Thesis within Finance, 10 credits
Stockholm School of Economics

THE EURO'S EFFECT ON CROSS-BORDER PORTFOLIO INVESTMENTS IN THE EUROZONE

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ABSTRACT

The introduction of the euro as a common currency represented a major step in the ongoing European integration process, with major implications for financial markets. This paper examines to what extent the euro has increased cross-border portfolio investments within the Eurozone, using newly released CPIS data. We show that cross-border portfolio investments have roughly doubled between two countries both using the euro, all else equal and controlling for a host of other factors. The results are significant and robust, and although they might seem large, they are in line with theory and are more conservative than previous findings. The euro thus appears to have reduced some of the obstacles to the international diversification predicted by the ICAPM. We also discover large differences in the euro's effect across the individual Eurozone members, even though it is not confined to any sub-set of our sample. The effect on debt holdings is much greater for the countries with the least developed financial markets, whereas the relationship seems to be the reversed for equity holdings. The data also indicates that the effect has increased gradually over time. This paper contributes to the existing literature in several ways; it is the first study to use the complete CPIS panel dataset and estimate the euro's effect over time; we apply an improved specification of the well-known gravity model and solve the "distance-puzzle"; and ours is the first study to isolate the euro's effect on asset holdings by country. However, there is still plenty of scope for further research in this vast field.

Keywords: International Asset Allocation, Cross-Border Investment, Common Currency Effect, Gravity Model, Euro, EMU, ICAPM

Tutor:	Professor Peter Englund
Presentation:	December 19th, 2007, 15.15-17.00
Venue:	Stockholm School of Economics, room 550
Discussants:	Philip Löfgren
	Ludvig Mattsson

Acknowledgements
We would like to thank our tutor Peter Englund at the Department of Finance for his valuable guidance and support as well as Per-Olov Edlund, Rickard Sandberg and Birgit Strikholm at the Department of Economic Statistics and Decision Support for their much needed assistance and advice on various econometrical issues.

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1 INTRODUCTION

The introduction of the euro as a common currency represented a major step in the ongoing European integration process, which can be said to have started with the European Coal and Steel Community in 1951. Today the euro is used, not only in the thirteen Eurozone member states, but also by countries, companies and individuals all around the world. The economical implications of the euro are numerous and have been the subject of as much academic research as dispute. One part of this vast research field of particular interest for international finance scholars, and with a direct impact on the countries and investors using the euro, is its effect on international portfolio allocation.

Previous empirical studies have shown that financial portfolios are generally biased towards the home market. Such an allocation is, however, irrational if one believes in international diversification as a means to reduce risk. Economists explain this home bias by various costs associated with cross-border investments, be it in the shape of information asymmetries, direct transaction costs or other. As a transnational institution, the European Monetary Union (EMU) with its final stage of a common currency is directed to strengthen European unity and encourage cross-border exchange. Primarily due to lack of data in the past, researchers have only begun to explore how the euro has affected international asset allocation decisions. There have been studies indicating that the effect might be very large, but no consensus has yet been reached and many aspects of the issue remain unexplored. The purpose of this study, therefore, is to examine to what extent the euro has encouraged cross-border portfolio investments within the Eurozone.

We are able to document a very large, significant and robust effect; our primary point estimate is that cross-border portfolio investments are 132 percent larger between two countries both using the euro, all else equal and controlling for a host of other factors. We also discover large differences in this effect across the individual Eurozone members as well as indications that the effect might be increasing over time. The results are clear-cut and robust, even though there is plenty of scope for further research to deal with some unresolved issues.

This paper contributes to the vast existing literature on international asset allocation and the impact of the euro in several ways. First of all, unlike even such recent papers as Coeurdacier and Martin (2007) we utilise the full CPIS dataset described below in section 6.2. This gives us access to five consecutive years of portfolio holdings and means that we have a panel dataset which enables us to measure for the first time the change in the euro's impact over time. Second of all, we are able to apply recent empirical findings on the bidirectional causality between trade in goods and holdings of financial assets. Coupled with using an improved specification (developed by Mátyás, 1997 and 1998) of the well tested gravity model we have an efficient and robust model that fits the data exceptionally well. This model gives new results on the impact of physical distance on asset allocation that contradict those of e.g. Coeurdacier and Martin (2007), but are more in line with what allocation theory predicts – thereby solving what Aviat and Coeurdacier (2007) dubbed the "distance-puzzle". Third of all, ours is the first study to our knowledge to isolate the euro's effect on asset holdings by country. Those results might give some clues to what causes the effect.

The rest of this paper is organised as follows. We start by briefly presenting the history and current status of the euro in section 2 before discussing the available theoretical framework for international asset allocation in section 3. We then introduce the well-known gravity model, which will serve as our empirical framework, by presenting its background and reviewing previous literature on common currency effects. This is done in section 4. Drawing on others'

experiences, we develop the model we will use in section 5, before discussing and giving an overview of the data used in section 6. Section 7 presents our results followed by section 8 in which we test and discuss them. Finally, section 9 concludes.

2 THE EURO

The euro was originally created by the provisions of the 1992 Maastricht Treaty, which envisaged the establishment of an economic and monetary union. Following earlier intentions and plans, the treaty formally instituted the EMU to be realized in three stages with the introduction of a common currency as the third and final stage. All European Union (EU) members have signed the Maastricht Treaty and are thereby also members of the EMU. However, Denmark, Sweden and the United Kingdom have opted not to adopt the euro for the time being. The first stage, on the other hand, has been implemented in these countries as well and entails the complete liberalisation of capital flows within the EMU. Denmark and the U.K. negotiated exemptions from the provision of the treaty that requires all EU members to eventually implement the third stage of the EMU, whereas Sweden circumvented the requirement by deliberately failing to meet the so called convergence criteria. The term Eurozone (also called Euro Area, Eurosystem or Euroland) is used for those EU members that use the euro in order to distinguish them from the EMU members. Within the Eurozone, the European Central Bank (ECB) is charged with carrying out monetary policy.

For EU member states to adopt the euro, they must meet four convergence criteria governing (i) inflation, (ii) government budgetary deficit and public debt, (iii) long term interest rates and (iv) stability of their exchange rates vis-à-vis the euro. The latter requirement stipulates that the candidate country takes part in the exchange rate mechanism ERM II for two consecutive years prior to entrance without devaluating during that period. This is the criterion Sweden is failing to meet. From 2001 when Greece adopted the euro until 2004 when new members joined the EU, Denmark was the only country taking part in ERM II. Under this mechanism, the currencies are allowed to fluctuate as much as 15 percent from the assigned value, but most countries have chosen narrower bands; the Danish krone is kept within 2.25 percent of its parity to the euro.

On January 1st 1999, eleven European countries (see Table 2 in section 6.1) introduced the euro in non-physical form when the exchange rates of their national currencies became permanently fixed against each other. For the first two years the euro was used only for commercial and financial transactions until notes and coins were introduced on January 1st 2002. Following a two month transition period, national notes and coins ceased to be valid on February 28th 2002. Greece failed to meet the convergence criteria prior to the initial introduction and adopted the euro on January 1st 2001. Slovenia joined the Eurozone on January 1st 2007, thereby becoming its thirteenth member. The non-EU members Monaco, San Marino, and Vatican City also use the euro by virtue of official agreements with EU member states. The situation is more unclear for Andorra, Montenegro and Kosovo which use the euro without any formal agreements with the EU.

With the total number of EU members currently at 27 and more looking to join, the Eurozone is expected to grow. The ECB has accepted Sweden's stance, but has at the same time made it clear that similar behaviour will not be tolerated from new member states, which are thereby obligated to adopt the euro when eligible. All EU member states except Denmark, Sweden and the U.K. have official plans for joining, but failure to comply with the convergence criteria already postponed the planned entry of Lithuania and Estonia on January 1st 2007. The next countries to join the Eurozone will be Cyprus and Malta from January 1st 2008.

3 INTERNATIONAL ASSET ALLOCATION

To understand what effect the euro might have on cross-border investments, we must first understand international asset allocation. Our study therefore starts with an exposition of the capital asset pricing model (CAPM), which underlies a large part of the literature on international investments and therefore will serve as the foundation for our theoretical framework. However, the model's predictions have not stood up to empirical testing; in practise, several of the underlying assumptions are violated. These violations will be explored in turn and linked to the introduction of the euro in order to gain a more complete understanding of how international asset allocation works in practise. Finally, we will discuss some predictions of the euro's effect.

3.1 CAPM

The CAPM relies on the mean-variance criterion to arrive at a set of efficient portfolios, which, for a given level of risk (variance) produce the highest expected return. This efficient frontier is achieved by combining assets with less than perfect correlation of returns (Markowitz, 1952). To this, Sharpe (1964), Lintner (1965) and Mossin (1966) added risk free borrowing, which, when combined with the efficient frontier, produces a universal capital allocation line (CAL). On the aggregate level, borrowing and lending cancel out, and the market portfolio, representing the entire wealth of the economy, is the optimal risky portfolio for all investors. Supply and demand will ensure that each individual security is priced so that it enters the market portfolio with a share equal to its share of market capitalisation. On a global scale, this means that investors are expected to hold the share of securities issued in a particular country that corresponds with that country's share of world market capitalisation. This notion is formalized by the international capital asset pricing model (ICAPM) developed by Solnik (1974).

3.2 Home Bias

Over the past four decades, many have tested empirically whether the ICAPM holds, but the results have been quite poor. Even though barriers to international investment, such as capital regulations, have decreased dramatically cross-border investment is still limited and much smaller than predicted by the theory, despite the potential gains from international diversification.[1] Berkel (2007) recently showed that U.S. investors in 2001 held nearly 90 percent of their portfolios in domestic equity, compared to a share of U.S. equity on the world market of only 50 percent. An even more pronounced bias can be observed in other countries. German investors held 67.8 percent in German equity whereas Germany's share of world market capitalisation was a mere 3.9 percent. For Spain, the corresponding figures were 85.9 and 1.25 percent respectively.

3.3 International Diversification and the Euro

The model's flaws lies mainly in its overly simplistic assumptions (Fama and French, 2004). Bodie et al. (2005) list six simplifying assumptions that underpin the basic version of the CAPM, of which we will focus on four: (i) perfect competition on capital markets; (ii) investors face the same universe of traded securities; (iii) there are no transaction costs; and (iv) there are homogenous expectations, requiring that all investors have access to the same information.[2] All assumptions are clearly simplifying and strict. In the following, we shall have a closer look at each of these in turn, looking at whether they hold in practice or not, before discussing the next best thing –

[1] See e.g. French and Poterba (1991) and Tesar and Werner (1995).

[2] The other two criteria are that (v) investors are rational mean-variance optimizers and (vi) plan for identical holding periods. Although these two might not hold either, they are more difficult to measure empirically and of a more technical nature.

optimizing the portfolio while facing costs of diversification. The limitations to international diversification will be put in the context of the euro's potential impact.

3.3.1 Financial Market Development

The assumption of perfect competition requires that all capital markets are well developed, yet we know that this is not the case. Berkel (2007) shows that the degree of financial market development in both the country of origin and the country of destination is an important determinant of foreign investments. Low market development hinders international investments because financial markets and intermediaries are important for mobilizing savings, allocating credit and facilitating hedging, pooling and pricing of risk. Low market development also leads to inefficiencies and thus implies additional risks and transaction costs. Prices in large, liquid markets are suggested to be more informative and thereby facilitate foreigners' investments. Although the concept of market development is admittedly vague, Berkel (2007) is able to confirm these results empirically by employing three proxy variables: (i) private credit in relation to gross domestic product (GDP) to capture the width of the banking sector; (ii) market capitalisation relative to GDP; and (iii) the free float market capitalisation, i.e. excluding closely held shares by controlling shareholders, to proxy for investor rights and liquidity. Martin and Rey (2004) use a theoretical model to derive how home bias is caused by co-ordination failures in imperfectly competitive markets. In such markets, it is optimal for entrepreneurs to keep a high share in their own businesses. In spite of empirical difficulties, we can conclude that the basic assumption does not always hold with the consequence that the better the market, the more foreign investments.

The level of market development is not directly affected by the euro, yet the convergence criteria mandatory for entering the Eurozone do include fiscal conservatism that might improve economic conditions in the long run. Furthermore, the centralised monetary policy will most likely entail lower levels of inflation for most countries, even though inflation is different within the Eurozone. Most significantly however, the euro itself represents one of the most liquid currencies in the world. Thus, domestic and foreign investors will gain access to improved derivatives markets and face lower bid-ask spreads on the exchange market. It seems likely that such improvements will foster intra-Eurozone investments.

3.3.2 Quantitative Restrictions

In order for investors to choose the same optimal risky portfolio, they must face the same investment opportunities, i.e. the same universe of traded securities. In practice however, there are sometimes explicit barriers to foreign investments in the form of capital regulations. Examples are restrictions on foreign exchange transactions and quantitative limitations on foreign ownership of companies. While these are clearly limitations to international investment, Kang and Stulz (1997) note that such restrictions have fallen over time as a result of capital deregulation sine the 1970's. French and Poterba (1991) and Cooper and Kaplanis (1994) argue that explicit barriers to international investment are no longer large enough to explain the observed home bias. Today, the still relatively low share of foreign holdings means that restrictions on foreign ownership of equity are no longer binding constraints.[3] Berkel (2007) also shows that direct barriers, such as capital flow restrictions, have no impact on the tendency to diversify internationally. Although explicit barriers might have restricted international investment in the past, this does not appear to be the case today.

[3] See French and Poterba (1991) and Lewis (1999).

All remaining capital regulations within the EU were eliminated through the first stage of the EMU and the euro is therefore not expected to have any additional effects of this nature. In either case, we do not expect such restrictions to constitute binding constraints.

3.3.3 Direct Transaction Costs and Currency Risk

Transaction costs are very real phenomena that distort the CAPM equilibrium, and these are often higher on international transactions or even unique to them. Additional taxes on foreign investments or double taxation as well as extra commission and higher bid-ask spreads for international transactions are a few examples (French and Poterba, 1991). One cost unique to cross-border investments and of great importance to our study is the existence of different currencies. The direct costs arising from investing in securities denominated in a different currency than your own are the service fees and commissions for foreign exchange transactions. Although it would normally seem clear that such transaction costs divert investments away from foreign markets, Tesar and Werner (1995) find that the rate of turnover in foreign holdings is greater than for domestic assets. Since transaction costs should typically induce a buy and hold strategy, they conclude that these types of costs are an unlikely explanation for home bias.

In spite of this, the conventional view is still that such costs hinder international investment. Costs for exchanging currencies have been completely eliminated with the euro. Other transaction costs might remain, although the increased liquidity discussed above could potentially serve to lower these too. More indirect costs could also be added to this list, such as costs for calculating in different currencies and costs for reporting holdings in a foreign currency. Reductions of these costs are typically expected to stimulate intra-Eurozone investments.

A special kind of transaction cost is currency risk. In the case of pure exchange rate risk, this risk can typically be hedged at a relatively low cost on developed financial markets using currency derivatives. If we assume that all investors have access to these markets as well as the skill required for using them, then this risk can be treated as another transaction cost on top of the others, quantifiable by the cost of hedging in proportion to the asset price. If not, or if investors for some other reason choose not to hedge, then the risk-return trade-off of a specific security will be different depending on which currency investors use to measure their wealth. Furthermore, the perfect hedge is only possible for fixed income investment, whereas investors in equity do not know a priori how much foreign currency they will receive and therefore should hedge. The investor's risk will therefore include two elements: the variability of the foreign market and the variability of the exchange rate. Depending on the correlation between the two risk elements, foreign securities could become either more or less attractive. According to standard macroeconomic theory, favourable economic shocks cause a country's currency to appreciate as well as increase the return on the stock market, while simultaneously increasing interest rates and thereby lowering the return on bonds. Foreign bonds would then become less risky since their fundamental return is negatively correlated with the country's exchange rate. On the other hand, foreign equity would then be more risky than domestic stocks, without necessarily having a higher expected return. Bodie et al. (2005) asses that currency exchange risk could account for as much as 27 to 75 percent of the total risk of foreign equity investments. On the other hand, they note that in an international portfolio, this risk is mostly diversifiable, since the correlation between different currencies is low. There will then be no need for currency hedging and currency risk should not have a big impact on asset allocation on the aggregate level. Still, most would agree that currency risk constitutes a limitation to international diversification, but since such risk is diversifiable it is unclear how significant the impact is.

As a direct result of the euro's introduction, exchange rates are fixed and pure currency risk thereby eliminated. Although real exchange rates will continue to fluctuate, this should hardly have any effect. In addition to the measurable exchange rate volatility, the more general concept of uncertainty will most likely be reduced as well. Foreign investors might be discouraged, not only by the observable fluctuations in the exchange rate, but also by uncertainty about the sustainability of the monetary regime. In this context, the euro represents a much more irrevocable commitment than any fixed exchange rate regime. For most countries, the euro is also much less volatile against e.g. the U.S. dollar than the former national currencies. The euro can therefore on these bases be expected to increase intra-Eurozone investments.

3.3.4 Information Asymmetries and Costs

To arrive at the same optimal risky portfolio investors must have homogenous expectations, something which requires that they have access to the same information. Information asymmetry is therefore one of the most popular explanations of home bias in financial holdings. Differences in accounting standards, disclosure requirements, regulatory environments and business culture across countries, all mean that there is an informational asymmetry between domestic and foreign investors. The better informed domestic investors thereby have an advantage on the market. These informational asymmetries can probably be overcome in most cases, but at a cost. The concept can therefore be considered equivalent to information costs. Although no clear definition of the concept exists, several studies have found that various proxy variables help explain investment patterns.

