limitations of meta-analysis

Meta-analysis has the potential advantage of offering a more objective and more systematic approach towards analyzing sources of variation in previously obtained

research results than the traditional qualitative literature review (Florax *et al* 2002:1). However, there are also serious potential problems that can lead to biased estimates.

One of the threats to the validity of a meta-analysis is publication bias. Publication bias arises whenever the probability that a study is published depends on the statistical significance of its results. It is also known as the 'file-drawer' problem. If studies that fail to find statistically significant effects are more likely to be consigned to the 'file drawer' and less likely to be submitted to journals or accepted for publication, then published results tend to overstate the size and significance of the effect being investigated (Stanley 2001:146). The presence of publication bias in a meta-analysis dataset can be assessed informally by plotting effect size for each study against the standard error of the effect size (Sutton *et al* 2001:142). In the absence of publication bias the resulting plot should be shaped like a funnel. Rose (2004a) investigates the possibility of publication bias in his third meta-analysis and finds visual evidence of it from funnel plots. Publication bias can be tested more formally using statistical tests that are based on the same symmetry assumptions as a funnel plot inspection (Sutton *et al* 2001:143). Rose (2004a) uses various statistical tests and all confirm the presence of publication bias in his meta-analysis. It appears that studies that find a strong trade effect associated with common currencies are more likely to be published. Interestingly, there is still significant publication bias, even if the Rose studies are not taken into consideration. One might have expected the opposite, since much of the research on the trade effect of currency unions was motivated by the desire to destroy the infamous Rose effect. According to Rose (2004a:13), one of the reasons for publication bias could be that currency unification is an intensely political issue and the political preferences of researchers might have an influence on the reported findings.

A significant limitation of Rose's meta-analysis is that each study is given an equal weight in the conclusion. However, since a number of studies rely on the same dataset, the number of truly independent observations is much lower. For example, it is not a coincidence that Rose (2000), Rose and Engel (2002) and de Sousa and Lochard (2003) all arrive at a trade-creating effect of 235 percent, since the three studies are based on the same dataset and a similar specification. Furthermore, Rose

(2004b) and its criticism, Subramanian and Wei (2003) are not independent either. These studies take a big common currency effect as given and are not directly concerned with currency unions.

Equal weighting of the different studies also implies that there is no discrimination, although later research on more relevant databases and using more sophisticated methodologies has typically yielded lower estimates. Meta-analysis in general is plagued by the problem that studies are not of the same high quality. The inclusion of poor or flawed studies in a meta-analysis can bias the pooled result and even mean that the meta-analysis comes to the wrong qualitative conclusions (Sutton *et al* 2001:143). Nevertheless, the quantitative survey of the literature shows convincing evidence that currency union has a positive effect on trade.

7.6 Conclusion

Rose's quantitative survey of the literature shows persuasive evidence that currency union membership has a positive effect on trade. The combined estimated effect is large in terms of both economic and statistical significance. According to Rose's conclusions from his latest meta-analysis, the trade-creating effect of common currencies is in the region of 30 to 90 percent. This is below the combined estimate of approximately 100 percent found in earlier versions of the meta-analysis, indicating that the estimated trade-creating effect of common currencies is getting smaller as more evidence is accumulated. The estimates are heterogeneous and not consistently tied to most features of the studies, with two notable exceptions. First, studies that focus on the euro find a lower effect of currency union on trade. Second, studies co-authored by Rose find a higher effect. These two results are confirmed by simple graphical representations of the estimates and an examination of quartiles. It is probable that Rose's estimates might bias the overall conclusion of the meta-analysis, not because his estimates are generally higher, but because there are a great number of Rose studies. The overrepresentation of Rose and the fact that many studies date back to the era before the introduction of the euro suggest that the effect of a currency union on trade is lower than suggested by Rose's meta-analysis, and probably falls in the range of 20 to 60 percent.

CHAPTER EIGHT

CONCLUSION

The purpose of this dissertation was to investigate the effect of common currencies on trade. The potential increase in trade is regarded as one of the most important benefits of a currency union. A country's costs and benefits from joining a currency union depend on how closely integrated its economy is with those of its potential partners. The traditional theory of optimum currency areas identifies those specific characteristics that are relevant for choosing the likely participants in a currency union. The intensity of trade with other potential members of the currency union and the extent to which domestic business cycles are correlated with those of other countries are among the most important criteria. The more two countries trade with each other and the more similar their business cycles are, the better candidates they are for a currency union.

Empirical studies trying to identify optimum currency areas in the world on the basis of the criteria suggested by OCA theory generally find that the costs of adopting a single currency are too high for most regions. However, these studies are by necessity backward looking and ignore the possibility that the costs and benefits of participating in a currency union may change over time. Contrary to the traditional OCA theory that postulates that a high degree of real integration is necessary for a monetary union to be successful, the endogeneity hypothesis postulates that countries do not need to meet many of the criteria before integration. In terms of the endogeneity argument, convergence will follow from joining a currency union and the integration process itself will turn the countries into optimal currency areas. The causality between economic integration and monetary integration is two-way and mutually reinforcing. In other words, the adoption of a common currency can foster more trade and synchronize business cycles between countries, thus increasing the benefits and reducing the costs of sharing a common currency. Therefore, instead of asking if a certain area forms an optimum currency area one should rather ask if a proposed currency union is a feasible currency area. Since the similarity in a number of the OCA criteria is expected to increase as a

consequence of membership in a currency union, the case for common currencies is stronger than previously thought.

In line with the endogeneity argument, advocates of currency unions argue that an increase in trade is an important benefit of adopting a common currency. However, indirect evidence from studies on the effect of exchange rate volatility on trade does not support this claim. The relationship between exchange rate volatility and levels of international trade is both theoretically and empirically ambiguous. On a theoretical level, it is possible for increased exchange rate variability to have a positive effect on trade, since changes in exchange rates do not simply represent risk, they also create profit opportunities. However, the idea that exchange rate volatility could promote trade goes against economic intuition. On an empirical level, most studies fail to find a consistent link between exchange rate volatility and trade. Some find a negative but modest effect, and there are some that find that the relationship is actually positive. Overall, the main empirical findings support the hypothesis that exchange rate variability does not have a significant impact on trade, which means that exchange rate volatility does not seem to be a serious obstacle to trade. This is bad news for the proponents of currency unions, since their arguments are weakened by this result.

Although volatility studies do not support the argument that the adoption of a common currency will encourage trade between members of a currency union, this cannot be taken as the final word on the relationship between trade and common currencies. The conclusion that common currencies do not have a significant impact on trade is based on the assumption that the adoption of a common currency is equivalent to the reduction of exchange rate volatility to zero. In a direct study of the effect of common currencies on trade Rose separated the currency union effect on trade from the effect of eliminating exchange rate volatility. Rose estimated that countries that share a common currency trade three times more than those that do not. Furthermore, the common currency effect on trade is separate from and additional to the effect of the complete elimination of exchange rate variability. The important finding is that a currency union is different from a fixed rate regime and has a significantly stronger effect on international trade.

While the trade-creating effect of common currencies is considerable, the existence of different national currencies only gives a partial explanation of the tendency to trade much more within countries than across borders. The border effect is much larger than the currency union effect. The adoption of a common currency can reduce some of the barriers to trade, but the exact reason behind the effect is not properly understood. However, the currency union effect on trade deserves serious attention, because more trade can lead to higher economic growth.

The study of the trade effect of common currencies is impeded by the fact that there are very few examples of currency union formations. One line of research therefore attempted to draw conclusions about the currency union effect on trade on the basis of the effect of currency union dissolutions on trade. However, if a currency union dissolution is found to have a negative effect on trade, it cannot be simply assumed that a currency union formation would have a symmetrical positive effect on trade. Furthermore, the conclusion of early research must be treated with care since the large estimated trade effect of common currencies is based mostly on the experience of small, poor, developing countries. Because of the different characteristics of the countries, the result cannot be applied to the monetary unification plans of major, developed economies.

Rose's methodology has been criticized on various points. Numerous authors attempted to correct for different methodological problems, such as non-random selection, non-linearities, simultaneity and aggregation bias. The various studies arrived at heterogeneous estimates, although the majority of the estimates is lower than the original Rose effect. However, even those studies that claim to have shrunk the currency union effect, generally find a positive estimate. While Rose's original estimate of factor three is highly implausible, even if in reality the effect is just a small fraction of that, it can still have a significant impact on trade and growth.

In order to find a more accurate estimate of the impact of common currencies on international trade some researchers extended their data set back into the late 19th and early 20th century, an era characterized by the gold standard. The remarkable finding of most studies is that the trade-promoting effect of monetary integration a century ago was similar in size to the Rose effect. The gold standard proved to be more important than tariff policy and just as important as decreasing transport costs

in fostering trade. However, there is also indication that the various currency areas of the era were formed because of existing strong trade links, in line with the traditional theory of optimum currency areas. The strong correlation between currency arrangements and trade intensity has survived the historical test, but the direction of causation is uncertain. There is also no guarantee that the historical evidence on the trade effect of common currencies would be relevant to contemporary monetary integration.

With the formation of the European Monetary Union it has at last become possible to estimate the effects of a common currency on trade directly. From the six studies on the topic to date the general consensus emerges that the trade impact of the euro is positive but modest in size compared to the estimated impact derived from evidence on other currency unions. It remains to be seen whether the effect is low because the euro is still in its infancy. It is possible that more trade will be created in the long run. However, it is also conceivable that EMU is indeed a special case and the bulk of the trade-creating effect has been realized before the adoption of the euro, in anticipation of EMU. Nevertheless, the euro studies added support to the hypothesis that currency unions promote international trade, while at the same time increased the doubt that the effect is indeed as large as previously claimed.

In a quest to summarize and evaluate the various research results in a formal and objective way, and to arrive at a single representative estimate of the common currency effect on bilateral trade, Rose turned to meta-analysis. His quantitative survey of the literature shows persuasive evidence that currency union membership has a positive effect on trade. The combined estimated effect is in the region of 30 to 90 percent, indicating that the estimated effect of common currencies on trade is getting smaller as more evidence is accumulated. Nevertheless, the effect is still significant, both statistically and economically.