Berkel (2007) finds that the informational asymmetries represented by physical distance, different legal systems and non-common colonial background help explain why asset allocation deviates from that suggested by the ICAPM. Kang and Stulz (1997) similarly study foreign ownership of Japanese firms and find that this is concentrated to the largest firms with good accounting performance. They conclude that compared to local investors, foreign investors have an informational disadvantage which is larger for small firms, and which prevents them from allocating strictly according to expected returns. Ahearne et al. (2004) use the portion of a country's market that has a public listing in the U.S. as a proxy for information costs for U.S. investors. They show that the portion of such listings is a major determinant of a country's share of U.S. investors' portfolios. Viewing different legal systems as an information barrier, Vlachos (2004) investigates the effect of regulatory harmonization and shows that bilateral differences in securities regulation and investor protection have large effects on the integration of securities markets. Tesar and Werner (1995) point out that these costs are often fixed per country as opposed to the variable transaction costs discussed under section 3.3.3 above. In much of the literature, information asymmetries are viewed as the main explanation for home bias in asset allocation.

Given the vagueness of the concept, it is not clear exactly what the euro will bring. Information asymmetries are expected to have decreased under the regulatory harmonisation of the EU, yet there is still some scope for the euro to improve matters further. Financial reporting in the same currency can be expected to increase transparency, and price comparisons are facilitated for the same reason. The implementation of a centralised monetary policy could potentially also lead to a convergence in expectations, at least regarding parts of the macroeconomic environment.

3.3.5 Optimizing under Constraints

Having seen how several of the assumptions underlying the CAPM are violated in practise, we can conclude that the CAPM in its original form does not provide an adequate description of investor behaviour. Home bias is clearly one consequence, but we focus here on the part of

investors' portfolios that are still allocated overseas. If we introduce either fixed costs per country or allow the variable costs to differ across countries, then the optimal outcome for a rational investor could be to invest in only a few countries, rather than all. The selection of countries will under such circumstances be influenced by the costs discussed in the sections above.

Moreover, based on Markowitz's (1952) selection criteria, the rational investor should choose to invest in markets which have low correlation with the home market. We therefore expect correlation of returns to be a determinant of investment. However, contrary to this established belief Tesar and Werner (1995) find that foreign holdings seem to reflect other factors than diversification of risk. They illustrate with the example of U.S. investors whose foreign portfolios are biased towards the Canadian market in spite of the strong correlation with the U.S. market. Berkel (2007) similarly finds that return correlation has no explanatory power in determining international investments.

In the context of the euro, we can note that the common monetary policy under the EMU will increase co-movement of interest rates and thereby also the return on bonds. Haselmann and Herwartz (2005) further claim that the economical integration under the EU in general will also likely increase correlation between stock market return. This would then reduce the potential gains from diversification within the Eurozone and make intra-Eurozone investments less attractive.

3.4 The Effect of a Common Currency

In the end, in spite of the extensive literature on the subject, no coherent theoretical framework has yet been presented that is able to explain the home bias in asset allocation. As we have seen though, several determinants of international allocation have been suggested, and as we shall see in the following sections, some have been verified empirically. Reflecting this lack of a generally accepted cohesive theory, the predicted effects of the euro are consequently unclear and even somewhat ambiguous. Nonetheless, the general opinion of most authors is that which is the most intuitive; the euro is expected to increase intra-Eurozone cross-border investments. The size of this effect is more difficult to estimate though. Two major studies were launched before the introduction of the euro: one commissioned by the EU (European Commission, 1990) and one by the Swedish government (SOU 1996:158). The former probably represents the most complete ex ante analysis of the effects of the euro and provides a thorough review of the microeconomics behind a common currency.

The EU study acknowledged that it is difficult to measure the effect of the euro on capital flows, but concluded that it will be more important for countries with less developed capital markets. Their general assessment of transaction costs stated that total transaction costs for companies could be estimated to 15 percent of companies' turnover in other euro countries. However, this figure could be twice as large for small and medium sized companies. Furthermore, the study found that the EMU could potentially reduce the "overall uncertainty for investors associated with the existence of national currencies and independent monetary policies. A reduction in overall uncertainty could lower the risk premium firms have to pay on equity and would greatly increase investment." (European Commission, 1990, p. 63) In addition, the introduction of the euro was expected to spur optimism among business leaders, and surveys showed that business people expected large gains from the euro ex ante.

The Swedish study was more pessimistic about the potential efficiency gains from the euro. First of all, they discussed the possibility that reduced uncertainty about nominal exchange rates might resurface elsewhere, such as in increased uncertainty about fiscal policy. The study concluded

that it was difficult to asses whether the overall level of uncertainty would be reduced as a result of the euro. They did nonetheless discuss the possibility that exchange rate volatility could skew portfolio investments towards the home market and that this could entail costs from lost diversification. However, they found it difficult to say if these costs to society were significant. Portfolio investments were otherwise discussed very little, although the study concluded that foreign direct investments (FDI) were expected to be virtually unaffected by short term currency fluctuations, but that long term movements could have a negative impact on FDI and goods trade. Their estimations of the transaction costs associated with national currencies reflected their mandate to survey costs and gains to society, and were thus expressed as one or a few percent of GDP. These estimates say little of how investors' allocation decisions would be affected.

Exactly how much a transaction cost reduction will affect investments is a question of how high the elasticity of substitution is between different securities. If investments in two different countries were perfect substitutes, then even a very small reduction in transaction costs would cause all investors to shift their entire portfolio to the relatively cheaper market. On the other hand, if each market is uniquely desired by the investor, then transaction costs would not have any effect, expect maybe to cause some of the investor's wealth to go to paying these costs rather then the actual investment. Coeurdacier and Martin (2007) construct a model that takes this into consideration. Based on what they believe are reasonable estimates, a reduction in transaction costs of around 15 percent as predicted by the European Commission (1990), is consistent with a doubling of investments within the currency union. Although these estimates are based on assumptions, they illustrate how even small reductions in costs can have large effects on investments.

4 THE GRAVITY MODEL

To estimate the effect of the euro on asset holdings we will use the well established gravity model as our empirical framework. In this section we review the literature to explain the origins and applications of the model. We first discuss the model's application to goods trade and the effect of currency unions on such trade, and then move on to financial assets and how the gravity model has been used to model international financial investments. Finally, we review previous studies of the effect of currency unions on cross-border financial investments.

4.1 The Gravity of Goods Trade

In 1687, scientist Isaac Newton published his treatise *Philosophiæ Naturalis Principia Mathematica*, which described the law of universal gravitation. Newton's gravitational law holds the attractive force between two bodies proportional to the bodies' masses and inversely proportional to the distance between them.

$$F_{ij} = G\frac{M_i M_j}{D_{ij}^2}$$

where F_{ij} is the attractive force; M_i and M_j are the masses; D_{ij} is the distance between the two bodies; and G is a gravitational constant.

Dating back to Tinbergen (1962) and Pöyhönen (1963), different models drawing on Newton's gravitational model, and thus collectively referred to as the gravity model, have been used extensively to model international trade flows. In the gravity model, bilateral trade flows substitute for Newton's attractive force and the countries' economic masses, measured by some form of national output, for the bodies' masses. Taking the natural logs of the gravity equation, we obtain the linear relationship

$$\ln Trade_{ij} = \alpha + \beta^1 \ln GDP_i + \beta^2 \ln GDP_j + \beta^3 \ln Dist_{ij} + \varepsilon_{ij} \quad (1)$$

where $Trade_{ij}$ is total trade (exports plus imports) between countries *i* and *j*; GDP_i and GDP_j are the countries' respective GDPs; $Dist_{ij}$ is the distance between the two bodies; α is a constant; and ε is a presumably well behaved error term. We expect β^3 to be less than zero. Since this model typically measures total gross trade flows, it does not matter which country is *i* and which is *j* in a given country pair.

The gravity model has been shown to describe a reasonable proportion of cross-country variations in trade, consistently yielding elasticities of trade with respect to income and distance which are economically large, correctly signed and statistically significant (Rose, 2000). Many authors have added additional variables to the equation in order to explain the part of trade that cannot be accounted for by the size of the economies and the distance between them. Commonly used variables, in what is then referred to as an augmented gravity model, include e.g. income per capita and dummies for common language, land border and free trade agreement (Head, 2003).

4.1.1 The Theory behind Gravity in Trade

Although the gravity model has been mostly celebrated for its outstanding performance in empirical work, many have also studied potential theoretical underpinnings of it. Early models based on increasing returns to scale and product differentiation across countries, were able to explain how international trade increases with national income. Distance is included as a proxy for various costs hindering trade, not least transportation costs. Anderson (1979) was one of the earliest works in this field that took things one step further and allowed for policy measures to reduce barriers and increase trade. Deardorrf (1984) reviews the early literature on the subject, especially in the context of the Hecksher–Ohlin Model. Later on, Deardorrf (1995) formally derives the gravity equation from this same model. Evenett and Keller (2002) discuss and evaluate the suggested theories up to date, and present a good overview of the literature.

4.1.2 Currency Unions and Trade

The seminal work on currency unions and trade by Andrew Rose (2000) provided a surprising result. By introducing a currency union dummy in a gravity model applied to an extensive data set, he found that countries with the same currency trade three times as much as otherwise. This estimate was much greater than anyone could imagine and Rose has also withstood heavy critique. Persson (2001) is only one example, arguing that Rose's results were biased since the decision to join a currency union is affected by the amount of trade ex ante, and the dummy variable is thereby endogenous in the model. Using more sophisticated techniques, he dramatically reduces the effect of currency unions. Following a vast amount of articles, Rose (2004) puts the different studies into perspective and analyses what conclusions that can be drawn from the literature. The consensus that eventually was reached is that there is a so called Rose effect of common currencies on trade, it is much larger than previously believed, but it is not as large as the original estimate by Rose (see Baldwin, 2006).

One important point raised by Rose himself in the original study is that his sample was based mainly on small and poor countries, many of which had adopted the U.S. dollar. Those results would thus not be applicable to the developed countries that formed the Eurozone. As soon as data became available though, researchers started to analyse what the euro had brought in terms of trade. The two studies by Micco et al. (2003) and Flam and Nordström (2003) both find evidence that the euro has boosted intra-Eurozone trade by somewhere between 10 and 20 percent. Both also find that the euro effect is increasing over time, leading Flam and Nordström to conclude that the long run effects might be much higher. Barr et al. (2003) find similar results

while still controlling for the endogeneity issue raised by Persson (2001). Neither of these estimates went unchallenged however. In response to these and other studies, Berger and Nitsch (2005) put the introduction of the euro in a historical perspective, thereby advancing a critique conceptually similar to that of Persson (2001). They play down the impact of the euro itself and argue that the introduction of the currency should be seen as the culmination of a series of policy reforms that have promoted economic integration since the 1950's. Once they introduce a variable to proxy for an integration trend, the effect of the euro disappears completely. Baldwin (2006) comprehensively reviews the empirical literature on the trade effects of currency unions, both the euro and others. Although Baldwin (2006) could be considered overly conservative, his opinion is that the euro's effect on trade is between five and ten percent. He also predicts that this estimate is likely to change as more data emerge.

4.2 The Gravity of Financial Assets

During the last decade or so the gravity model has also become popular to analyse transactions in and holdings of financial assets. Portes and Rey (1999) pioneered the use of the gravity model in this field when they showed that the model explains transactions in financial assets just as well as it explains trade in goods. Their study, and subsequent ones, adopt an augmented gravity model and find that the elasticity of equity flows with respect to market size is close to one for both source and destination country, whereas variables that proxy transaction costs and information asymmetries (most noticeably distance) have negative impact. These studies typically apply a model where country *i*'s financial holdings in country *j* are given by

$$\ln Holdings_{ij} = \alpha + \beta^1 \ln M_i + \beta^2 \ln M_j + \beta^3 \ln Dist_{ij} + \sum_k \beta^k Z_{ij} + \varepsilon_{ij} \qquad (2)$$

where M_i and M_j are the countries' market sizes; $Dist_{ij}$ is the distance between the two countries; α is a constant; Z_{ij} is a set of various variables influencing asset holdings; and ε is the error term. In this application, we distinguish between the two countries and let country *i* be the source country, i.e. the source of the invested capital, and country *j* the destination country. Capital thus flows from *i* to *j*, but subsequent repayments (dividend, interest and amortization) flow from *j* to *i*. Given the origins of the gravity model and its brief history in the field of international finance, we will draw heavily on the trade literature to develop our model and discuss our results.

4.2.1 Holdings versus Flows

In the original gravity model, trade in goods is modelled as cross-border flows. This appears natural as goods are consumed and therefore new flows are continuously generated. This is not, however, the case with financial assets, which contrary to goods are not perishable. Portes et al. (2001) explore this nuance of equity flows and argue that in a CAPM setting of international diversification, large continuous flows can only be generated by a new set of investors entering every period or a continuous arrival of new information. Flows generated from these alternatives would, however, probably not suffice to explain the extent of observed financial flows. This leads Portes and Rey (1999), who only had data on transactions, to conclude that information asymmetry causes the flows, with new information continuously arriving to sustain investors' heterogeneous beliefs.

However, effects on the economy at large are more likely caused more by the level of investments, not by the amount of trading. Furthermore, the ICAPM predicts a certain sustained allocation of assets, not the intensity of portfolio rebalancing. Hence, in order to better understand the implications for the economy as well as be able to base our analysis on the ICAPM, we model financial holdings instead of flows. This is now made possible through the release of the CPIS data described later. As mentioned above, modelling holdings is more

attractive since financial assets as opposed to goods are not consumed. This is not to say that it is uninteresting to study flows, but that would constitute a different type of study, since holdings and flows do not necessarily behave similarly.

4.2.2 The Theory behind Gravity in Financial Assets

Since the application of the gravity model on financial assets is much younger, the theoretical underpinnings are only beginning to emerge. The fairly intuitive relationship between the market size of the source and destination countries and international investments is derived formally by Martin and Rey (2002 and 2004). Martin and Rey (2002) focus on emerging markets and conclude that countries with low income are more vulnerable to financial crashes, thereby giving them fewer incentives to globalise their financial markets. Martin and Rey (2004) discuss the general case where cost of capital decreases with a growing investor base, which, coupled with risk diversification motives and market segmentation, explains the link between market size and cross-border investments. Portes and Rey (1999) first suggested using physical distance to proxy for various information costs. Since then, several empirical as well as theoretical works have followed. Martin and Rey (2004) acknowledge distance as a proxy for transaction costs in their model. Lane and Milesi-Ferretti (2004) use the same proxy to test their own theoretical framework. Coeurdacier and Guibaud (2006) allow for a wider range of transaction costs and what they call financial frictions. Since one such transaction cost (different currencies) is of our prime concern, it should be noted that the models by Martin and Rey (2004), Lane and Milesi-Ferretti (2004) and Coeurdacier and Guibaud (2006) all incorporate high, but empirically consistent elasticities of substitution, as do Coeurdacier and Martin (2007) in their simplified framework. The result is that even a fairly small reduction in transaction costs can have large implications for the size of the cross-border asset holdings.

4.2.3 Currency Unions and Cross-Border Investments

Portes and Rey's (1999) seminal work on international capital flows was the first study to use the gravity model for modelling cross-border capital flows. They apply a gravity model to gross cross-border equity flows and show that the equation accounts for 70 percent of the variance in financial flows; thus arguing that the gravity model explains transactions in financial assets just as well as it explains trade in goods. Portes et al. (2001) confirm the effectiveness of the gravity model in studying financial asset flows between the U.S. and 40 other countries. Apart from a multitude of variables measuring information asymmetries among other things, Portes and Rey (1999) also include a currency union dummy. When using market capitalisation as their size (or mass) variable, they find that countries hold 68 percent as much assets in countries with the same currency as otherwise. However, in their preferred specification when they used GDP, the effect disappears as insignificant. Lane and Milesi-Ferretti (2004) study holdings rather than flows and find a common currency effect of up to 200 percent depending on specification. However, when they use a more sophisticated estimation technique (Tobit regression) to better account for zero values in the data, the effect shows up as much smaller and insignificant in some of the sub-samples.

Many studies have also looked specifically at the euro's effect. Berkel (2006) investigates the effect of the euro on gross portfolio flows in and out of Germany. When controlling for country pair fixed effects, she finds that portfolio flows are 40 to 50 percent larger between Germany and other Eurozone countries than for non-euro countries. Furthermore, this euro effect remains the same when she controls for financial and macroeconomic reforms connected to the formation of the EMU. Haselmann and Herwartz (2005) also focus on Germany but measure financial holdings. They find that the euro caused a large increase of German holdings in the rest of the Eurozone.

Lane (2005) studies the impact of the euro on international bond portfolios throughout the Eurozone, and shows that cross-border investment between Eurozone members is around 200 percent larger than among other country pairs. He argues that a "'euro area bias' has superseded 'home bias'" (2005, p. 5) and that financial regionalization is at the moment a stronger force than financial globalization. Coeurdacier and Martin (2007) also study holdings and find that the euro has increased intra-Eurozone investments by 45 percent for equity and 150 percent for bonds. Their results prove very robust even when controlling for a multitude of variables correlated with the euro dummy.

In conclusion, the existing literature has found a very large and significant euro effect on intra-Eurozone investment. For currency unions in general, there appears to be a similar, but less pronounced effect. Although we will compare our results with those of Portes and Rey (1999), they are not really comparable since we study holdings and Portes and Rey study flows. Instead, Coeurdacier and Martin (2007) and Lane (2005) represent the studies most similar to ours since they use the same CPIS data and focus on the euro effect. However, no previous study to our knowledge has had access to the full CPIS dataset from 2001 to 2005; we are thereby able to for the first time estimate the effect over time.