Rose's meta-analysis finds that the estimates are heterogeneous and not consistently tied to most features of the studies. However, even simple graphical representations of the estimates and an examination of quartiles clearly show that studies that focus on the euro find a lower effect of currency union on trade, while studies co-authored by Rose find a higher effect. Rose's estimates might bias the overall conclusion of the meta-analysis, not because his estimates are generally higher, but because there

are a great number of Rose studies. The overrepresentation of Rose and the fact that many studies date back to the era before the introduction of the euro suggest that the effect of a currency union on trade is somewhat lower than suggested by Rose in his meta-analysis and rather falls in the range of 20 to 60 percent.

The qualitative conclusion is that currency union formation has a positive effect on trade. However, it would be unwise to maintain that the results lead to the conclusion that countries should form currency unions to increase their trade and economic growth. The trade-promoting factor should definitely be considered in a country's decision to join a currency union, together with other factors. How much weight should be attached to this specific factor, is debatable, and will depend on the characteristics of the specific countries involved.

It is important to remember that the estimated trade effect is a percentage change. Even if the currency union effect on trade is as large as 100 percent, if two countries had no trade relations before the formation of the currency union, their trade will not increase at all in terms of the estimated trade effect. Whether a common currency has a doubling or tripling effect on trade does not make any difference, since any multiple of zero is still zero. The implication is that two countries must be natural trading partners to benefit from the trade-creating effect of common currencies. A currency union is not a magic wand. Just because two countries adopt a currency, they will not suddenly start to trade with each other. On the other hand, if the volume of trade between two countries is high, then forming a currency union can lead to substantial trade benefits in absolute terms, even if the percentage value of the trade effect is low. Finally, if two countries have strong trade links, it must be asked whether the high volume of trade is due to anticipations about the formation of a prospective currency union. If trade has increased because of future expectations about a common currency, then trade may not increase further once the currency union is actually formed.

LIST OF SOURCES

- Abrams, RK 1980. *Actual and potential trade flows with flexible exchange rates*. Federal Reserve Bank of Kansas City Working Paper 80-01
- Ahumada, H & Martirena -Mantel, AM 2001. *Towards a potential monetary union in Latinoamerica: testing the endogeneity criteria for Mercosur*. Torcuato di Tella University Working Paper.
- Alesina, A & Barro, R 2001. One country, one currency? In idem (eds) *Currency unions*. Stanford: Hoover Institution Press, 11-20.
- Alesina, A & Barro, R 2002. Currency unions. *Quarterly Journal of Economics*, 117(2): 409-436.
- Alesina, A, Barro R & Tenreyro, S. 2002. *Optimal currency areas*. NBER Working Paper 9072. Available at <http://papers.nber.org/papers/w9072.pdf>
- Anderson, JE & van Wincoop, E 2001. *Gravity with gravitas: A solution to the border puzzle*. NBER Working Paper 8079
- Anderton, R & Skudelny, F 2001. *Exchange rate volatility and euro area imports*. European Central Bank Working Paper 64. Available at <http://www.ecb.int/pub/wp/ecbwp064.pdf>
- Arize, AC 1998a. The effects of exchange rate volatility on U.S. imports: An empirical investigation. *International Economic Journal*, 12(3): 31-40.
- Arize, AC 1998b. The long-run relationship between import flows and real exchange rate volatility: The experience of eight European countries. *International Review of Economics and Finance*, 7(4): 417-35.
- Arize, AC, Osang, T & Sloodje, D 2000. Exchange rate volatility and foreign trade: Evidence from thirteen LDC's. *Journal of Business and Economic Statistics*, 18(1): 10-17.
- Artis, M & Zhang, W 1997. International business cycles and the ERM: Is there a European business cycle? *International Journal of Finance and Economics*, 2(1):1-16.
- Artis, M, Kohler, M & Melitz, J 1998. Trade and the number of OCA's in the world. *Open Economies Review*, 9(1): 537-568.