5 OUR MODEL

All of the studies presented above have utilised some version of an augmented gravity model, but there is no clear consensus on exactly how such a model should be specified. We shall now develop the model for international asset allocation that we will use to analyse the effect of the euro. In doing so, we draw on many previous theoretical and empirical results found in the literature and build a model suited for our purposes and the panel dataset at hand. First, we discuss the individual effects that are present in panel datasets before commenting on the issue of nominal versus real data. Finally, we describe which variables we include in our model and why.

5.1 Individual Effects

Having access to a panel data set brings many advantages such as reduced risk of omitted variable bias, yet we must make one important decision: how to model the individual effects. Some studies, such as Portes and Rey (1999) and Rose (2000), pool their panel data, but this method disregards much available information and severely increases the risk of biased estimates. Better estimation techniques are available.

To use fixed effects (FE) estimation would mean modelling an individual fixed effect for each country pair. This approach requires the least strict assumptions and controls for all specific bilateral conditions that might affect holdings, including historical events.[4] However, since our sample period starts after the euro was introduced, its dummy variable is time invariant and thereby absorbed by the fixed effects, meaning that FE estimation is not possible in our case.

Random effects (RE) estimation on the other hand means that one has to assume that the country pair specific intercepts are drawn from a distribution and represent random deviations from a mean intercept. Some authors use RE, but then typically as a complement to FE estimation.[5] The problem is, as both Rose (2002) and Portes and Rey (1999) point out, that the assumption required is theoretically unjustified. The circumstances affecting a country's holdings in another country,

[4] This is also the preferred specification of Micco et al. (2003) when they estimate the effect of the euro on trade in goods.

[5] Rose (2002) uses both RE and FE and comments correctly that FE estimation is consistent in a wider set of circumstances but that it might not be efficient. Both Rose (2002) and Rose and Spiegel (2002) find that their results change little between the two techniques.

such as historical ties and cultural proximity, cannot be considered a random deviation and RE should thus not be used.

The remaining possibility is to model fixed effects for the individual countries in the pair. Some studies use fixed effects in only one dimension,[6] but this would neither eliminate the risk for bias nor control for all circumstances. Instead, Anderson and van Wincoop (2001) theoretically derive the intuitive result that trade resistance between two nations *i* and *j* can be broken down into (i) the bilateral trade barrier between *i* and *j*, (ii) *i*'s resistance to trade with all other countries and (iii) *j*'s resistance to trade with all other countries. However, for the same reasons that we cannot use FE, we cannot fully implement Anderson and van Wincoop's methodology with pair specific effects. When considering panel data models on the other hand, Mátyás (1997 and 1998) argues that the proper specification of the gravity model is to use source, destination and time specific effects.[7] In our view, this method is by far most suitable for our sample since we can control for all characteristics that determine a country's propensity to invest abroad as well as be the recipient of foreign investments. This is therefore chosen for our baseline model which then, based on (2), takes the basic form

$$\ln Holdings_{ij,t} = \alpha^0 + \alpha_i^1 + \alpha_j^2 + \lambda_t + \sum_k \beta^k Z_{ij,t}^k + \varepsilon_{ij,t} \qquad (3)$$

where country *i*'s holdings of assets issued in country *j* is explained by source country, destination country and time (or business cycle) fixed effects – α^1, α^2 and λ respectively – as well as a set of variables Z with variation in at least two of the dimensions *i*, *j* and *t*, (including of course market size and distance). We also include an overall intercept α^0.

The estimation is done using an extensive set of dummy variables – a not entirely unproblematic method. Aviat and Coeurdacier (2007) are concerned about the risk of multicollinearity when estimating many coefficients. Multicollinearity, however, will not lead to biased estimates, only less efficient ones, and any insignificant results will in that case be self-evident. Mátyás (1998) points out that the dummy approach is not parsimonious and opts for RE estimation when faced with a large data set. As noted above, however, this is theoretically inconsistent. Also, our data set is not much larger than that used by Mátyás (1997) himself when performing dummy estimation. We do, nonetheless, perform both RE and pooled estimation of our model as robustness checks to address the issues of both efficiency and parsimony (see section 8.1). The conclusion thereof is that neither of these methods works as well as ours.

5.2 Real versus Nominal Figures

Most datasets for either trade or financial asset holdings are, as our own, denoted in current U.S. dollars. A reported change in value can therefore be due to four different reasons; (i) net investments or divestures, (ii) increases or decreases in the real value of assets, (iii) inflation in the U.S. dollar or (iv) changes in the real exchange rate of the respective currency vis-à-vis the U.S. dollar. The first two effects are what we want to measure. Keeping a larger stake in a country following an increase in value is also an investment decision, albeit of a more passive nature.

The second two reasons, dollar inflation and exchange rate fluctuations, are on the other hand clearly undesired since we want to study the real effects. Rose (2000) and others solve the problem of dollar inflation by deflating the data series by an appropriate measure of U.S.

[6] In their preferred specification, Coeurdacier and Martin (2007) use only source country effects since it allows them to test the impact of variables with variability only in the *j* dimension. However, they admit that this might result in omitted variable bias.

[7] Both Coeurdacier and Martin (2007) and Lane (2005) have used source and destination country fixed effects, but these studies used cross-sectional data and therefore did not include fixed time effects.

inflation. In our specification, such a deflation would make no difference because it is captured by the year specific fixed effects λ anyway.[8] Dollar inflation will thus not affect our results.

However, apart from changes in the value of a dollar, there could also be a relative change in value of the currency in which the assets are denominated and the dollar. The basic way of accommodating this is through the use of GDP, also in current U.S. dollars, of the countries in the pair. Any drop in the dollar value of euro denominated assets following a depreciation of the euro would thus be matched by a similar drop in the dollar value of the GDPs of the two euro countries. As we shall see in section 7, the elasticity of holdings with respect to the GDP turns out to be reasonably close to unit for all asset classes, meaning that this variable should incorporate most exchange rate effects. Micco et al. (2003) further introduce an index of the real exchange rate of each country in the pair vis-à-vis the dollar in the regression. Yet whereas they study trade in goods – often priced in U.S. dollars – we study financial holdings – typically denominated in the domestic currency – meaning that the situation would then call for more sophisticated solutions. Reassuringly however, Micco et al. find that introducing the index does not change their results. In sum, we do not believe that the use of nominal data will affect our results.

5.3 Explanatory Variables and Model Specification

Having outlined the basic structure of the model, it remains to decide which variables to include. Market size and distance are the key variables in the original gravity model presented in section 4, but our augmented model will contain many more regressors that are assumed to affect cross-border asset holdings; stock market return correlation, dummies for common language and common legal origin, an EU membership dummy and an EU trend variable, trade in goods and of course a euro dummy.

We expect large, rich countries to hold more foreign financial assets. As discussed under section 4.2.2, there is theoretical motivation for this intuitive idea. When Portes and Rey (1999) first used the gravity model to explain cross-border equity flows, they used stock market capitalisation to proxy for market size. However, whilst Portes and Rey only studied equity flows, we also study foreign debt holdings and therefore believe that GDP is better, since it is a more general proxy for economic size. Importantly, stock market capitalisation is very heavily correlated with GDP (at least in our sample) and Coeurdacier and Martin (2007) also find that the choice did not affect their results. Aviat and Coeurdacier (2007) similarly find that their results were unaffected and note that GDP is more consistent with the theoretical foundations they use. The use of market capitalisation in our model (not reported in this paper) yielded virtually identical results.[9] The effect of the euro was almost exactly the same, and the only real difference was that the elasticity with respect to market size was much lower. In our baseline model, we thus use the (log of the) product of the two countries' GDP ($\ln GDP_{i,t} GDP_{j,t}$) as our size variable. Although it is not completely obvious, we expect holdings to be proportional to this product and thus the elasticity to be close to one.

Since financial assets are weightless, we would not normally expect distance by itself to have an effect. When Portes and Rey (1999) discovered the surprising effect that distance had a large and significant negative effect on equity flows, they attributed this to distance being correlated with

[8] It should also be noted that Rose's (2000) sample period stretches over the 1970's and 80's when inflation was a much bigger issue.

[9] The market capitalisation we then used covered all domestically incorporated companies listed on the country's stock exchanges, except investment companies, mutual funds, or other collective investment vehicles. It is measured at the end of the year and reported in current U.S. dollars. The data was downloaded from the World Bank's World Development Indicators (WDI Online) [http://devdata.worldbank.org/dataonline] and originates from Standard & Poor's Emerging Stock Markets Factbook and supplemental S&P data.

costs of obtaining information. The more costly it is to obtain information about the market, the less investors trade. Portes and Rey (1999) also make the important distinction that flows need not be correlated with holdings; high costs for obtaining information could cause less trading even if the position being held is large. However, Aviat and Coeurdacier (2007) find that distance has a negative effect on holdings too. This result is very surprising, and Aviat and Coeurdacier (2007) even dub it the "distance-puzzle". The reason is that theories of international diversification discussed above in section 3 predict asset holdings to decrease as business cycle convergence increases. Since business cycles are typically believed to be more correlated between physically close countries, distance should have a positive effect. As we include the distance between the two countries ($\ln Dist_{ij}$) in our model, we are thus not sure what to expect from it.

Classical diversification theory, as laid out in section 3, predicts decreasing financial holdings with increasing market co-movements. However, empirical evidence seems to disagree. When Coeurdacier and Guibaud (2005) test the effect of stock market correlation, they, counter to diversification theory, find that asset holdings are positively correlated with stock market returns. Aviat and Coeurdacier (2007) further investigate asset allocation and find that even after controlling for both goods trade and distance, investor portfolios are biased towards markets that are positively correlated with their home markets. They note that "[t]his effect is quite large, very significant and absolutely at odds with the finance literature predictions" and therefore dub it the "correlation-puzzle" (2007, p. 34). However, Coeurdacier and Guibaud (2005) argue that return correlations in today's highly internationally integrated markets are determined endogenously; increased market integration leads to higher return correlation. When instrumenting current correlation with past correlation, they find that the effect on asset holdings is negative, as predicted by the theory.[10] We include the correlation between monthly returns of the main stock market indices in the two countries respectively ($CorrRM_{ij,t}$).[11] It remains to be seen whether the diversification effect or the endogeneity effect dominates.

Both a common legal origin and a shared language are believed to alleviate information asymmetries, as discussed under section 3.3.4, and thereby facilitate cross-border investment. We therefore include dummy variables for both these cases ($Legal_{ij}$ and $Lang_{ij}$). The selection of languages requires judgement. The basic idea is to try to capture if communication between two countries is sufficiently aided by sharing a common language so as to reduce trading costs and costs for obtaining information. In some cases, this does not coincide with official languages. Legal origin is taken from La Porta et al. (1998 and 2002). See Table 2 on page 18 and appendix A.1 for details on both language and legal origin.

Similar reasoning applies to EU membership, since the EU aims to promote European integration. The first stage of the EMU also included the complete deregulation of cross-border capital movements. A dummy for both countries being EU members (EU_{ij}) is thus introduced. Berger and Nitsch (2005) were able to eliminate the euro effect on goods trade by including an index for European integration that they themselves constructed. We are sceptical to their method of constructing an index since it entails an arbitrary definition of integration, and feel that their results might be overly conservative. However, in order to address the very real issue of concern

[10] Coeurdacier and Guibaud (2006) develop a theory to explains how this endogeneity arises.

[11] Unlike the other variables, we let this enter the gravity equation in level form as opposed to logged. This is partly due to practical considerations, since this variable sometimes takes on negative values and therefore cannot be logged. Technically, this does not pose a problem since the variable will always be between negative one and one, meaning that as long as the estimated coefficient is reasonable, the effect for the entire range will be too. Theoretically, it implies an increasing elasticity as opposed to a constant one. For all reasonable estimates – such as the ones we get – this relationship is very plausible and possibly even more attractive than a constant elasticity.

that they do raise, we include an EU trend variable ($EUtrend_{ij,t}$). This takes the value one for the first sample year (2001), two for the next and so on, when both countries are EU member states and zero for all other country pairs.

We also add what will be the centre of our attention, i.e. a dummy for when both countries use the euro, which we expect to have a positive impact on intra-Eurozone investment.

5.3.1 The Effect of Trade

More bilateral trade in goods and services can also be assumed to cause increased portfolio investments, but this relationship is a little more complicated than for the other variables. A large number of papers argue that bilateral trade in goods is positively correlated with holdings of financial assets. Rose and Spiegel (2002) for instance argue that sovereign creditors lend more to (i.e. has larger debt holdings in) countries with whom they trade more, since the threat of reducing trade is a means to enforce international debt and larger trade volumes give better possibilities to enforce repayments.[12] Coeurdacier (2006) and Lewis (1999) argue that home bias in trade and financial holdings are related; countries more open to trade also have more open financial markets. Aviat and Coeurdacier (2007) claim that in the presence of information asymmetries, entrepreneurs will learn more about other countries by trading goods with each other and this will then facilitate cross-border portfolio investments. Lane (2005) believes that the volume of trade is a good predictor for the level of bilateral real exchange rate volatility which in turn influences financial holdings. It is also conceivable that agents engaged in trade might want to hedge for currency risk in accounts payable and receivable through investments in the foreign market.[13] All this implies that trade in goods might be an important determinant of portfolio asset holdings. Indeed, many studies also find empirical support for this.[14]

There are, however, also reasons to believe that asset holdings affect trade. Rose and Spiegel (2002) note that international borrowing might encourage trade or, alternatively, both borrowing and trade can be driven by common factors. Lane (2000) finds that openness to trade determines asset holdings, and it is not difficult to imagine some measure of general openness that can affect both asset holdings and trade simultaneously. Aviat and Coeurdacier (2007) reverse their main argument and claim that information asymmetries might just as well imply that lessons learned from international investing facilitate trade. Lane (2000) also argues that FDI may give rise to trade in goods and services. We only look at portfolio investments, excluding FDI, but similar arguments could apply when investors buy larger stakes in foreign companies. Even a company buying only, say five percent,[15] of a foreign company might do so in the hope of strengthening relations and increasing trade.

Hence, there are many reasons to believe that causality runs in both directions. It is therefore not surprising that Aviat and Coeurdacier (2007) find clear evidence of this using instrumental variable (IV) estimation of asset holdings and trade respectively. In order not to violate the OLS assumption of strictly exogenous explanatory variables and get biased estimates, we too must then use an IV approach. Others have used the same technique and the literature is therefore rich with suggestions on suitable instruments for trade in goods. These instruments must be correlated with commodities trade but uncorrelated with asset holdings through the error term.

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[12] This conclusion is partly based on previous work by Rose (2002) showing that trade declines drastically after a country defaults on, or rather renegotiates, its debt obligations.

[13] Lane (2000) argues along similar lines.

[14] See e.g. Lane (2000), Aviat and Coeurdacier (2007), Lane and Milesi-Ferretti (2004) and Mishra (2007).

[15] When the share bought is ten percent or higher it is classified as an FDI by CPIS and excluded from our data. See section 6.2.

We use five instruments for trade in goods; (i) the product of the countries' land area ($\ln Area_i Area_j$) and dummy variables for when both countries (ii) are islands ($Island_{ij}$) or (iii) landlocked ($Llock_{ij}$) or (iv) share a common border ($Border_{ij}$) or (v) belong to the same free trade area (FTA_{ij}). All of these are well used in studies on the determinants of bilateral trade, such as Rose (2000), who finds, as expected, that physically large countries, island nations, bordering states and countries in the same FTA trade more with each other, whereas landlocked countries trade less. Aviat and Coeurdacier (2007) and Rose and Spiegel (2002) use the same variables for this purpose. All instruments used are time invariant in our sample, but given the fact that we also use the other explanatory variables described above in the first stage regression, this should not pose a problem.

5.3.2 The Final Model

The variables and their definitions are summarised in Table 1 while more detailed definitions and sources are described in appendix A.1. Note that the model is estimated as a log-linear model where all variables except $CorrRM_{ij,t}$, $EUtrend_{ij,t}$ and the dummies are in natural logarithms.

Table 1 List of variables

Variable	Definition
TRADEijt	Sum of exports and imports in USD between countries *i* and *j* during year *t*.
EQTijt	Country *i*'s holdings of portfolio equity issued by country *j* at the end of year *t* (USD).
DEBTijt	Country *i*'s holdings of debt securities issued by country *j* at the end of year *t* (USD).
HOLDijt	Country *i*'s total portfolio holdings in country *j* at the end of year *t* (USD).
AREAiAREAj	The product of the total land areas in km² of countries *i* and *j*.
ISLANDij	Dummy variable which is unity if *i* and *j* are both islands.
BORDERij	Dummy variable which is unity if *i* and *j* share a land border.
LLOCKij	Dummy variable for when *i* and *j* are both landlocked (without coastline).
FTAij	Dummy variable which is unity if *i* and *j* are part of the same FTA.
DISTij	Great Circle distance in kilometres between the geographic centres of *i* and *j*.
GDPitGDPjt	Product of nominal GDP of countries *i* and *j* in year *t* in USD.
EUij	Dummy variable which is unity if country *i* and *j* are both EU members.
EUtrendijt	Takes values 1=2001, 2002=2, etc, when both *i* and *j* are EU members.
LEGALij	Dummy variable which is unity if *i* and *j* have the same legal origin.
LANGij	Dummy variable which is unity if *i* and *j* share a common language.
CorrRMijt	The correlation between returns on stock markets in countries *i* and *j* during year *t*.
EUR11	Dummy variable which is unity if both *i* and *j* use the euro.

Note: See appendix A.1 for more detailed definitions and sources.

Drawing on equations (2) and (3) outlined in sections 4.2 and 5.1 respectively, and including all the variables discussed, the first stage regression of our IV approach applies the log-linear model:

$$\begin{aligned}\ln Trade_{ij,t} &= \alpha^0 + \alpha_i^1 + \alpha_j^2 + \lambda_t + \beta^1 \ln Area_i Area_j + \beta^2 Island_{ij} + \beta^3 Border_{ij} + \beta^4 Llock_{ij} \\ &+ \beta^5 FTA_{ij} + \beta^6 \ln Dist_{ij} + \beta^7 \ln GDP_{i,t} GDP_{j,t} + \beta^8 EU_{ij} + \beta^9 EUtrend_{ij,t} + \beta^{10} Legal_{ij} \\ &+ \beta^{11} Lang_{ij} + \beta^{12} CorrRM_{ij,t} + \beta^{13} Eur11_{ij} + \varepsilon_{ij,t}\end{aligned} \quad (4)$$

We then use the predicted values of trade from this estimation as a variable in our second stage regression on asset holdings. Asset holdings will be measured as equity, debt and total holdings respectively in the model:

$$\begin{aligned}\ln Holdings_{ij,t} &= \alpha^0 + \alpha_i^1 + \alpha_j^2 + \lambda_t + \beta^1 \ln Dist_{ij} + \beta^2 \ln \overline{Trade}_{ij,t} + \beta^3 \ln GDP_{i,t} GDP_{j,t} \\ &+ \beta^4 EU_{ij} + \beta^5 EUtrend_{ij,t} + \beta^6 Legal_{ij} + \beta^7 Lang_{ij} + \beta^8 CorrRM_{ij,t} + \beta^9 Eur11_{ij} + \varepsilon_{ij,t}\end{aligned} \quad (5)$$

where α^0 is the overall intercept, α^1 and α^2 are source and destination country fixed effects, λ is the year specific effects and ε is the error term that is assumed to comply with the basic OLS assumptions. This is thus our baseline model which will serve as the basis for further testing.

6 DATA

When it comes to empirical work in practise, any model employed will only be as good as the data it is used on. In this section we will therefore have a closer look at the data we use, focusing on the relevant issues. We begin by presenting our sample of countries before describing the data on portfolio investments used. We then discuss certain problematic issues with it and end by presenting an overview of the data and some basic raw data analyses.

6.1 Sample of Countries

The 24 countries in our sample are those OECD nations that are classified as high-income countries by the World Bank. These include all of the so called EU-15 nations that entered before 1995, but none of the countries which entered the EU later. Since our data covers year-end portfolio holdings from 2001 to 2005, all EU countries in our sample have been members during the entire sample period and our EU dummy variable is hence time invariant. The same goes for the euro dummy. The only Eurozone country not in our sample is Slovenia which adopted the euro in 2007, i.e. one year after the end of our sample period. None of the small countries using the euro without being EU or Eurozone members are in our sample and Denmark is the sole participant of ERM II. The selection of countries has been based on the desire to have a dataset as complete as possible while using only comparable countries with fairly well-developed capital markets. The sample countries are presented in Table 2 below.

Table 2 List of sample countries

Country		**EU country** (Affiliation year)	**Euro country** (Adoption year)	**Language(s)**	**Legal origin**[a]
Australia	AU			English	English
Austria	AT	1995	1999	German	German
Belgium	BE	1957	1999	Dutch, French, German	French
Canada	CA			English, French	English
Denmark	DK	1973		Danish (Scandinavian)	Scandinavian
Finland	FI	1995	1999	Finnish, Swedish (Scandinavian)	Scandinavian
France	FR	1957	1999	French	French
Germany	DE	1957[b]	1999	German	German
Greece	GR	1981	2001	Greek	French
Iceland	IS			Icelandic	Scandinavian
Ireland	IE	1973	1999	English	English
Italy	IT	1957	1999	Italian	French
Japan	JP			Japanese	German
Korea, Republic of	KR			Korean	German
Luxembourg	LU	1957	1999	Luxembourgish, German, French	French
Netherlands	NL	1957	1999	Dutch, Frisian	French
New Zealand	NZ			English, Maori	English
Norway	N			Norwegian (Scandinavian)	Scandinavian
Portugal	PT	1986	1999	Portuguese	French
Spain	ES	1986	1999	Spanish	French
Sweden	SE	1995		Swedish (Scandinavian)	Scandinavian
Switzerland	CH			German, French, Italian	German
United Kingdom	GB	1973		English	English
United States	US			English	English

a) Source: La Porta et al. (1998 and 2002).

b) West Germany was one of the founding countries. In October 1990 East and West Germany were unified and East Germany thereby became an EU member.

Potential outliers in this sample are mainly Luxembourg, Switzerland and Greece. Luxembourg is a small nation that has attracted large volumes of foreign capital placements, mainly for tax

purposes. Switzerland is an established financial centre in Europe and is also known for large foreign investments. Greece finally, adopted the euro later than the other Eurozone nations, only one year before the first data in our sample. We will control for the impact of outliers as a robustness check in section 8.6.

6.2 The CPIS Data

One of the main features of this study is the use of new, recently released data on international portfolio investment holdings compiled by the International Monetary Fund (IMF). As opposed to even such recent papers as Coeurdacier and Martin (2007), we have a dataset covering year-end holdings for five years; from 2001 up to 2005. The IMF first performed its Coordinated Portfolio Investment Survey (CPIS) in 1997 following demands for a global survey of portfolio investments. Then, only 29 countries participated, whereas important countries in our sample such as Germany did not. From 2001 and onwards the survey is performed on a yearly basis in a large number of countries and regions and data is currently available for up to 2005.

The CPIS data covers year-end bilateral holdings of portfolio investments in equity and debt securities measured in current U.S. dollars. Debt securities include both short term and long term debt, and are available separately, although we have chosen to look only at total debt. CPIS distinguishes between direct and portfolio investments and only includes portfolio investments. A direct investment is one made with the objective of obtaining a lasting interest and includes both the initial purchase as well as all subsequent transactions between the parties. This translates into holding ten percent or more of ordinary shares or voting power. Debt transactions between such entities are also considered as direct investments and are thus excluded from the data. CPIS compiles each country's residents' investments in securities issued by non-residents. Residence does not necessarily coincide with nationality, but is rather the centre of an entity's economic interest. For corporate entities, the country of legal incorporation is used to determine residence. A person who has resided abroad for more than one year is considered a non-resident. One observation in the data we use will hence consist of, for example, the total value of French equity securities (typically issued in France) held by Germans (typically German citizens). In this case, France will be the destination country (j) – since it is the destination of the funds being transferred across the border – and Germany will be the source country (i).[16]

6.3 Issues with the Data

There are some problems with the data which must be addressed. One such issue is that the CPIS data does not tell us in what currency the asset is denominated, only in what country it is issued. For our purposes this could be a problem. However, as Lane (2005) notes, the vast majority of domestically issued financial assets are denoted in the domestic currency and the problem, if any, should not be large.[17]

Officially, the data for 2005 is preliminary (as is that for 2003) and will probably be updated. However, we do not believe that any subsequent revisions will be influential, especially not for the developed countries in our sample.

We find one interesting observation; for 2005, there are reported debt securities issued in the Netherlands being held by residents in the Netherlands totalling U.S. dollars 2,359.4, whereas the

[16] See IMF's website for a more detailed description of the CPIS data. There, the data can also be downloaded directly. [http://www.imf.org/external/np/sta/pi/cpis.htm]

[17] When investigating this, he finds that 93 percent of outstanding bonds were denoted in the domestic currency.

other values for when the reporting and partner country are the same are coded as either zero or missing value. This is of course only a minor error in the data which we disregard.

Negative entries, although rare, do exist in the data and signify short positions, typically resulting from the sale of securities acquired under repurchase agreements (repos). When the buyer of a security purchased under a repo sells the security to a third party, a short position occurs. Although this is the main cause of short positions, the treatment of repos differs between countries and negative entries on the aggregate level can in some cases indicate problems with omitted data. Regardless, these cause a problem when doing the logarithmic transformation required for estimating the gravity model. In total holdings, there are no negative entries. There is one negative recording of debt and eight recorded short positions in equity holdings in our sample, which can be compared to the total of 2,760 observations. The negative entries are reported in Table 22 in appendix A.3. Since the negative entries are so rare and the underlying data uncertain, we chose to ignore these and let them enter the logged series as missing values. Since we analyse each asset class separately, total holdings will be completely unaffected by this problem. In either case, even for equity holdings, nine out of 2,760 observations will likely not cause any distortions and there is little reason to believe that it could bias the effect of the euro.

It is, however, more difficult to disregard the more numerous zero values in the same manner. In 123 out of the 2,760 observations at least one of the three reported holdings figures takes the value zero. The numbers of reported zeros for equity and debt holdings are 84 and 44 respectively. These overlap in 19 observations for which all three variables are zero, shown in Table 23 in appendix A.3. Moreover, there were also 14 observations for which both equity and debt holdings were reported as missing values but total holdings reported as zero. We assume that these zero values were actually missing and recode them as such.

Many countries apply a threshold when conducting their surveys meaning that in some cases where zero holdings are reported, there might actually be small holdings. Although the exclusion of zero values might not be entirely appropriate, few alternatives exist. Furthermore, when analysing the data, we find that the zero values are fairly evenly distributed across years and countries, suggesting that excluding them will probably not result in any bias. This is therefore the treatment we adopt for our baseline regressions. Another option is to recode the resulting missing values as zeros in the logged series. This method is equivalent to adding one dollar to all values before doing the transformation since the logarithm of one is zero. We do this as a robustness check in section 8.4 and as we shall see there, the results do change some although the euro effect remains roughly the same. We can still conclude that this method is inferior to our baseline method.[18]

In the CPIS data there are also some missing values. Some of these are due to existing data not being disclosed for reasons of confidentiality. Switzerland for example has become increasingly discrete in revealing its residents' foreign holdings. For 2001 they conceal only the figures for investments in Iceland (out of our sample countries) whereas they for 2005 choose to disclose 12 out of 23 entries. The confidential figures pose a potential source of error since it means that our missing values are not randomly distributed. However, we believe this to be a minor problem and doubt that it will affect our conclusions in any way. There are a total of 276 observations for which at least one of the three values is missing and 79 in which total holdings is missing.

Of our other variables, only $TRADE_{ij,t}$ contains missing values. There are, however, merely three such observations, all of which include Luxembourg as the partner country. This data, which is

[18] Lane and Milesi-Ferretti (2004) use Tobit regression to better account for zero values, but that is beyond the scope of this paper.

obtained from the United Nations' Commodity Trade Statistics Database (COMTRADE), also contains some so called re-imports, were goods are exported only to be imported again shortly thereafter. This is reported as imports from oneself and we list these observations in Table 21 in appendix A.3, even though they are not observations in our data. The total number of observations used in each regression is reported in connection with the results.

One problem that does affect our results is the fact that total holdings are rarely equal to the sum of debt and equity holdings. Reported total holdings are smaller than the sum in 1,305 cases, greater than the sum in 1,141 cases and equal only for 314 of the observations. One reason for this is that figures for the separate classes are sometimes not disclosed for confidentiality reasons while total holdings are reported. In other cases, it is due simply to errors in the data. As we shall see later on, this does affect our results, in some cases causing the euro's effect on total holdings to appear to be greater than the effect on both asset classes separately. Due to the fact that some figures are reported for total holdings but not broken down by asset class, we believe it is best to trust more in the figures for total holdings, even though the separate figures yield more conservative estimates of the euro's impact. In either case, this fact should be born in mind when interpreting the results.

Lane (2005) and Lane and Milesi-Ferretti (2004) discuss other potential problems with the CPIS data. Because we use a more recent and complete release of data, we feel somewhat more comfortable with the data than they do. It should still be noted, as in all empirical work, that any study is only as good as its data and there are always potential sources of error that cannot be wholly compensated for.

6.4 Overview of Data

Every decent empirical study should begin with a look at the data. We start by looking at some basic statistics before moving on to data analysis to see if some patterns are distinguishable in the raw data.

6.4.1 Summary Statistics and Correlations

In Table 3 below we present summary statistics of the most important numerical variables we use. They are presented here in level form rather than the log-form we use in our estimations.

Table 3 Summary statistics

Variable	N	Mean	Std. dev.	Min	Max	Unit
TRADEijt	2757	12.6	33.4	0.001	503	USD billion
HOLDijt	2681	24.8	60.8	0	815	USD billion
EQTijt	2598	10.9	33.4	-11.5	538	USD billion
DEBTijt	2525	15.0	36.4	-0.011	555	USD billion
GDPit	2760	1190	2290	7.9	12400	USD billion
DISTij	2760	5506	5425	196	19814	km
CorrRMijt	2760	0.5544	0.2726	-0.4041	0.9726	$-1<\rho<1$
AREAi	2760	1331269	2989009	2586	9984670	km^2

What is far more interesting though, is to look at the development over our sample period. Table 4 lists the average values for those variables which change over time. One should remember that these are simple, non-weighted averages and differences between countries therefore play a part. The 38 percent growth in GDP from 2001 to 2005 thus appears impressive, but does not reflect the true average growth rate for the countries in our sample. One should also remember that the numbers are nominal, but inflation is not really an issue here and it is clear that both international trade and portfolio investments have increased dramatically. Still bearing in mind that differences between countries are a factor, trade has increased steadily by a total of 55 percent

over the five years. Even more noteworthy, cross-border portfolio holdings in all asset classes have roughly doubled in the first years of the new millennium.

Table 4 Average values by year

Variable	2001	2002	2003	2004	2005
TRADEijt	10.30	10.60	12.10	14.10	16.00
HOLDijt	16.60	18.60	24.80	30.50	33.70
EQTijt	8.00	7.36	10.50	13.20	15.80
DEBTijt	9.04	12.00	15.80	18.70	19.70
GDPit	1010.00	1060.00	1190.00	1320.00	1390.00
CorrRMijt	0.5898	0.6399	0.5480	0.4329	0.5617

Note: All figures are in USD billion except for $CorrRM_{ij,t}$ which is a correlation coefficient.

Observing this massive growth in cross-border investments gives rise to the question of what might have caused it. A natural starting point is to look at a correlation matrix of all the variables we use, as in Table 5. We must bear in mind though, that these are simple two-way correlations that do not adjust for the impact of other variables. We see that commodities trade is correlated with all the explanatory variables, with only two insignificant coefficients and only the island dummy having a counter-intuitive negative sign. Holdings in the different asset classes are heavily correlated with each other as well as with trade. Distance is negatively correlated with all asset classes but insignificantly so with equity holdings. Correlation in stock market returns has a positive sign, but as discussed above under section 5.3, this was not entirely unexpected. The EU dummy and the EU trend variable are, somewhat surprisingly, negatively correlated with equity holdings. Of the instrumental variables, fewer are significantly correlated with asset holdings than with trade, and the coefficients are smaller as was both expected and desired. The remaining coefficients are as expected except for the euro dummy which is actually negatively correlated with equity holdings, albeit insignificantly so. Looking at the other relationships, they are more or less as expected.

Table 5 Pairwise correlations

	TRADEijt	HOLDijt	EQTijt	DEBTijt	DISTij	GDPitGDPjt	EUR11	CorrRMijt	EUtrendijt	EUij	LEGALij	LANGij	AREAiAREAj	ISLANDij	BORDERij	LLOCKij	FTAij
TRADEijt	1	0.60*	0.53*	0.54*	-0.13*	0.55*	0.08*	0.19*	0.09*	0.08*	0.15*	0.18*	0.50*	-0.04	0.39*	-0.03	0.09*
HOLDijt	0.60*	1	0.88*	0.90*	-0.06*	0.71*	0.07*	0.14*	0.09*	0.05*	0.13*	0.17*	0.19*	0.00	0.20*	0.01	-0.01
EQTijt	0.53*	0.88*	1	0.58*	-0.00	0.67*	-0.03	0.10*	-0.01	-0.04*	0.09*	0.18*	0.24*	0.00	0.13*	0.03	-0.08*
DEBTijt	0.54*	0.90*	0.58*	1	-0.08*	0.60*	0.13*	0.14*	0.15*	0.11*	0.14*	0.12*	0.11*	0.02	0.21*	-0.02	0.04
DISTij	-0.13*	-0.06*	-0.00	-0.08*	1	0.10*	-0.43*	-0.26*	-0.51*	-0.59*	-0.14*	-0.06*	0.12*	0.20*	-0.27*	-0.10*	-0.74*
GDPitGDPjt	0.55*	0.71*	0.67*	0.60*	0.10*	1	-0.11*	0.04	-0.11*	-0.14*	-0.01	0.00	0.17*	-0.02	-0.01	-0.03	-0.19*
EUR11	0.08*	0.07*	-0.03	0.13*	-0.43*	-0.11*	1	0.14*	0.61*	0.72*	0.28*	-0.00	-0.09*	-0.13*	0.23*	0.02	0.55*
CorrRMijt	0.19*	0.14*	0.10*	0.14*	-0.26*	0.04	0.14*	1	0.21*	0.24*	0.06*	0.12*	0.06*	-0.23*	0.19*	0.02	0.10*
EUtrendijt	0.09*	0.09*	-0.01	0.15*	-0.51*	-0.11*	0.61*	0.21*	1	0.86*	0.14*	-0.03	-0.10*	-0.13*	0.17*	-0.01	0.66*
EUij	0.08*	0.05*	-0.04*	0.11*	-0.59*	-0.14*	0.72*	0.24*	0.86*	1	0.16*	-0.04*	-0.12*	-0.15*	0.20*	-0.01	0.77*
LEGALij	0.15*	0.13*	0.09*	0.14*	-0.14*	-0.01	0.28*	0.06*	0.14*	0.16*	1	0.46*	0.18*	0.10*	0.30*	0.03	0.17*
LANGij	0.18*	0.17*	0.18*	0.12*	-0.06*	0.00	-0.00	0.12*	-0.03	-0.04*	0.46*	1	0.25*	0.17*	0.49*	0.25*	-0.04*
AREAiAREAj	0.50*	0.19*	0.24*	0.11*	0.12*	0.17*	-0.09*	0.06*	-0.10*	-0.12*	0.18*	0.25*	1	-0.02	0.10*	-0.02	-0.07*
ISLANDij	-0.04	0.00	0.00	0.02	0.20*	-0.02	-0.13*	-0.23*	-0.13*	-0.15*	0.10*	0.17*	-0.02	1	-0.01	-0.03	-0.12*
BORDERij	0.39*	0.20*	0.13*	0.21*	-0.27*	-0.01	0.23*	0.19*	0.17*	0.20*	0.30*	0.49*	0.10*	-0.01	1	0.09*	0.19*
LLOCKij	-0.03	0.01	0.03	-0.02	-0.10*	-0.03	0.02	0.02	-0.01	-0.01	0.03	0.25*	-0.02	-0.03	0.09*	1	-0.04
FTAij	0.09*	-0.01	-0.08*	0.04	-0.74*	-0.19*	0.55*	0.10*	0.66*	0.77*	0.17*	-0.04*	-0.07*	-0.12*	0.19*	-0.04	1

*Note: Statistically significant correlation coefficients at the 5 percent level are indicated by *.*

Given the limitations of pairwise correlations, we move on to partial correlations where we control for the impact of the other variables. Since our a priori belief is that most variables have constant elasticities vis-à-vis each other, we also now use logged values. These correlations are shown in Table 6.