- Asseery, A & Peel, DA 1991. The effects of exchange rate volatility on exports. *Economics Letters*, 37(2): 173-177.
- Babetski, J 2003. *EU enlargement and endogeneity of OCA Criteria: Evidence from the CEECs*. CERGE-EI, Charles University conference paper. Available at <http://roses.univ-paris1.fr/Conference/articles/Babetskii03-311.pdf>
- Bah, I & Amusa, HA 2002. *Real exchange rate volatility and foreign trade: Evidence from South Africa's exports to the United States*. unpublished conference paper. Available at <http://www.up.ac.za/academic/economic/econ/conference/Conference2002/full%20papers/Deji.pdf>
- Baldwin, R & Taglioni, R 2004. *Positive OCA criteria: Microfoundations for the Rose effect*. Geneva: Graduate Institute of International Studies. Available at <http://www.tcd.ie/iis/pdf/baldwinROSE.pdf>
- Baron, DP 1976. Fluctuating exchange rates and the pricing of exports. *Economic Enquiry*, 14: 425-38.
- Barr, D, Breedon, F & Miles, D 2003. Life on the outside: economic conditions and prospects outside euroland. *Economic Policy*, 18 (37): 573-613.
- Bayoumi, T 1994. *A formal model of optimum currency areas*. CEPR Discussion Paper 968. Available at <http://ideas.repec.org/p/cpr/ceprdp/968.html>
- Bayoumi, T & Eichengreen, B 1994. *One money or many? Analysing the prospects for monetary unification in various parts of the world*. Princeton Studies in International Finance, No76. International Finance Section, Princeton University.
- Bayoumi, T & Prasad, E 1995. *Currency unions, economic fluctuations and adjustment: Some empirical evidence*. CEPR Discussion Paper 1172.
- Beine, M & Docquier, F 1998. A stochastic simulation model of an optimum currency area. *Open Economies Review*, 9: 227-255.
- Bélanger, D, Gutiérrez, S & Raynauld, J 1998. *Exchange rate variability and trade flows: Sectoral estimates for the U.S.-Canada case*. Cahiers de Recherche IEA-8901. École des Hautes Études Commerciales.
- Belke, A & Heine, JM 2001. *On the endogeneity of an exogenous OCA-criterion: The impact of specialization on the synchronization of regional business cycles in Europe*. HWWA Discussion Paper 119.
- Bini-Smaghi, L 1991. Exchange rate variability and trade: Why is it so difficult to find any empirical relationship? *Applied Economics*, 23: 927-935.

- Bofinger, P 1994. Is Europe an optimum currency area? In Steinherr, A (ed) *30 years of European monetary integration from the Werner plan to EMU*. London: Longman, 38-56.
- Bomberger, WA 2002. *Decolonization and estimates of the time series effect of currency unions*. University of Florida Working Paper.
- Brada, JC and Mendez, JA 1988. Exchange rate risk, exchange rate regime and the volume of international trade. *Kyklos*, 41(2): 263-280.
- Broll, U & Eckwert, B 1999. Exchange rate volatility and international trade. *Southern Economic Journal*, 66(1): 178-185.
- Buiter, WH 1995. *Macroeconomic policy during a transition to monetary union*. CEPR Discussion Paper 1222.
- Bun, M & Klaassen, F 2002. *Has the euro increased trade?* Tinbergen Institute Discussion Paper 2002-108/2.
- Clark, PB 1973. Uncertainty, exchange risk, and the level of international trade. *Western Economic Journal*, 11: 302-13.
- Cohen, B 2001. Beyond EMU: The problem of sustainability. in Eichengreen, B & Frieden, J (eds.) *The Political Economy of European Monetary Unification*, Westview Press. Available at <http://www.polsci.ucsb.edu/faculty/cohen/recent/beyond.html>
- Corden, WM 1972. *Monetary integration*. Essays in International Finance, No93. International Finance Section, Princeton University.
- Corsetti, G & Pesenti P 2002. *Self-validating optimum currency areas*. NBER Working Paper 8783. Available at <http://www.nber.org/papers/w8783>
- Côté, A 1994. *Exchange rate volatility and trade: a survey*. Bank of Canada. Working Paper 94-5. Available at <http://www.bank-banque-canada.ca/publications/working.papers/1994/wp94-5.pdf>
- Cushman, DO 1986. Has exchange rate risk depressed international trade? The impact of third-country exchange risk. *Journal of International Money and Finance*, 5: 361-79.
- Darvas, Z & Szapáry, G 2004. *Business cycle synchronization in the enlarged EU: Comovements in the old and new members*. MNB Working Paper 2004/1.
- De Grauwe, P 1988. Exchange rate variability and the slowdown in the growth of international trade. *IMF Staff Papers*, 35: 63-84.

- De Grauwe, P 2003. *Economics of monetary integration*. Oxford; New York: Oxford University Press. 5th ed.
- De Grauwe, P & Skudelny, F 2000. The impact of EMU on trade flows. *Weltwirtschaftliches Archiv*, 136(3): 381-402.
- De Grauwe, P & Vanhaverbeke, W 1993. Is Europe an optimum currency area? Evidence from regional data. In: Masson, PR & Taylor, MP (eds) *Policy issues in the operation of currency unions*. Cambridge: Cambridge University Press.
- De Grauwe, P & Verfaillie, G 1988. Exchange rate variability, misalignment, and the European Monetary System. In: Marston, RC (ed) *Misalignment of exchange rates: Effects on trade and industry*. Chicago: University of Chicago Press, 77-100.
- De Nardis, S & Vicarelli, C 2003. Currency unions and trade: The special case of EMU. *Weltwirtschaftliches Archiv*, 139 (4): 625-649.
- De Sousa, J & Lochard, J 2003. *Do currency unions solve the border effect puzzle?* LESSOR/ROSES unpublished
- De Souza, LV 2002. *Trade effects of monetary integration in large, mature economies: A primer on the European Monetary Union*. Kiel Institute of World Economics Working Paper No. 1137. Available at <http://www.uni-kiel.de/ifw/pub/kap/2002/kap1137.pdf>
- Decressin, J & Fatás, A 1995. Regional labor market dynamics in Europe. *European Economic Review*, 39: 1627-1655.
- Dell'Ariccia, G 1999. Exchange rate fluctuations and trade flows: evidence from the European Union. *IMF Staff Papers*, 46(3): 315-334.
- Demers, M 1991. Investment under uncertainty, irreversibility and the arrival of information over time. *Review of Economic Studies*, 58: 333-350.
- Demopoulos, GD & Yannacopoulos, NA 2001. On the optimality of a currency area of a given size. *Journal of Policy Modeling*, 23:17-24.
- Eichengreen, B 1992. *Should the Maastricht treaty be saved?* Princeton Studies in International Finance, No74. International Finance Section, Princeton University.
- Eichengreen, B & Irwin, DA 1995. Trade blocks, currency blocks and the re-orientation of trade in the 1930s. *Journal of International Economics*, 38(1): 1-24.
- Emerson, M, Gros, D, Italianer, A, Pisani-Ferry, J & Reichenbach, H 1992. *One market, one money: An evaluation of the potential benefits and costs of forming an economic and monetary union*. Oxford: Oxford University Press.