Now, trade is negatively correlated with total holdings and the product of areas. Other surprises include the EU and common legal origin dummies being negatively correlated with total holdings. The correlation between physical distance and asset holdings now becomes positive,

although it remains negative for total holdings. Even more surprisingly, the euro dummy is now significantly negatively correlated with both equity and debt holdings.

Table 6 Partial correlations of logged values

	lnTRADEijt	lnHOLDijt	lnEQTijt	lnDEBTijt	lnDISTij	lnGDPitGDPjt	EUR11	CorrRMijt	EUtrendijt	EUij	LEGALij	LANGij	lnAREAiAREAj	ISLANDij	BORDERij	LLOCKij	FTAij
lnTRADEijt	1	-0.10*	0.09*	0.03	-0.44*	0.82*	0.01	0.14*	-0.13*	0.09*	0.16*	0.14*	-0.02	0.16*	0.08*	-0.07*	0.10*
lnHOLDijt	-0.10*	1	0.86*	0.87*	-0.14*	0.13*	0.18*	-0.07*	0.00	-0.08*	-0.05*	0.05*	0.00	0.08*	-0.06*	0.02	-0.03
lnEQTijt	0.09*	0.86*	1	-0.62*	0.04	-0.08*	-0.19*	0.11*	0.01	0.06*	0.03	0.00	0.02	-0.02	0.02	-0.02	-0.06*
lnDEBTijt	0.03	0.87*	-0.62*	1	0.12*	0.05*	-0.08*	0.07*	-0.01	0.10*	0.05*	0.01	-0.09*	-0.05*	0.05*	0.01	0.11*
lnDISTij	-0.44*	-0.14*	0.04	0.12*	1	0.30*	0.08*	-0.11*	-0.01	0.01	0.09*	-0.08*	0.41*	0.18*	-0.34*	-0.21*	-0.49*
lnGDPitGDPjt	0.82*	0.13*	-0.08*	0.05*	0.30*	1	-0.07*	-0.08*	0.18*	-0.03	-0.11*	-0.27*	0.36*	-0.13*	-0.01	0.01	-0.31*
EUR11	0.01	0.18*	-0.19*	-0.08*	0.08*	-0.07*	1	-0.04	0.00	0.39*	0.26*	-0.14*	-0.01	-0.09*	0.15*	0.05*	-0.03
CorrRMijt	0.14*	-0.07*	0.11*	0.07*	-0.11*	-0.08*	-0.04	1	-0.02	0.09*	-0.05*	0.01	0.09*	-0.17*	-0.03	-0.03	-0.11*
EUtrendijt	-0.13*	0.00	0.01	-0.01	-0.01	0.18*	0.00	-0.02	1	0.59*	0.02	0.05*	-0.11*	0.00	0.00	0.00	0.10*
EUij	0.09*	-0.08*	0.06*	0.10*	0.01	-0.03	0.39*	0.09*	0.59*	1	-0.10*	0.00	-0.08*	-0.02	-0.06*	-0.01	0.36*
LEGALij	0.16*	-0.05*	0.03	0.05*	0.09*	-0.11*	0.26*	-0.05*	0.02	-0.10*	1	0.35*	-0.03	0.03	0.03	-0.07*	0.08*
LANGij	0.14*	0.05*	0.00	0.01	-0.08*	-0.27*	-0.14*	0.01	0.05*	0.00	0.35*	1	0.25*	0.10*	0.32*	0.21*	-0.22*
lnAREAiAREAj	-0.02	0.00	0.02	-0.09*	0.41*	0.36*	-0.01	0.09*	-0.11*	-0.08*	-0.03	0.25*	1	-0.04	0.09*	-0.05*	0.36*
ISLANDij	0.16*	0.08*	-0.02	-0.05*	0.18*	-0.13*	-0.09*	-0.17*	0.00	-0.02	0.03	0.10*	-0.04	1	0.01	-0.03	0.06*
BORDERij	0.08*	-0.06*	0.02	0.05*	-0.34*	-0.01	0.15*	-0.03	0.00	-0.06*	0.03	0.32*	0.09*	0.01	1	-0.11*	-0.14*
LLOCKij	-0.07*	0.02	-0.02	0.01	-0.21*	0.01	0.05*	-0.03	0.00	-0.01	-0.07*	0.21*	-0.05*	-0.03	-0.11*	1	-0.19*
FTAij	0.10*	-0.03	-0.06*	0.11*	-0.49*	-0.31*	-0.03	-0.11*	0.1*	0.36*	0.08*	-0.22*	0.36*	0.06*	-0.14*	-0.19*	1

*Note: Statistically significant correlation coefficients at the 5 percent level are indicated by *.*

Taken together, these results serve to emphasize the importance of using a theoretically founded model. Only through use of this can one wholly control for the impact of other variables and isolate the separate effects from each variable. Such a model can also control for the country specific effects that might otherwise bias the correlation coefficients. Before we move on to doing so, however, we shall have a further look at the raw data to see if we can spot any patterns.

6.4.2 Benchmark U.S. Holdings

The U.S. has very large capital markets and can in many ways be thought of as a benchmark for asset holdings (Martin and Rey, 2004). To see how market size – measured by us as GDP – might determine foreign financial holdings, we use U.S. holdings as the yardstick and compare these with the GDP of each country. Figure 1 shows the share of U.S. total portfolio holdings (as a percentage of the total holdings in the other sample countries) minus that country's GDP (again as a percentage of the total in the group) for 2001 and 2005.

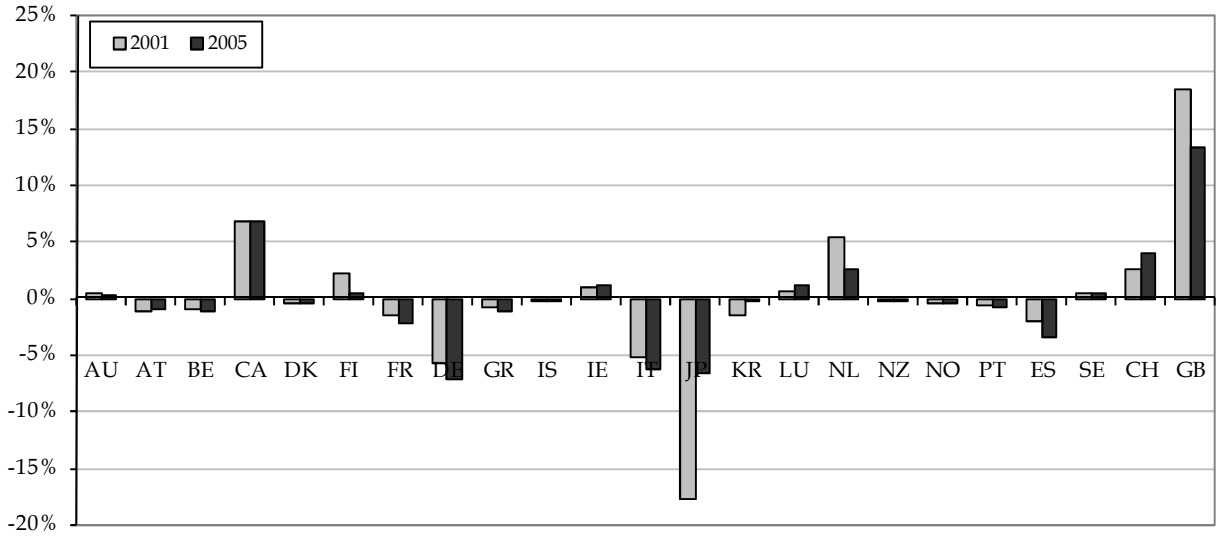

Figure 1 Share of U.S. total portfolio holdings minus share of GDP

Overall we see that the size of the GDP explains a large part of the relative allocation of U.S. foreign holdings with many countries having close to the expected allocated share. This is in line with CAPM as commented above under section 3 and is the rationale for including GDP as the mass variable in the gravity equation. Some deviations are noteworthy though. The U.K. and Canada are clearly and largely overrepresented in U.S. financial holdings. Cultural, historical and linguistic bonds come to mind, as well as spatial proximity in the case of Canada. Japan is clearly underrepresented, and considering that this bias has decreased from 2001 to 2005 it is most likely due to Japan's poor macroeconomic (and stock market) performance throughout the 1990's. Although there is little point in speculating, these and other deviations do tell us that market size is not the whole story behind asset allocation.

6.4.3 Trends by Groups

To try to spot trends in the data and get an indication of what effect the euro might have had, Figure 2 plots the average total portfolio holdings over time for five groups; (i) all countries, (ii) euro countries' holdings in other euro countries, (iii) non-euro countries' holdings in other non-euro countries, (iv) euro countries' holdings in non-euro countries and (v) non-euro countries' holdings in euro countries. Panel A shows the equally weighted averages and panel B the average values weighted by the product of the two countries' GDPs.

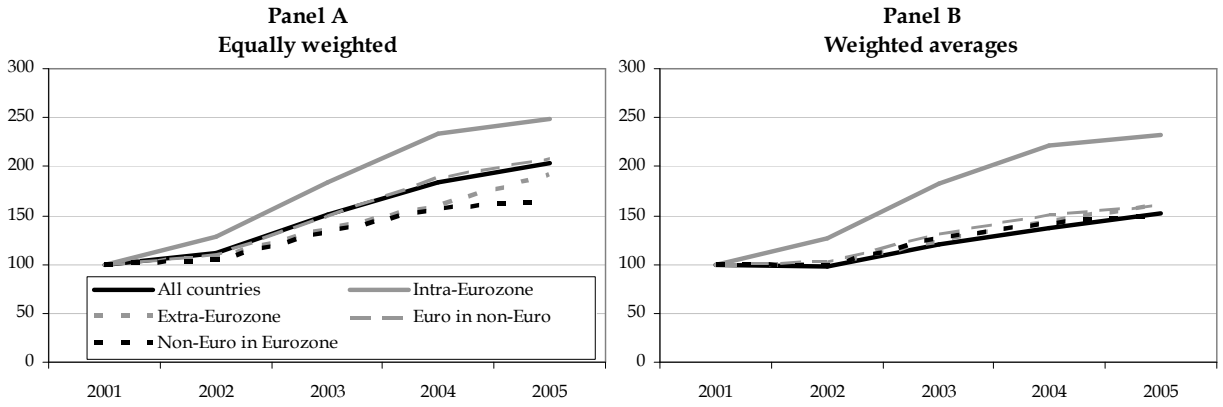

Figure 2 Average total portfolio holdings by groups

Note: All series are indexed (2001=100). Panel A shows the equally weighted averages in each group for each year. Panel B shows average values weighted by the product of the two countries' GDP.

The trend is clearly rising in all groups, yet one should note two things. Firstly, since these are dollar values any growth in the value of the holdings, e.g. growth in stock markets, will show up as an increase even if no additional investments (purchases) have been made. The downturn of global stock markets from 2000 to 2002 and the upswing from 2003 and onwards is visible in panel B for some groups. Secondly, the values are nominal thus including any effect of inflation. The latter is however of minor significance in our data set since the average inflation over all countries and years is only 2.30 percent with a global maximum of 6.39 percent per annum.[19] Bearing this in mind, the data still suggests an increasing trend in all groups. As can be seen when comparing the two panels, holdings in and by small countries (i.e. low GDP) has grown more than the larger country holdings. In the equally weighted panel, the two groups extra-Eurozone holdings and non-euro countries' holdings in the Eurozone both lie below the all countries average, thus reflecting that there are countries with large GDP outside the Eurozone.[20]

[19] Inflation is measured here as the annual percentage change in consumer price index (CPI) and the data is gathered from the World Bank's World Development Indicators (WDI Online). [http://devdata.worldbank.org/dataonline] The data originates from the International Monetary Fund (IMF), International Financial Statistics (77IFS).

[20] Primarily the U.S., Japan, Canada and Australia.

The most striking feature of the two graphs is, however, that euro countries' holdings in other euro countries have increased far more than any other group. Looking only at these data, there appears to be a euro effect on asset holdings. Still, one cannot rely on this observation alone since we have not controlled for any other effects that might have influenced cross-border portfolio holdings. We shall therefore move on to estimating our model.

7 RESULTS

We begin by estimating the baseline models (4) and (5) developed above before we move on to examine the euro's effect over time and by country. In the final sub-section we attempt to disentangle the effect of reduced exchange rate volatility. The estimation of the fixed effects model developed under section 5.1 is done by using an extensive set of dummy variables. The estimates of these variables do not say much and are of little interest. They are therefore not reported for ease of display, except for in Table 20 in appendix A.2 for the baseline estimation. The same goes for the overall intercept. Using dummy variables for all cases would cause perfect multicollinearity and so the dummies for the year 2000 and the U.S. are always excluded. All estimation is done using ordinary least squares (OLS) with Newey-West heteroscedasticity and autocorrelation consistent (HAC) standard errors, also know simply as Newey-West standard errors.[21] When calculating these, we allow for the full four lags in the autocorrelation function which is the maximum possible in our sample.

All variables are in log-form except for the EU trend, the dummies and the stock market correlation variable.[22] This means that the estimated coefficients can be interpreted as the approximate percentage change in holdings when the independent variable in question increases by one percent. As for the dummy variables, the change resulting from the dummy being one is given by the natural base *e* raised to the estimate. The interpretation of the estimated coefficient for the stock market correlation is slightly more involved, but the sign of the estimate can still be readily interpreted.

7.1 Baseline Estimation

The results from the estimations of the baseline models (4) and (5) are shown in Table 7 below. Looking firstly at the first stage regression of trade in goods and focusing on the set of instruments and other variables, we see that the model in general performs very well; adjusted R^2 is exceptionally high (0.95) and all but two variables are significant. The high R^2 is in part due to the estimation technique with an extensive set of dummy variables, but as we shall see later on in section 8.1, the model has very large explanatory power regardless of this effect; R^2 is 0.89 without the fixed effects. Most variables have the expected signs. The product of land areas is insignificant, but is highly significant when using regular OLS standard errors, and still has explanatory power. Both the EU dummy and the EU trend variable have negative signs, but we must then remember that the FTA dummy includes also the European Community (EC) free trade area. The EU dummy thus measures the union's impact over and above its trade liberalization, such as various institutional and regulatory effects. Considering the EU's efforts to harmonize product standards, it is still remarkable that the effect is negative, but not at all unfeasible. Stock market correlation shows up as significant with a positive sign. Although there is no immediately clear intuition behind this, this might be the result of reversed causality where countries trading a lot with each other experience a greater correlation in business cycles and

[21] Originally developed in Newey and West (1987).

[22] As discussed separately in section 7.4, exchange rate volatility is estimated both in level and log form.

thereby also greater stock market correlation. The landlocked dummy is the only real surprise, being significant with a positive sign contradictory to both intuition and earlier findings.[23] Most likely, this occurs since the only landlocked countries in our sample are Austria, Luxembourg and Switzerland, producing a low number of landlocked pairs, where Luxembourg and Switzerland might be non-representative to the general population. Finally, we can note a highly significant – both economically and statistically – effect from the euro. The estimated coefficient of 0.21 suggests that the euro has raised trade between the Eurozone countries by ($e^{0.21}$ – 1=) 23.9 percent, holding all else equal. This estimate is roughly of the same size as those of Flam and Nordström (2003) and Micco et al. (2003). Taken together, our instruments perform fairly well, meaning that the model works well.

Table 7 Baseline model estimation of (4) and (5)

	First stage		*Second stage*					
	lnTRADEijt		**lnEQTijt**		**lnDEBTijt**		**lnHOLDijt**	
lnAREAiAREAj	0.24525							
	(0.27960)							
ISLANDij	0.04108							
	(0.10075)							
BORDERij	0.15663	**						
	(0.07543)							
LLOCKij	0.27464	**						
	(0.11462)							
FTAij	0.87504	***						
	(0.12433)							
lnDISTij	-0.75827	***	0.25595		0.46604	**	0.47655	**
	(0.05074)		(0.23203)		(0.19949)		(0.20657)	
lnTRADE_hatijt			0.78622	***	0.82356	***	0.95323	***
			(0.24857)		(0.20517)		(0.22057)	
lnGDPitGDPjt	0.68759	***	0.94858	***	1.46755	***	1.11096	***
	(0.15002)		(0.35101)		(0.33167)		(0.30296)	
EUij	-0.29205	**	0.16430		0.93285	***	0.52866	***
	(0.13773)		(0.16571)		(0.18182)		(0.15909)	
EUtrendijt	-0.03224	**	-0.06996	**	-0.03277		-0.03868	
	(0.01464)		(0.02993)		(0.02798)		(0.02535)	
LEGALij	0.35506	***	0.15056		0.13905		-0.01889	
	(0.04725)		(0.13084)		(0.11218)		(0.11277)	
LANGij	0.12907	*	0.05762		0.07318		0.08162	
	(0.06811)		(0.11670)		(0.10672)		(0.10193)	
CorrRMijt	0.09233	*	0.20664	*	-0.06855		-0.00915	
	(0.05537)		(0.11123)		(0.10633)		(0.09341)	
EUR11	0.21430	***	0.79046	***	0.60355	***	0.84013	***
	(0,06079)		(0,12518)		(0,13652)		(0,12239)	
N	2639		2506		2480		2662	
Adj. R^2	0.94560		0.90020		0.89210		0.90080	
RMSE	0.48314		0.89294		0.87490		0.81962	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively). The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are not shown here, but reported in Table 20 in appendix A.2.*

Turning next to our primary results from the second stage regressions, we will comment on all three regressions jointly, pointing out differences where they occur. Again, the model performs very well with an impressive adjusted R^2 (between 0.89 and 0.90) and most estimates being

[23] See e.g. Rose (2000) and Micco et al. (2003).

significant. Most variables perform roughly as expected. The instrumented trade variable has a strong positive impact with elasticities close to one. The product of GDPs is also highly significant with elasticities close to unit as expected. Looking at the EU variable, EU members prefer to invest in other member countries. The effect is very large and highly significant except in the case of equities where the coefficient is insignificantly different from zero. This phenomenon, however, is decreasing over time as the estimated coefficient for EU trend variable has a negative sign, albeit only significant for equity holdings. This could potentially be explained by a large initial effect from capital deregulations under the EMU and subsequent global deregulations, although we have no further support for this. Stock market correlation is insignificant (and slightly negative) for debt holdings, which also dominate total holdings. This is expected since the variable is not related to bond yields or other interest rates. If anything, stock market return tends to be negatively correlated with stock market return. On the other hand, return correlation has a positive and significant impact on equity holdings. This suggests that the endogeneity effect dominates, i.e. that increased capital market integration and cross-border holdings increase stock market return correlation. This could be investigated further by instrumenting $CorrRM_{ij,t}$ in the regression, although this is beyond the scope of this study and of too small importance to influence our results in any significant way. The dummies for common language and legal origin have the expected signs (except for $LEGAL_{ij}$ on total holdings) but are insignificant. The insignificance could possibly be due to multicollinearity with each other as well as other variables.

There is one important novelty compared to previous studies; distance enters with a positive sign in all regressions. This result clearly contradicts those of both Portes and Rey (1999) and Aviat and Coeurdacier (2007). Importantly however, Portes and Rey study capital flows whereas we look at holdings. As noted under section 5.3, Portes and Rey (1999) argue that costs for information cause flows to decrease with distance, but there is no apparent connection to holdings. It is therefore premature to disregard the effect of information costs, which in either case is theoretically appealing. Nonetheless, both Aviat and Coeurdacier (2007) and Coeurdacier and Martin (2007) find a negative impact of distance also on holdings, although Aviat and Coeurdacier (2007) reduced this dramatically when they instrumented trade in goods as we do. However, whereas these two studies only had access to cross-sectional data, we allow for both source and destination country fixed effects as well as year specific effects in our panel data. Without being able to pinpoint how fixed effects matter in this case, we can still say that our approach is in general more attractive from an econometric point of view, especially since it reduces problems with omitted variable bias. As we shall see in section 8.1, both RE and pooled OLS estimation result in negative estimates for distance. Furthermore, our results are in line with standard diversification theory when we add the assumption that correlation of returns is decreasing in physical distance. This crucial assumption also offers an additional confirmation of our results; in the case of equity holdings where we included return correlation explicitly, the estimated coefficient is only roughly half the size and insignificant. If we exclude this variable, the coefficient for distance rises to 0.28 and gets more significant, although still only with a *p*-value of 0.23. We have thereby provided a potential solution to the distance-puzzle in that the empirics fit the theory. Distance is negatively correlated with return correlation (see Table 5 and Table 6 above) which in turn has a negative impact on holdings, thereby resulting in an estimated positive effect of distance. When we control for return correlation, the effect of distance on holdings disappears.

Finally, we note a very large and significant effect from both countries using the euro. The effect is higher for equity than for debt, but higher still for total holdings. This apparent paradox is

explained by the problems with the data discussed above under section 6.3. Even so, it is significant at the one percent level for all asset classes. The estimated coefficients correspond to effects of 120, 83 and 132 percent for equity, debt and total holdings respectively. Two Eurozone members thus hold roughly twice as much investment in each other as in other countries, all else equal. At first, the estimated effect of the euro might seem implausibly large, but our estimates are in fact smaller than those of Coeurdacier and Martin (2007) and Lane (2005) presented in section 4.2.3. Furthermore, the effect is in line with theories incorporating elasticity of substitution between assets as discussed in section 3.4.

7.2 Effect over Time

Several studies have found that the euro's effect on trade in goods has been gradually increasing over time. Previous studies of the euro's effect on investments have only had access to cross-sectional data and thereby not been able to investigate if a similar pattern is observable in the financial data. We shall now see how the effect of the euro is distributed in time. We do so by using two different estimation techniques and focusing on total asset holdings. We first fit a linear growth trend related to the euro by adding a trend variable that takes the value 1 in 2001, 2 in 2002, etc, whenever both countries are Eurozone members and zero otherwise. Next, we add a new set of year dummies for each year (except 2001) which are one in the particular year only if both countries use the euro and zero otherwise. In both regressions, the regular euro dummy is still included. The results from both techniques are shown in Table 8.

All estimated coefficients not related to the euro differ only slightly from the baseline case in Table 7. The growth trend specification yields a large and significant overall estimate of the euro effect as well as a positive trend. However, the trend variable is hardly statistically different from zero having a *p*-value of 0.154. The coefficient of 0.04 can be interpreted as the percentage increase in the effect of the euro each year. The total percentage effect each year is more accurately given by $(e^{0.718+0.041\times y} - 1)$, where y is the year number starting with 1 in 2001. The year specific estimates are all significant, with a somewhat lower overall estimate (*EUR11*) corresponding to the effect in the year 2001. Here, the total percentage effect each year is given by $(e^{0.718+\lambda EUR} - 1)$ where λ^{EUR} is the estimated coefficient in the respective year. Although we only show the results for total holdings here, the results are similar for equity and debt.

Table 8 Estimating time varying effect

lnHOLDijt	Growth trend		Year specific estimates	
lnDISTij	0.47641	**	0.47591	**
	(0.20662)		(0.20679)	
lnTRADE_hatijt	0.95314	***	0.95283	***
	(0.22063)		(0.22080)	
lnGDPitGDPjt	1.09367	***	1.09089	***
	(0.30354)		(0.30955)	
EUij	0.60426	***	0.60353	***
	(0.16465)		(0.16479)	
EUtrendijt	-0.06385	**	-0.06350	**
	(0.02966)		(0.02972)	
LEGALij	-0.01891		-0.01855	
	(0.11281)		(0.11293)	
LANGij	0.08165		0.08175	
	(0.10197)		(0.10205)	
CorrRMijt	-0.01485		-0.02522	
	(0.09374)		(0.09613)	
EUR11	0.71801	***	0.68260	***
	(0.14495)		(0.13189)	
EURtrend	0.04081			
	(0.02862)			
λ EUR2002			0.21894	***
			(0.06472)	
λ EUR2003			0.16766	*
			(0.08545)	
λ EUR2004			0.17485	*
			(0.10242)	
λ EUR2005			0.22627	**
			(0.11360)	
N	2662		2662	
Adj. R^2	0.90080		0.90080	
RMSE	0.81959		0.81967	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are not shown here. The instrumented trade variable is the same as in the baseline regression.*

The percentage effects from both estimations are illustrated more clearly in Figure 1 along with the overall estimate from the baseline specification (dashed line). The growth trend estimate is rising each year by construction, given the positive estimate. The interpretation of the year specific estimates is more ambiguous. On the one hand, the estimate for 2002 is almost as high as that for 2005, suggesting that there is no clear pattern and that the effect is virtually constant over time. On the other hand, excluding 2002, the effect is rising each year. Notably, 2002 was the year in which the euro notes and coins were introduced. Price comparisons were facilitated, costs for cash exchange were completely eliminated and the euro became more than an abstract concept to the citizens of the Eurozone. Still, the financial institutions that are the key players on capital markets are unlikely to have been much affected by this change. It is therefore not too clear according to economic theory how notes and coins could have boosted the euro effect, even though the coincidence is striking.

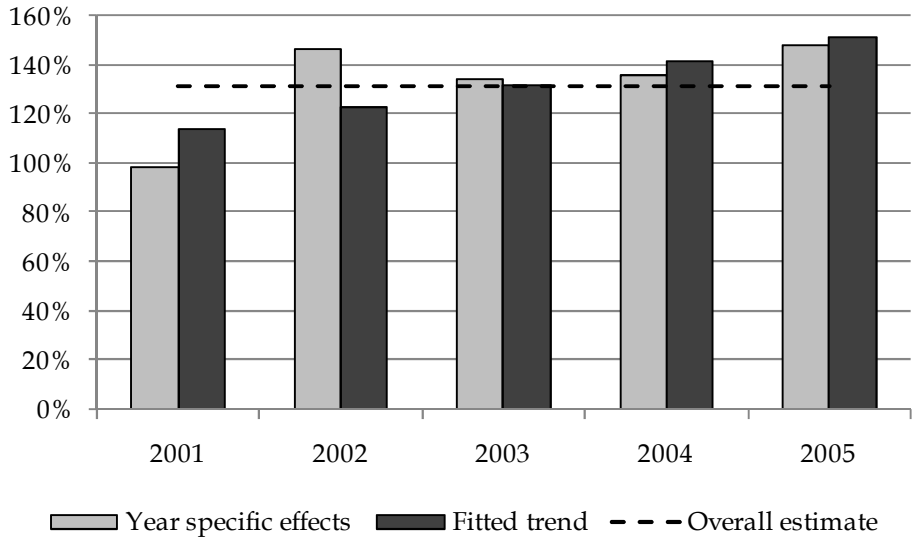

Figure 3 The euro effect on total holdings over time

Note: The reported figures give the percentage increase in Eurozone countries' total financial holdings in other Eurozone countries due to the euro for a given year, ceteris paribus. The reported figure for each year is thus an estimate of the cumulative effect over all preceding years. The year specific effects are computed by multiplying the fixed euro effect with the given euro year dummy. The fitted trend is computed by multiplying the fixed euro effect with the trend effect to the power of the value of the trend corresponding to each year.

In conclusion, we can not know for sure if the introduction of notes and coins had an extraordinary impact on cross-border investments in the Eurozone. Nonetheless, both estimation techniques still suggest that the effect from the euro has grown gradually over the sample period. However, in light of the insignificant coefficient of the growth trend and the ambiguous interpretation of the year specific estimates, this result cannot be considered robust.

7.3 Effect by Country

Some studies of the effect of currency unions on trade have isolated the effect by country or by group of countries, but ours is the first study to our knowledge that does this for portfolio investments.[24] Such a breakdown presents a more nuanced picture that could have important implications for predictions as well as the understanding of the euro's effect. In this study, we will merely outline the differences and point out that although the euro's effect is not evenly distributed, the overall estimate cannot be explained by the experiences of a few countries.

In order to isolate the country specific effects, we create new dummy variables for each euro country that take the value one when the destination country is the country in question and the source country is another euro country. The estimates thus measure how much more attractive each euro-country has become in the eyes of other euro countries as a result of the common currency. In this regression, we exclude the overall euro dummy. Table 9 presents the results.

As can be seen, the other coefficients are more or less the same as in the baseline estimation. Most country effects are significant; for total holdings, only France's effect is statistically insignificant. There are clear differences across countries. Figure 4 illustrates the effect, country by country, for each asset class (sorted by the effect on total holdings). It is noticeable how the effect on total holdings is sometimes greater than that on each separate class, which is due to the problems with the data discussed under section 6.3. Nonetheless, it is evident how debt constitutes a much larger share of total holdings than equity. The effect on equity holdings in Luxembourg can

[24] Coeurdacier and Martin (2007) separately analyses the effects for Sweden as a non-euro country and allows for a Scandinavian effect, yet they do not isolate the intra-Eurozone effect for each euro country as we do.

Table 9 The euro effect by country

	lnEQTijt		lnDEBTijt		lnHOLDijt	
lnDISTij	0.24965		0.47560	**	0.49959	***
	(0.23628)		(0.19856)		(0.10687)	
lnTRADE_hatijt	0.77766	***	0.83849	***	0.98169	***
	(0.25137)		(0.20457)		(0.11228)	
lnGDPitGDPjt	0.94916	***	1.43786	***	1.08620	***
	(0.35127)		(0.33020)		(0.22780)	
EUij	0.16566		0.92793	***	0.52171	***
	(0.16583)		(0.18227)		(0.11545)	
EUtrendijt	-0.07035	**	-0.03018		-0.03787	
	(0.02977)		(0.02767)		(0.02349)	
LEGALij	0.18046		0.14285		-0.05237	
	(0.13989)		(0.11349)		(0.06918)	
LANGij	0.04578		0.08100		0.07920	
	(0.11838)		(0.10689)		(0.06760)	
CorrRMijt	0.21328	*	-0.07210		0.00073	
	(0.10979)		(0.10579)		(0.08901)	
EUR-FI	1.05792	***	0.28010		0.37858	**
	(0.23705)		(0.26746)		(0.17019)	
EUR-FR	0.55222	***	0.12238		0.26264	
	(0.19757)		(0.23382)		(0.16940)	
EUR-DE	0.95190	***	0.46362	**	0.63617	***
	(0.20905)		(0.21270)		(0.16602)	
EUR-GR	0.12325		1.04068	***	1.55698	***
	(0.20202)		(0.24663)		(0.17421)	
EUR-IE	1.03826	***	0.89869	***	0.75033	***
	(0.33407)		(0.34116)		(0.16835)	
EUR-IT	0.73960	***	0.93272	***	1.25053	***
	(0.23310)		(0.27550)		(0.16958)	
EUR-LU	1.84963	***	-0.19432		0.65363	***
	(0.62883)		(0.36956)		(0.16996)	
EUR-NL	0.56532	**	0.35636		0.42803	**
	(0.22545)		(0.22679)		(0.16871)	
EUR-PT	0.68670	***	1.19493	***	1.42700	***
	(0.21788)		(0.28275)		(0.17323)	
EUR-ES	0.64679	***	0.66379	***	0.75085	***
	(0.22165)		(0.24254)		(0.16931)	
EUR-AT	0.26838		0.99882	***	1.39563	***
	(0.23752)		(0.27864)		(0.17000)	
EUR-BE	0.79787	***	0.51010	*	0.73983	***
	(0.24525)		(0.27149)		(0.16998)	
N	2506		2480		2662	
Adj. R^2	0.90260		0.89460		0.90380	
RMSE	0.88203		0.86483		0.80739	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are still included in the regression but not shown here. The instrumented trade variable is the same as in the baseline regression.*

certainly be dismissed as an outlier for our purposes. Luxembourg, being a tax haven, could very well have been used to shuttle capital elsewhere and in either case, this large effect is not representative for any other country. Trying to spot patterns, what comes first to mind is how Greece and Portugal, some of the poorest EU countries, have experienced the greatest increase in debt and total holdings. In fact, Greece, Portugal, Italy and Spain, taking four of the top five

positions when it comes to the euro's effect on debt holdings, are the four euro countries in our sample with the lowest GDP per capita.[25] The bottom three countries – France, Finland and the Netherlands – are the Eurozone countries in our sample with the highest stock market capitalisation per capita, a variable sometimes used as a proxy for financial development.[26] Without going too far, it appears as if the euro has improved the debt markets in the more financially underdeveloped countries. This is not surprising considering that the convergence criteria govern public finance while the ECB keeps inflation in check. It is also exactly what was predicted a priori (European Commission, 1990 and SOU 1996:158). Looking at the effect on equity holdings, on the other hand, the order is almost completely reversed. Those four countries with the highest effect on total holdings have had some of the lowest boosts to their stock markets, whereas Ireland, Germany, Finland and Belgium have seen the largest effects. It is thus more likely that the effect of the euro on this market has been more to reduce transaction costs. Considering that equity markets are typically subject to more frequent trading, this makes sense. However, without a more thorough analysis, it is difficult to say more on this subject.