- Estevadeordal, A, Frantz, B & Taylor, AM 2003. The rise and fall of world trade, 1870-1939. *Quarterly Journal of Economics*, 118(2): 359-407.
- Ethier, W 1973. International trade and the forward exchange market. *American Economic Review*, 63: 494-503.
- Fatás, A 1997. EMU: *Countries or regions? Lessons from the EMS experience*. CEPR Discussion Paper 1558. Available at www.cepr.org/pubs/dps/DP1558.asp
- Fidrmuc, J 2004. The endogeneity of the Optimum Currency Area criteria, intra-industry trade, and EMU enlargement. *Contemporary Economic Policy*, 22: 1-12.
- Fidrmuc, J & Fidrmuc, J 2003. Disintegration and trade. *Review of International Economics*, 11(5): 811-829.
- Flam, H & Jansson, P 2000. *EMU effects on international trade and investment*. Seminar Paper 683. Stockholm University. Available at <http://www.iies.su.se/publications/seminarpapers/683.pdf>
- Flam, H & Nordström, H 2003. *Trade volume effects of the euro: Aggregate and sector estimates*. Available at <http://www.ne.su.se/research/seminars/pdf/030909.pdf>
- Flandreau, M & Maurel, M 2001. *Monetary union, trade integration, and business cycles in 19th century Europe: Just do it*. CEPR Discussion Paper 3087.
- Fleming, JM 1971. On exchange rate unification. *Economic Journal*, 81: 467-488.
- Florax, R, Groot, H & de Mooij, R 2002. *Meta-analysis*. Tinbergen Institute Discussion Paper 2002-041/3. Available at <http://www.tinbergen.nl/discussionpapers/02041.pdf>
- Fountas, S & Aristotelous, K 1999. Has the European Monetary System led to more exports? Evidence from four European Union countries. *Economic Letters*, 62: 357-363. Available at <http://ideas.repec.org/p/fth/galeco/31.html>
- Franke, G 1991. Exchange rate volatility and international trading strategy. *Journal of International Money and Finance*, 10: 292-307.
- Frankel, J 2003. The UK decision re EMU – implications of currency blocks for trade and business cycle correlations. In *Submissions on EMU from leading academics*, HM Treasury, 93-104.
- Frankel, J & Rose, A 1996. *Economic structure and the decision to adopt a common currency*. CIDER Working Paper C96-073, University of California at Berkeley.
- Frankel, J & Rose, A 1997. Is EMU more justifiable ex post than ex ante? *European Economic Review*, 41: 753-760.

- Frankel, J & Rose, A 1998. The endogeneity of the optimum currency area criteria. *Economic Journal*, 108: 1009-1025.
- Frankel, J & Rose, A 2002. An estimate of the effect of common currencies on trade and income. *Quarterly Journal of Economics*, 117(2): 437-466.
- Frankel, J & Wei, S. 1993. *Trade blocks and currency blocks*. NBER Working Paper 4335. Available at <http://papers.nber.org/papers/w4335.pdf>
- Fukuda, H 2002. *The theory of optimum currency areas: An introductory survey*. Keio University Mita festival paper. Available at <http://www.clb.econ.mita.keio.ac.jp/kaji/mitafest/fukuda.pdf>
- Ghosh, AR & Wolf, HC 1994. *How many monies? A genetic approach to finding optimum currency areas*. NBER Working Paper 4805. Available at <http://papers.nber.org/papers/w4805.pdf>
- Glick, R & Rose, A 2002. Does a currency union affect trade? The time-series evidence. *European Economic Review*, 46: 1125-1151.
- Guillaume, DM & Stasavage, D 2000. Improving policy credibility: Is there a case for African monetary unions? *World Development*, 28(8): 1391-1407. Available at doi:10.1016/S0305-750X(00)00038-3.
- Head, K & Mayer, T 2000. Non-Europe: The magnitude and causes of market fragmentation in the EU. *Weltwirtschaftliches Archiv*, 136(2): 238-314.
- HM Treasury 2003. *EMU and trade*. Available at http://www.hm-treasury.gov.uk/media/C4AA1/adsuf03_456.pdf
- Hoffmann, M 2003. *Financial integration, specialization and trade: More or less business cycle symmetry?* Konstanz University Seminar Paper.
- Honohan, P 2001. Discussion: Currency unions and trade: How large is the treatment effect? – Currency unions and trade: The effect is large. *Economic Policy*, 33: 457-59.
- Hooper, P & Kohlhagen SW 1978. The effect of exchange rate uncertainty on the prices and volume of international trade. *Journal of International Economics*, 8(4): 483-511.
- Horvath, R & Komarek, L 2002. *Optimum currency area theory: An approach for thinking about monetary integration*. Warwick University Economic Research Paper No 647.

- Imbs, J 1998. *Fluctuations, bilateral trade and the exchange rate regime*. University of Lausanne, DEEP Working Paper 9906. Available at <http://www.hec.unil.ch/deep/Textes/9906.pdf>
- Inter-American Development Bank 2002. *Más allá de las fronteras: El nuevo regionalismo en América Latina. Capítulo 9: Uniones monetarias*. Available at http://www.iadb.org/res/publications/pubfiles/pubB-2002S_1779.pdf
- International Monetary Fund 1984. *Exchange rate volatility and world trade*. Occasional Paper 28.
- Jonung, L & Sjöholm, F 1998. *Should Finland and Sweden form a monetary union?* Stockholm School of Economics, Working Paper Series in Economics and Finance No. 224.
- Kalemli-Ozcan, S, Sørensen, B & Yosha, O 2000. *Risk sharing and industrial specialization: Regional and international evidence*. Research Working Paper RWP 00-06 Federal Reserve Bank of Kansas City. Available at <http://www.kc.frb.org/publicat/reswkpap/PDF/rwp00-06.pdf>
- Kalemli-Ozcan, S, Sørensen, B & Yosha, O 2001. Economic integration, industrial specialization, and the asymmetry of macroeconomic fluctuations. *Journal of International Economics*, 55(1):107-137.
- Kenen, PB 1969. The theory of optimum currency areas: An eclectic view. In Mundell, RA & Swoboda, AK (eds) *Monetary problems of the international economy*. Chicago: University of Chicago Press, 41-60.
- Kenen, PB 2000. *Currency areas, policy domains, and the institutionalisation of fixed exchange rates*. CEP Discussion Paper 467. Available at <http://cep.lse.ac.uk/pubs/download/dp0467.pdf>
- Kenen, PB 2002. *Currency unions and trade: Variations on themes by Rose and Persson*. Reserve Bank of New Zealand Discussion Paper 2002/08.
- Kenen, PB 2003. What we can learn from the theory of optimum currency areas. In *Submissions on EMU from leading academics*, HM Treasury, 147-160.
- Klaassen, F 2004. Why is it so difficult to find an effect of exchange rate risk on trade? *Journal of International Money and Finance*, 23(5): 817-839.
- Klein, MW 1990. Sectoral effects of exchange rate volatility on United States exports. *Journal of International Money and Finance*, 9: 299-308.
- Klein, MW 2002 *Dollarization and trade*. NBER Working Paper 8879.

- Koray, F & Lastrapes, WD 1989. Real exchange rate volatility and U.S. Bilateral trade: A VAR approach. *Review of Economics and Statistics*, 71: 708-12.
- Kroner, KF & Lastrapes, WD 1993. The impact of exchange rate volatility on international trade: Reduced form estimates using the GARCH-in-mean model. *Journal of International Money and Finance*, 12: 298–318.
- Krugman, P 1993. Lessons of Massachusetts for EMU. In Giavazzi, F & Torres, F (eds) *Adjustment and growth in the European Monetary Union*. New York: Cambridge University Press, 241-261.
- Lastrapes, WD & Koray, D 1990. Exchange rate volatility and U.S. multilateral trade flows. *Journal of Macroeconomics*, 12: 341-62.
- Levy-Yeyati, E 2001. *On the impact of a common currency on bilateral trade*. Universidad Torcuato di Tella Working Paper.
- López-Córdova, JE & Meissner, CM 2003. Exchange-rate regimes and international trade: Evidence from the classical gold standard era. *American Economic Review*, 93 (1): 344-353.
- Lucas, RE 1976. Econometric policy evaluation: A Critique. Reprinted in idem 1981. *Studies in business cycle theory*. Cambridge, MA and London: MIT Press, 104-130.
- McCallum, J 1995. National borders matter: Canada-US regional trade patterns. *American Economic Review*, 85(3): 615-623.
- McKenzie, MD 1998. The impact of exchange rate volatility on Australian trade flows. *Journal of International Financial Markets, Institution and Money*, 8(1): 21-38.
- McKenzie, MD 1999. The effect of exchange rate volatility on international trade flows. *Journal of Economic Surveys*, 13(1): 71-106.
- McKenzie, MD & Brooks, RD 1997. The effect of exchange rate volatility on German-US trade flows. *Journal of International Financial Markets, Institution and Money*, 7(1): 73-87.
- McKinnon, RI 1963. Optimum currency areas. *American Economic Review*, 53: 717-725.
- Melitz, J 1995a. A suggested reformulation of the theory of optimal currency areas. *Open Economies Review*, 6(3): 281-298.
- Melitz, J 1995b. The current impasse in research on optimum currency areas. *European Economic Review*, 39: 492-500.