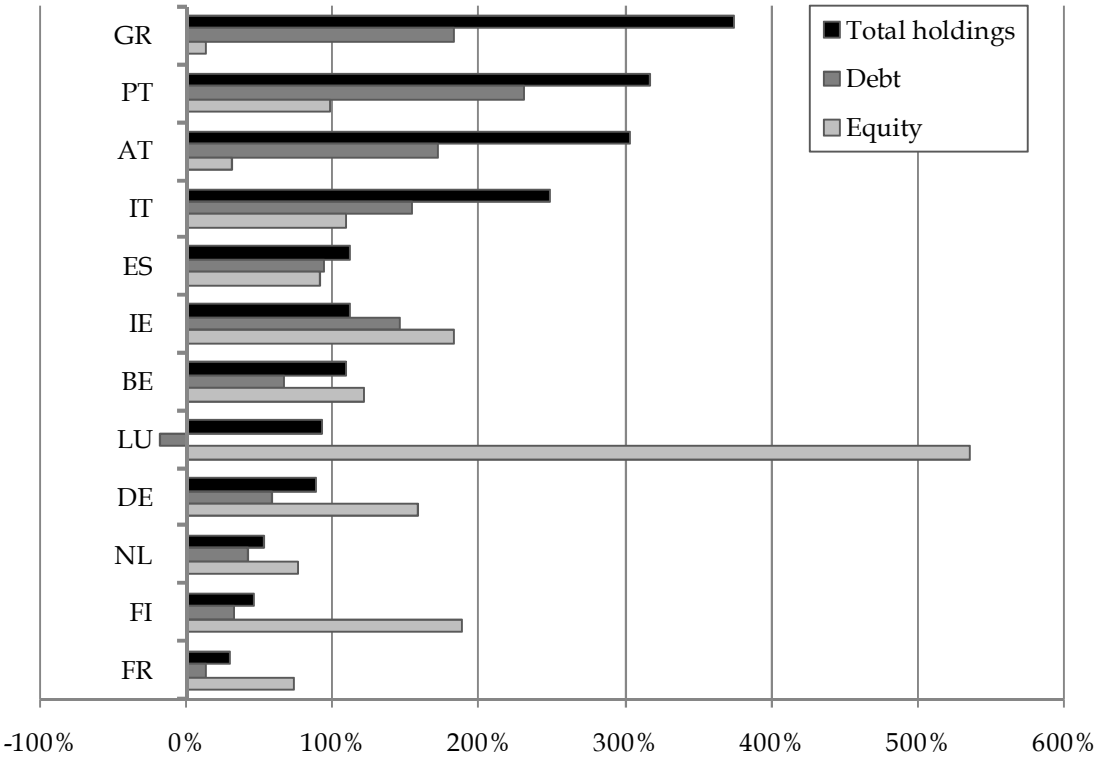

Figure 4 The euro effect by country

Note: The reported figures give the percentage increase in Eurozone countries' holdings in the respective countries due to the euro, ceteris paribus. Since reported total holdings are sometimes greater than the sum of debt and equity holdings reported separately, the effect on total holdings in some cases constitutes the largest estimate.

In conclusion it is clear that although the euro's effect has been very different between countries, the impact is highly economically significant across the board. The overall results in the previous sections can thus not be explained by the experiences of a few single countries. Although it is beyond the scope of our study, a more thorough analysis of these differences against the backdrop of different country characteristics could potentially yield a more complete understanding of the origins of the euro effect.

[25] Population figures from OECD's Statistical Country Profiles. [http://stats.oecd.org/WBOS] are used with our GDP data to produce GDP per capita.

[26] See footnotes 25 and 9 for data sources.

7.4 Common Currency versus Fixed Exchange Rates

One of the most obvious consequences of introducing the euro as a national currency is to fix the nominal exchange rate against the rest of the Eurozone. Moreover, the euro clearly represents a much more irrevocable commitment as opposed to the various fixed exchange rate regimes that have come and gone throughout the 20th century. It is therefore likely that the euro reduces risk by far more than pegging the exchange rate. The correct measure of currency risk is up for debate though. The long-term currency risk faced by investors buying securities issued overseas is not that the nominal exchange rate fluctuates. To the extent that this is matched by differences in inflation between the two countries, the investor's wealth measured in real home currency terms will not be affected. The euro has, however, also reduced real exchange rate volatility as is evident in Table 10.[27]

Table 10 Summary statistics for exchange rate volatilities

		All countries	Intra-Eurozone	Excl. intra-Eurozone
Var(NER)ijt	Mean	10.359%	0%	13.615%
	Std. dev.	36.905%	0%	41.784%
Var(RER)ijt	Mean	0.057%	0.006%	0.073%
	Std. dev.	0.114%	0.004%	0.126%

Note: The table gives summary statistics for the variance in bilateral nominal exchange rates, Var(NER), and the variance in bilateral real exchange rates, Var(RER). The methods for computing these differ and so the two variables are not directly comparable with each other. See appendix A.1 for details on the computation. In the table, we summarize over all years. In intra-Eurozone, we have included only the observations when both the source and the destination country use the euro. The last column excludes these observations.

Furthermore, having the same currency, as opposed to one currency pegged against another, completely eliminates the direct transaction costs involved in buying and selling foreign currency. Given this, it becomes interesting to analyze to what extent the euro boosts cross-border asset holdings in addition to the expected positive effect of pegged exchange rates. Although it is not possible to completely isolate this effect in the absence of a controlled experiment and especially considering our sample, we can still proxy the effect by analysing the impact of exchange rate volatility.

Several studies estimating the effect of a common currency on trade have included a measure of exchange rate volatility.[28] Typically, the variance of nominal bilateral exchange rate is included in level form in the log-linear model, which is what we start with. This variable is called $Var(NER)_{ijt}$,. In addition to this, we also want to test if volatility in real exchange rates can better proxy for currency risk and uncertainty, which is why we include $Var(RER)_{ijt}$. See appendix A.1 for a more thorough explanation. Each variable is included in turn and the results are shown in Table 11.

With respect to most variables, the results are very similar to the baseline specification. None of the coefficients for exchange rate volatility is significant, although some are when using OLS standard errors. The estimates for nominal exchange rate volatility are even positive, whereas those for real exchange rate volatility have the expected sign. The latter estimates are also much larger, which was expected since the variance of real exchange rates is much lower (see Table 10). Interestingly, the estimated coefficients for the euro's effect are even larger in all regressions than in the baseline regressions. Thus, based on these results, it would appear as if the effect of exchange rate volatility, if any, is marginal and that the effect of the euro is robust and independent of the former effect. The effects of currency uncertainty do not even become significant when we exclude the euro dummy from the regressions.

[27] Although this is not theoretically obvious, it is well documented that the exchange rate regime affects the exchange rate volatility, even in real terms. See Flood and Rose (1999) and SOU 1996:158.

[28] See e.g. Rose (2000) and Barr et al. (2003).

Table 11 Controlling for exchange rate volatility

	lnEQTijt		lnEQTijt		lnDEBTijt		lnDEBTijt		lnHOLDijt		lnHOLDijt	
lnDISTij	0.23947		0.23499		0.45002	**	0.45572	**	0.47020	**	0.44546	**
	(0.23269)		(0.23457)		(0.20080)		(0.20026)		(0.20830)		(0.20346)	
lnTRADE_hatijt	0.77606	***	0.76216	***	0.81410	***	0.81171	***	0.94844	***	0.91775	***
	(0.24936)		(0.25107)		(0.20607)		(0.20571)		(0.22210)		(0.21629)	
lnGDPitGDPjt	0.96198	***	0.94722	***	1.48211	***	1.45633	***	1.11734	***	1.09403	***
	(0.34999)		(0.35043)		(0.33210)		(0.33119)		(0.30354)		(0.30230)	
EUij	0.18369		0.16082		0.95206	***	0.92750	***	0.53589	***	0.51648	***
	(0.16668)		(0.16564)		(0.18271)		(0.18217)		(0.16159)		(0.15985)	
EUtrend	-0.06758	**	-0.06846	**	-0.03083		-0.03109		-0.03818		-0.03447	
	(0.02974)		(0.02986)		(0.02795)		(0.02793)		(0.02532)		(0.02532)	
LEGALij	0.14752		0.15437		0.13647		0.13906		-0.01923		-0.01460	
	(0.13091)		(0.13109)		(0.11250)		(0.11203)		(0.11293)		(0.11207)	
LANGij	0.05659		0.06239		0.07030		0.07599		0.08172		0.08913	
	(0.11678)		(0.11640)		(0.10681)		(0.10649)		(0.10208)		(0.10137)	
CorrRMijt	0.18962	*	0.20045	*	-0.08366		-0.07256		-0.01337		-0.02053	
	(0.10978)		(0.11167)		(0.10721)		(0.10648)		(0.09288)		(0.09404)	
EUR11	0.80380	***	0.82049	***	0.61627	***	0.62536	***	0.84448	***	0.88733	***
	(0.12355)		(0.13026)		(0.13513)		(0.13846)		(0.12132)		(0.12430)	
VarNERijt	0.19066				0.17530				0.05536			
	(0.12976)				(0.11303)				(0.11594)			
VarRERijt			-27.65793				-22.19912				-46.88974	
			(25.83641)				(28.28216)				(30.89077)	
N	2506		2506		2480		2480		2662		2662	
Adj. R^2	0.90040		0.90020		0.89230		0.89210		0.90080		0.90100	
RMSE	0.89203		0.89281		0.87414		0.87488		0.81967		0.81874	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are not shown here. The instrumented trade variable is the same as in the baseline regression.*

What both Rose (2000) and Barr et al. (2003) found was that exchange rate volatility did have a negative effect on trade, but that the effect of a common currency remained large and significant on top of this. Baldwin and Taglioni (2004) and Baldwin et al. (2005), however, criticised their findings and developed a model to explain the large currency effect. This is also applicable to portfolio investments. Their basic insight was that reduced currency risk does not only cause exporting companies to export more, but also cause more companies to start exporting. A similar reasoning is easily applied to investors. It seems unlikely that the very large increases observed can be explained at the micro level by individual investors increasing their overseas investment by over 100 percent, and so, the entrance of more international investors make the estimates more plausible. Baldwin et al. (2005) further argue that currency risk affects small companies (investors in our case) more, and that these are the ones that enter the market when the volatility approaches zero. This also makes sense since, in contrast to small individual investors, large financial institutions can more easily hedge exchange rate risk on derivatives markets, something which requires skill as well as access to these markets.[29] The main implication of this model is that the relationship between international investment and exchange rate volatility is not (log-) linear, but convex, as illustrated in Figure 5 below.

[29] The EU study too predicted that small companies would be more affected by the efficiency gains (European Commission, 1990).

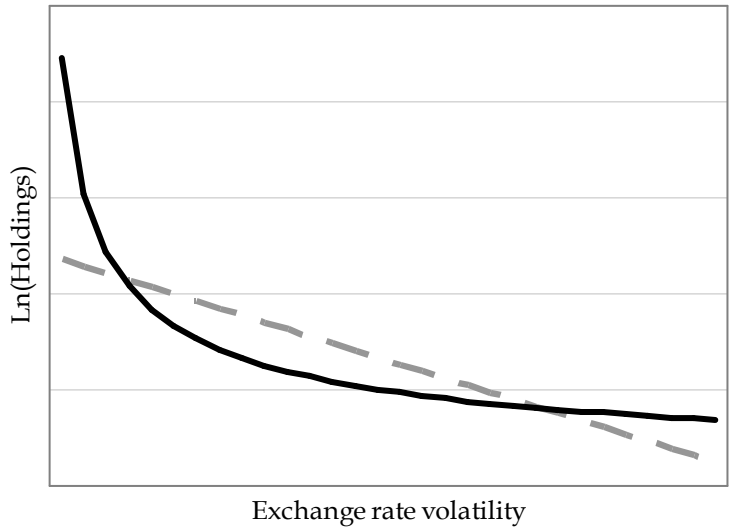

Figure 5 Convexity of the volatility effect

Source: Replicated and modified from Figure 1 in Baldwin et al. (2005, p. 16) and Figure 4 in Baldwin and Taglioni (2004, p. 13).

Note: The solid line represents an equation of the type $[Var(ER)^{\beta^1}] \times \beta^0$ *where* $\beta^1 < 0$. *The dashed line is a fitted linear regression.*

Thus, a linear estimation of type we just did (illustrated by the dashed line) will underestimate the effect of the reduced volatility when the volatility approaches zero. Furthermore, since the euro reduces this volatility, the euro dummy will pick up the remaining effect (the distance between the dashed and the solid lines to the left in Figure 5). If we wish to isolate the "pure currency effect" from the effect of reduced exchange rate volatility, we must resort to another specification. Depending on the exact nature of the convex relationship, the problem could perhaps be overcome by using the logarithm of exchange rate volatility as the regressor. Unfortunately, we will then be unable to use nominal volatility, since it is zero within the Eurozone and we are left only with real volatility.[30] The results from these regressions, including real exchange rate volatility in logs, are shown in Table 12.

As can be seen, the results are no better this time around with all estimates for the volatility effect being insignificant. It is also interesting to note that in the only case when the coefficient has the expected negative sign, i.e. when regressing equity holdings, the estimate for the euro dummy is larger than in the baseline specification. In the other regressions of debt and total holdings the volatility estimates are positive and the euro estimates are smaller. This could be interpreted as support for the convexity theory of Baldwin and Taglioni (2004) and that our specification is erroneous, although it is not clear. Baldwin et al. (2005) propose several other specifications, including polynomial equations for volatility, and do find empirical support for their theories in commodities trade. We were not able to improve our results by doing the same.

[30] Coeurdacier and Martin (2007) add the logarithm of nominal exchange rate volatility, but only when regressing just Swedish holdings. They thereby avoid the problem of zero nominal volatility and find that exchange rate volatility matters a lot for bonds but not at all for equity holdings.

Table 12 Controlling for logarithmic exchange rate volatility

	lnEQTijt		lnDEBTijt		lnHOLDijt	
lnDISTij	0.26326		0.45352	**	0.46657	**
	(0.23189)		(0.19906)		(0.20703)	
lnTRADE_hatijt	0.79004	***	0.81588	***	0.94658	***
	(0.24858)		(0.20551)		(0.22097)	
lnGDPitGDPjt	0.93899	***	1.49202	***	1.12735	***
	(0.35196)		(0.33327)		(0.30387)	
EUij	0.13596		0.97907	***	0.56280	***
	(0.17278)		(0.19192)		(0.16567)	
EUtrend	-0.06735	**	-0.03746		-0.04211	
	(0.03063)		(0.02841)		(0.02602)	
LEGALij	0.14025		0.15735		-0.00679	
	(0.13117)		(0.11268)		(0.11348)	
LANGij	0.06427		0.06164		0.07470	
	(0.11638)		(0.10659)		(0.10178)	
CorrRMijt	0.20445	*	-0.06699		-0.00533	
	(0.11174)		(0.10624)		(0.09405)	
EUR11	0.83760	***	0.52938	***	0.79067	***
	(0.15172)		(0.15293)		(0.13920)	
lnVarRERijt	-0.01670		0.02665		0.01831	
	(0.02570)		(0.02508)		(0.02222)	
N	2506		2480		2662	
Adj. R^2	0.90020		0.89220		0.90080	
RMSE	0.89295		0.87464		0.81955	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are not shown here. The instrumented trade variable is the same as in the baseline regression.*

In conclusion, our results suggest that the euro's effect on cross-border investments is independent of any reduction in exchange rate volatility, which in turn seems to have little or no effect. However, there are quite strong reasons to believe that this is not the case and that the model we use to test this is not correctly specified. Most likely, the observed euro effect is due in part to the reduction in exchange rate volatility that the euro entails and in part to other reasons, specific to a common currency. However, the value of separating the components of the effect is questionable, because most likely one cannot attain the low uncertainty associated with a currency union without the irrevocable commitment such a union entails. What matters here is namely investors' expected risk, and this includes the risk of the monetary regime itself.

8 ROBUSTNESS CHECKS

Having presented our main results, we will now investigate their validity through extensive robustness checks. We will in turn (i) test the chosen technique for individual effects, (ii) exclude insignificant estimates to reduce multicollinearity, (iii) test for systematic selection bias due to the exclusion of zero values, (iv) check if trade really is endogenous, (v) perform cross-sectional analysis to control for parameter stability and (vi) control for outliers. We end by discussing the overall robustness of our results.

First however, we can note that most common econometrical pitfalls have already been dealt with. Unit roots are not an issue since we have micro panels with only five years of data. On the other hand, common trends could be a problem, primarily for GDP, trade and investment. However, any common trends are taken care of by the year specific fixed effects λ. Autocorrelation and heteroscedasticity are both corrected for by using the Newey-West standard errors. Indeed, this practise sometimes rendered estimates insignificant that were not so with OLS standard errors. The estimation technique with a set of dummies can hardly be considered parsimonious, but as we shall see in section 8.1, the explanatory power is still very high when

these are excluded. Multicollinearity might have caused some of the insignificant estimates, such as for common legal origin and language, but has not affected our primary results. The euro dummy is strongly correlated with the EU dummy since only three EU members are not using the euro, but this has not stopped us from obtaining highly significant estimates of the euro effect and EU effect separately. In fact, the strong correlation between these variables coupled with the euro effect showing up as large and significant, only strengthens the robustness of the separate estimates.

8.1 Random Effects Estimation and Pooled OLS

To verify that our fixed effects estimation is suitable and to compare it with previous studies, we estimate the baseline model using both pooled OLS and RE. These results are reported in appendix A.2, Table 13 and Table 14 respectively. The pooled OLS estimation is in effect the same as before, but without the dummies representing α^1, α^2 and λ. In the RE case, we fit the model using the GLS estimator (in Stata).

At first glance, the two regressions seem to fit the data fairly well, from an econometrical point of view. R^2 is high, around 0.88 for both first stage regressions, and between 0.45 and 0.58 in the second stage regressions. These high values for the pooled OLS illustrate that although our fixed effects did account for a sizable share of explanatory power, the variables still fit the data very well with an explanatory power (R^2) rarely seen in empirical models. The root mean square error (RMSE) is higher for OLS than with fixed effects, indicating that pooled OLS fits the data slightly worse. However, most estimated coefficients are still highly significant.