- Melitz, J 2001. *Geography, trade and currency union*. CEPR Discussion Paper 2987.
- Melitz, J 2003. Statement. In *Submissions on EMU from leading academics*, HM Treasury, 171-174.
- Micco, A, Stein, E & Ordoñez, G 2003. The currency union effect on trade: early evidence from EMU. *Economic Policy*, 18 (39): 316-356.
- Midelfart, KH 2003. Discussion on 'The currency union effect on trade: early evidence from EMU'. *Economic Policy*, 18 (39): 343-345.
- Mongelli, F 2002. *New views on the OCA theory: What is EMU telling us?* ECB Working Paper 138. Available at <http://repec.org/res2002/Mongelli.pdf>
- Moreno, R 2000. *Does pegging increase international trade?* FRBSF Economic Letter September 29. Available at <http://www.frbsf.org/econsrch/wklyltr/2000/el2000-29.html>
- Mulatu, A, Florax, R & Withagen, C 2001. *Environmental regulation and competitiveness*. Tinbergen Institute Discussion Paper 2001-039/3. Available at <http://www.tinbergen.nl/discussionpapers/01039.pdf>
- Mundell, RA 1961. A theory of optimum currency areas. *American Economic Review*, 51: 657-665.
- Nitsch, V 2000. National borders and international trade: Evidence from the EU. *Canadian Journal of Economics*, 33(4): 1091-1105.
- Nitsch, V 2002a. *Comparing apples and oranges: The trade effect of multilateral currency unions is small*. Bankgesellschaft Berlin, unpublished.
- Nitsch, V 2002b. Honey, I shrunk the currency union effect on trade. *World Economy*, 25(4): 457-474.
- Obstfeld, M & Rogoff, K 1995. The mirage of fixed exchange rates. *Economic Perspectives*, 9: 73-96
- Obstfeld, M & Rogoff, K 1996. *Foundations of international economics*. Cambridge, Mass.: MIT Press.
- Obstfeld, M & Rogoff, K 2000. *The six major puzzles in international macroeconomics: Is there a common cause?* NBER Working Paper 7777.
- Pain, N 2002. EMU, investment and growth: some unresolved issues. *National Institute Economic Review*, 180: 96-108
- Pakko, MR & Wall, HJ 2001. Reconsidering the trade-creating effects of a currency union. *Federal Reserve Bank of St. Louis Review*, 83(5): 37-45.

- Parsley, DC & Wei, S 2001. *Limiting currency volatility to stimulate goods market integration: A price based approach*. NBER Working Paper 8468. Available at <http://www.nber.org/papers/w8468>
- Perée, E & Steinherr, A 1989. Exchange rate uncertainty and foreign trade. *European Economic Review*, 33: 1241-64.
- Persson, T 2001. Currency unions and trade: How large is the treatment effect? *Economic Policy*, 33: 433-448.
- Pickard, J 2003. *Exchange rate volatility and bilateral trade flows: An analysis of US demand for certain steel products from Canada and Mexico*. Virginia Polytechnic Institute and State University thesis. Available at <http://scholar.lib.vt.edu/theses/available/etd-06232003-095319/unrestricted/etd.pdf>
- Pöyhönen, P 1963. A tentative model for the volume of trade between countries. *Weltwirtschaftliches Archiv*, 90: 93-100.
- Presley, JR & Dennis, EJ 1976. *Currency areas*. London: Macmillan.
- Pugh, G 2002. *Intra-European trade, exchange rate variability and monetary cooperation in Europe: Some quantitative evidence for the single currency debate*. Revised version of Staffordshire University Division of Economics Working Paper 98.9
- Puhani, P 1999. *Labour mobility – An adjustment mechanism in Europland?* ZEW Discussion Paper No. 99-47.
- Quirici, F 2003. *The endogeneity of optimum currency area criteria in historical perspective – some lessons for European Monetary Union (EMU)*. Oxford University Working Paper.
- Rapp, TA & Reddy, NN 2000. The effect of real exchange rate volatility on bilateral sector exports. *Journal of Economics (MVEA)*, 26(1): 87-104.
- Ricci, L 1997. *A model of an optimum currency area*. IMF Working Paper 76. Available at <http://ideas.repec.org/p/imf/imfwpa/9776.html>
- Ritschl, A & Wolf, N 2003. *Endogeneity of currency areas and trade blocks: Evidence from the inter-war period*. Humboldt University unpublished
- Rodrik, D 1993. *Trade and industrial policy reform in developing countries: A review of recent theory and evidence*. NBER Working Paper 4417. Available at <http://www.nber.org/papers/w4417.pdf>.

- Rose, A 2000. One money, one market: Estimating the effect of common currencies on trade. *Economic Policy*, 30: 7-33.
- Rose, A 2001. Currency unions and trade: The effect is large. *Economic Policy*, 33: 449-461.
- Rose, A 2002a. *The effect of common currencies on international trade: A meta-analysis*. Available at <http://faculty.haas.berkeley.edu/arose>
- Rose, A 2002b. *The effect of common currencies on international trade: Where do we stand?* MAS Occasional Paper No.22. Available at <http://www.mas.gov.sg/resource/download/MASOP022-ed.pdf>
- Rose, A 2004a. *A meta-analysis of the effect of common currencies on international trade*. NBER Working Paper 10373. Available at <http://papers.nber.org/papers/w10373pdf>
- Rose, A 2004b. Do we really know that the WTO increases trade? *American Economic Review*, 94(1): 98-114.
- Rose, A & Engel, C 2002. Currency unions and international integration. *Journal of Money, Credit and Banking*, 34(4): 1067-89.
- Rose, A & van Wincoop, E 2001. National money as a barrier to international trade: The real case for currency union. *American Economic Review*, 91(2): 386-90.
- Saiki, A 2002. *Common currency as an export promoting strategy?* unpublished Brandeis University working paper
- Sauer, C & Bohara, AK 2001. Exchange rate volatility and exports: Regional differences between developing and industrialized countries. *Review of International Economics*, 9(1): 135-152.
- Schelkle, W 2001. *The optimum currency area approach to European monetary integration: Framework of debate or dead end?* South Bank European Papers No2/2001. Available at <http://www.sbu.ac.uk/euroinst/201.pdf>
- Sekkat, K 1997. *Exchange rate variability and EU trade. Final report to the Commission to the EU*. Available at http://europa.eu.int/comm/economy_finance/publications/economic_papers/2001/ecp127en.pdf
- Sercu, P & Vanhulle, C 1992. Exchange rate volatility, international trade and the value of exporting firms. *Journal of Banking and Finance*, 16: 155-82.
- Smith, C 2002. *Currency unions and gravity models revisited*. Reserve Bank of New Zealand. Discussion Paper 2002/07.

- Stanley, TD 2001. Wheat from chaff: Meta-analysis as quantitative literature review. *Journal of Economic Perspectives*, 15(3): 131-150.
- Steffens, FE 1991. *Only study guide for STA 102-J (Applied statistics)*. Pretoria: University of South Africa.
- Subramanian, A & Wei, S 2003. *The WTO promotes trade, strongly but unevenly*. NBER Working Paper 10024.
- Sukar, AH & Hassan, S 2001. US exports and time-varying volatility of real exchange rate. *Global Financial Journal*, 12(1): 109-119.
- Sutton, AJ, Abrams, KR & Jones, DR 2001. An illustrated guide to the methods of meta-analysis. *Journal of Evaluation in Clinical Practice*, 7(2): 135-148.
- Tavlas, GS 1993. The 'new' theory of optimum currency areas. *The World Economy*, 16: 663-685.
- Tenreyro, S 2001. *On the causes and consequences of currency unions*. Harvard University unpublished
- Tenreyro, S & Barro, RJ 2003. *Economic effects of currency unions*. NBER Working Paper 9435. Available at <http://www.nber.org/papers/w9435>
- Thom, R & Walsh, B 2002. The effect of common currency on trade: Ireland before and after the sterling link. *European Economic Review*, 46: 1111-1123.
- Thursby, JG & Thursby, MC 1987. Bilateral trade flows, the Linder hypothesis, and exchange risk. *Review of Economics and Statistics*, 69(3): 488-495.
- Van den Bergh, J, Button, KJ, Nijkamp, P & Pepping, GC 1997. *Meta-analysis in environmental economics*. Dordrecht: Kluwer Academic Publishers.
- Viaene, JM 2003. Discussion on 'The currency union effect on trade: early evidence from EMU'. *Economic Policy*, 18 (39): 345-346.
- Viaene, JM & de Vries CG 1992. International trade and exchange rate volatility. *European Economic Review*, 36 (6): 1311-1321.
- Visser, H 2000. *A guide to international monetary economics: exchange rate theories, systems, and policies*. Cheltenham, U.K. ; Northampton, Mass. : E. Elgar, 2nd ed.
- Wang, K & Barrett, CB 2002. *A new look at the trade volume effects of real exchange rate risk*. Cornell University Applied Economics Management Working Paper No. 2002-41 Available at http://aem.cornell.edu/faculty_sites/cbb2/Papers/Trade&FXRiskJune%202002.pdf

- Weichselbaumer, D & Winter-Ebmer, R 2003. *A meta-analysis of the international gender wage gap*. CEPR Discussion Paper 4127. Available at <http://www.cepr.org/pubs/dps/DP4127.asp>
- Willett, TD 1986. Exchange rate volatility, international trade and resource allocation: A perspective on recent research. *Journal of International Money and Finance: Supplement*, 5: S101-S112.
- Yetman, J 2002. *Currency unions, trade flows, and capital flows*. Hong Kong Institute for Monetary Research unpublished