Starting with the first stage regressions, the pooled OLS estimates all have the expected signs and are highly significant. The only two exceptions are the product of land areas and, interestingly, the euro dummy, which are both insignificantly negative. The same is true with RE, where the FTA and euro dummies are the only unexpected results, both being insignificantly negative. The insignificant effect of the FTA dummy is quite strange. It seems unlikely that an FTA would have an insignificant effect on trade, and this was the most significant instrumental variable in the baseline regression. Regardless, both first stage regressions appear rather solid and indicate that the euro had no effect on trade. Since trade in goods is not the subject of our study, we will not comment more on this, other than to note that these results clearly contradict the previous ones as well as those of other studies.

Moving on to the second stage regressions, however, we discover some peculiar results. Both regressions say that distance has a significant and negative effect on holdings; yet we could not dismiss this a priori. However, with RE, the elasticities approach three, meaning that a one percent increase in distance results in an almost three percent decrease in holdings. In the OLS regression, trade does not appear to have any effect at all on holdings. In the RE estimation on the other hand, the elasticities are almost negative three again – clearly unexpected and unreasonable. The OLS estimates for the product of GDPs are reasonable, whereas coefficients of more than three in the case of RE seem unfeasible. The dummies for EU membership, shared language, and common legal origin all have the right sign and are mostly significant, but they are in many cases unreasonably high. The OLS estimate for example, says that two countries with a common language hold five times more equity in each other than otherwise, while the RE estimate says that the same effect is to multiply equity holdings by twelve. Not everything is different though; most coefficients for stock market return correlation are similar to what was found using the baseline specification.

Turning to the coefficients of our interest, we see that we have done some damage to the euro effect. The OLS estimates for the effect of the euro are roughly of the same size for debt and total holdings and still highly significant. Only in the case of equity holdings is the effect considerably smaller (equivalent to an eleven percent increase) and insignificant. Using RE, the coefficients for debt and total holdings are smaller but still economically large and statistically significant. Now however, the euro effect on equity holdings is insignificant and even slightly negative.

Summing up, pooled OLS works, but not well. Many estimates are strange, contradicting both theory and previous empirical findings. On the other hand, RE does not work at all, producing mostly nonsense results. Furthermore, as discussed above in section 5.1, there are ex ante theoretical arguments against both RE and pooled OLS. It would therefore appear as if our treatment of individual effects is the best choice, at least in this case when FE estimation is not possible. We have seen how the choice of estimation technique has serious implication, yet at the same time, the euro effect was only slightly reduced for debt and total holdings and disappeared only for equity holdings. Our results are therefore fairly robust with respect to estimation technique, but much more so considering that our baseline specification is the superior one.

8.2 Treating Trade as Exogenous

Even though we already established that the causality between trade and portfolio investments is bidirectional, it is still of interest to test this idea and at the same time provide a further robustness check of the baseline model. We therefore estimate the baseline model (5) with the instrumented trade variable replaced with the original trade variable.

The results are presented in Table 15 in appendix A.2. Compared to the baseline estimation, the EU dummy is slightly larger and the EU trend variable is now significant and negative for all asset classes. The coefficient for stock market correlation is slightly higher for equity holdings but still not significant for the other asset classes. Other differences are more noticeable; distance is now a negative and significant determinant of all asset classes. This is because distance has a negative effect on trade which in turn is positively correlated with investments. Our results thus clearly show, in accordance with Aviat and Coeurdacier (2007), that the effect of distance on investments cannot be correctly estimated without considering the bidirectional causality between trade and investments. This effect also has other consequences in the estimation. Commodities trade now appears to have a much smaller impact on investments. This happens since some of the negative relationship between distance and trade is captured in the estimate of the latter. The estimates for the product of GDPs are larger in all regressions because trade is positively affected by the same variable. The dummies for common legal origin and language are now much larger and significant for all estimates, except for language on equity holdings. Both of these variables are also positive determinants of trade. Finally, we note that the estimated effect of the euro is larger than in the baseline estimation. This is, however, an erroneous result, since the introduction of a positively correlated endogenous variable causes an upward bias for all variables that are positively correlated with both trade and holdings. Thus, trade must be instrumented in the model to acquire unbiased estimates and our baseline specification was therefore the correct one in this respect.

8.3 Excluding Insignificant Estimates

Some estimates were insignificant in the baseline estimation. Even though this is typically not a problem, multicollinearity could still be reduced by excluding the insignificant variables. When doing so, we do not re-estimate the first stage regression meaning that the excluded variables will in effect serve as additional instrumental variables. Only two of the estimates for the original

instrumental variables were insignificant in the first stage regression anyway. In the regression of equity holdings, we exclude distance and the dummies for common legal origin and language. Even though the EU dummy was also insignificant, we do not exclude this since it is highly correlated with the euro dummy and excluding this gives an even higher estimate for the euro effect. When regressing debt and total holdings, we exclude the EU trend variable, the dummies for common legal origin and language as well as stock market correlation – all of which were insignificant in the baseline estimation. The results are presented in Table 16 in appendix A.2. The adjusted R^2 of the regressions are only marginally reduced by excluding these variables and the only insignificant estimate is now the EU dummy in the regression of equity holdings. The estimated coefficient for distance is now larger for debt and total holdings. This is somewhat unexpected since distance is negatively correlated with common legal origin and language (see Table 5), but the difference is not great. In all regressions, the coefficients for the product of GDPs are closer to one which is the expected elasticity. The effect of trade has not changed significantly. The EU dummy is slightly lower for debt and total holdings while the EU trend is larger on equity holdings. The effect of stock market correlation is now much larger and more significant on equity holdings. This is easily explained by distance being negatively correlated with stock market correlations. Most importantly, the euro dummy is actually larger in the case of equity holdings and only slightly lower for debt and total holdings. Thus, our primary results change little when excluding the insignificant estimates.

8.4 Dealing with Zero Values

As discussed in section 6.3, some values are zero and these were previously excluded since the model is estimated in logarithms. Another way of dealing with these values is to treat the log of the zero values as zeros as well. This is equivalent to adding one dollar to all observations in the original series, since the log of one is zero. In the baseline estimation we excluded the observations for which holdings were zero also from the first stage regression. This is therefore also repeated, although the differences are small in this case.

The results from these new estimations are shown in Table 17 in appendix A.2. We see that the first stage regression does not differ much from the baseline estimation and still fits the data well. This is expected since the zero values did not affect the first stage regression in the first place, and these results merely tell us that there is no systematic selection bias in the zero values with respect to any of the regressors. Looking next at the second stage regressions, we do notice some differences though. RMSE is higher and R^2 lower (between 0.64 and 0.74), indicating that the model now fits the data less well than in the baseline estimation. This is natural since zero values are always a problem when estimating by a log-linear model. The main question is instead if any systematic selection bias arises from excluding the zero values. The estimated coefficients for distance are roughly twice as large but still not significant for equity holdings. The coefficients for trade are also larger but less significant for equity holdings than in the baseline estimation. The EU dummy and the product of GDPs are about the same, although GDP is less significant, whereas the EU trend lost its significance for equity. Common legal origin now has a much higher impact, but it is still not significant for debt and total holdings. Sharing a language now appears to have a very large, negative and significant impact on equity and debt holdings. Stock market correlation now has a large negative impact across the board, but is still only significant for equity. Of our main interest, the euro dummy is much larger for equity, lower for debt and about the same for total holdings. It did, however, loose its significance for debt holdings, whereas it remains highly significant in the other regressions.

The issue of zero values is clearly an area of concern and could maybe have been dealt with better than in our baseline estimation. On the other hand, letting the logs of zeros be zero proved to be an inferior solution. The model did not fit the data as well, and some estimates, like distance, trade and common language, seem implausible. The estimated euro effect was affected, but still pulled through pretty well. When Lane and Milesi-Ferretti (2004) use Tobit regression, they render the common currency effect insignificant in some sub-samples. Such more sophisticated econometrical techniques could potentially improve the precision of our estimates, but given our results thus far, we have no strong reason to fear that our baseline estimates are systematically biased by this issue.

8.5 Cross-Sectional Analysis and Parameter Stability

The previous studies using the CPIS data have only had access to cross-sectional data from 2001, although some have also used the preliminary data from 1997 for comparative purposes. Although the use of the full panel data set is superior for both econometrical and economical reasons, we shall now test for parameter stability by estimating a cross-sectional model on each year respectively. We do so by estimating the baseline model without the year specific fixed effects λ. When computing the Newey-West standard errors we no longer control for autocorrelation and we are also forced to drop the EU trend variable. It is important to remember that even though this serves as a test of parameter stability and we do expect the results to be the same as in the baseline estimation, there could also be important differences due to the year specific fixed effects. Furthermore, this type of estimation only considers static information and the estimate with respect to a particular variable will therefore not include the information from when this variable changes for a given country pair. Historical circumstances are therefore likely to play a larger role.

The results are shown in Table 18 in appendix A.2. The individual R^2 and RMSE are similar to the baseline estimation indicating a good fit of the model. The estimates for trade appear robust with all coefficients around one and significant.[31] The dummies for common legal origin and language as well as stock market correlation are all insignificant as in the baseline estimation, except in 2001 when stock market correlation is actually negative and significant. The EU dummy also holds up fairly well, except in 2001 when it is much lower and insignificant. The coefficient for distance, on the other hand, has on average the same size but is insignificant for the first two years. The biggest surprise, however, is the product of GDPs, which is actually negative in all years except 2001, but only significant in the last two years. Considering the very significant results in the baseline estimation, this indicates that asset allocation on average depends on market size, but that there are large deviations in a given year. The focal point of our study, the euro dummy, holds up very well; all estimates are large and highly significant with the average value close to the baseline estimate. Together with the trade variable, the euro dummy is the most stable of our estimates.

Although we do not report the full regressions for equity and debt holdings, the estimates for the euro's effect are illustrated in Figure 6 below. All these estimates are significant at the one percent level, except for debt in 2003 when the estimate is significant at the five percent level. These estimates should not be viewed together as an estimation of the euro's effect over time like in Figure 3. Instead, these results should be seen as individual cross-sectional estimates of the euro's total effect. As can be seen, the average estimates are roughly the same as the overall estimates. Only the estimate for debt seems unstable, with lower estimates for the last three years.

[31] For this exercise, we do not re-estimate the first stage regression.

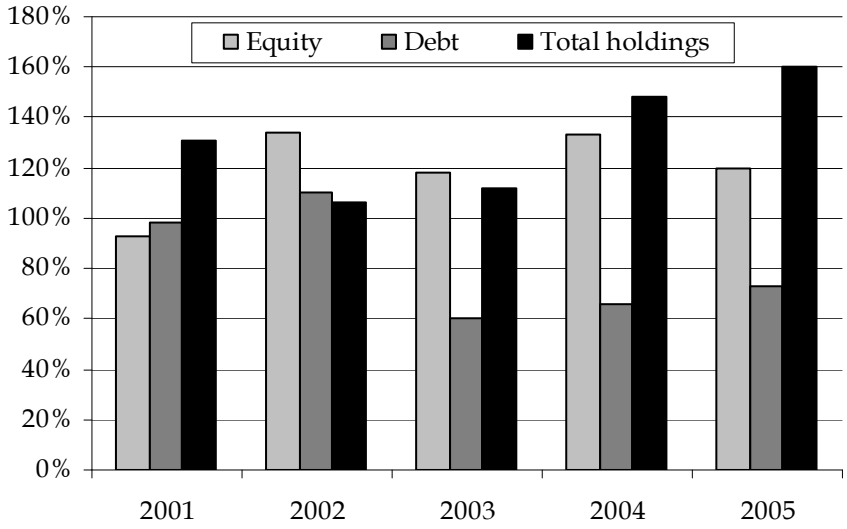

Figure 6 Cross-sectional estimates of the euro's effect

Note: The reported figures give the percentage increase in Eurozone countries' holdings in other Eurozone countries due to the euro for a given year, ceteris paribus. The reported figures should not be viewed together as estimates of the euro's effect by year, but as separate cross-sectional estimates of the total effect. The corresponding regressions for total holdings are reported in Table 18 whereas those for debt and equity are not reported.

Summing up, we have seen how the estimates for some important variables like the product of GDPs are not stable. On the other hand, this does not necessarily imply parameter instability since panel data considers a wider information set, including historical events. Most importantly, the estimates for the euro's effect are highly stable in all regressions and the results are robust across the different cross-sections.

8.6 Controlling for Outliers

We also want to see if the results are dependent on some specific country. Also, as was noted under section 6.1, Greece, Luxembourg and Switzerland could potentially be outliers. We confirmed this in the case of Luxembourg when looking at the country specific euro effects illustrated in Figure 4. We shall therefore now estimate the baseline model (5), excluding one country or group of countries at a time. These countries will then be excluded, one at a time, from both the source and destination country list. For this exercise, we do not redo the first stage estimations.

In Table 19 in appendix A.2, we report the estimates obtained when simultaneously excluding Greece, Luxembourg and Switzerland. As can be seen, the only noticeable differences are that the coefficient for the EU dummy is higher and now also significant for equity holdings and that the EU trend variable is now significantly negative for total holdings. The estimated euro effect is higher for equity and debt, while slightly lower for total holdings. In total, excluding these countries did not make a big difference. We also estimate the baseline model excluding all countries, one at the time. We do not report all these regressions, but all estimates of the euro effect are illustrated in Figure 7 in appendix A.2, where panels A, B and C show the different estimates for equity, debt and total holdings respectively. All of these estimates are significant at the one percent level except for the effect on debt when excluding the U.K. which has a p-value of 0.011. We see that excluding Denmark leads to a lower estimate for the effect on equity while higher on debt and total holdings. Although we did not anticipate Denmark to be an outlier, it is a special case since it is the only country in our sample that takes part in ERM II. The estimated effect on equity became higher when excluding Greece, but also Finland. Excluding Luxembourg gave a higher effect on debt, whereas excluding the U.K. gave a much lower effect on debt. The

estimates for total holdings appear somewhat more stable, but excluding Luxembourg clearly made it higher and excluding Switzerland made it lower.

Overall, we see that the estimates are sensitive to the sample but not greatly so. All estimates remain economically large and statistically significant, meaning that our results are not due to the specific sample at hand. Furthermore, our assessment of potential outliers seems correct, although Denmark – taking part in ERM II – could be added along with, unexpectedly, the U.K. In either case, the impact of excluding these countries was not great enough to warrant concern.

8.7 Discussion of the Results

Having developed the baseline analysis and subjected it to several tests, it is time to evaluate our results. Excluding insignificant estimates did not change the results and trade is clearly endogenous. Treating trade as an exogenous variable results in biased estimates of several variables, most notably distance. There appears to be some outliers in the sample and the results did vary when excluding these. However, the effect was small and there was no systematic bias due to outliers. Our sample is thus suitable. Some estimates proved not to be stable over the different cross-sections. This is not, however, necessarily a cause for concern but could simply mean that panel data estimation is required to obtain correct estimates. Most importantly, the estimate for the euro effect was one of few that actually were very stable in the cross-sections. All this does not mean though that our model is without flaws.

We saw that our method of dealing with individual effects in panel data was superior to both RE and pooled OLS. However, it was not possible for us to use FE, and this method has several advantages, such as being able to completely account for historical factors. As more countries adopt the euro and new data becomes available, it would be valuable to compare our results to those from FE estimation. Even though Mátyás (1997 and 1998) argues that the technique we used is the correct one, it is not unlikely that FE estimation will prove superior since it controls for fixed effects for each country pair.

Our treatment of the zero values was not optimal, yet setting the zero values to zero in the logged series proved to be even worse. Even though we did not find any indication of systematic selection bias in the zero values, the use of more sophisticated techniques could surely improve the model.

Although we have performed several tests, we have not been able to account for all potential issues. One of the most pertinent critiques is that the decision to adopt the euro is not a random choice, but could be endogenously dependent on things like the amount of cross-border investment from other Eurozone members. To account for this endogeneity, Persson (2001) proposes a technique that considers each country's propensity to join a currency union. Micco et al. (2003) also discuss this issue but conclude that it is not a major problem in their study since they directly look at the effect for the euro countries, estimated using data from both before and after the implementation of the euro. In this context, it is important to remember that we have looked at what effect the euro has had on the countries that already use the euro. When more countries join and provide data from before and after the adoption of the euro, the problem will be alleviated but not resolved. Denmark, Sweden and the U.K. probably have the same propensity to adopt the euro as any other Eurozone nation from an economical perspective and domestic politics is the main reason for why they have not. Their decisions can therefore most likely be considered exogenous. Still, for academics who wish to isolate the effect of the common currency, this does not suffice. Persson's method could then be used, or another one proposed by Barr et al. (2003); both are rather technically advanced. Such methods could potentially deal with

the issues raised by Berger and Nitsch (2005); that the adoption of the euro is simply a culmination of a longstanding process of economic integration.

Considering all this, our findings of an economically very large and statistically significant effect from the euro on cross-border investment are currently some of the best estimates available. They are in line with previous findings, and even somewhat more conservative. Yet one must always remember exactly which question we have addressed. We cannot say anything about the dynamic effect on investments from joining the Eurozone.

9 CONCLUSION

Summing up, we have seen a large and significant effect from the euro on intra-Eurozone cross-border investments; equity, debt and total holdings by euro countries in other euro countries have increased by 120, 83 and 132 percent respectively, ceteris paribus. These estimates might seem large, yet theoretical models based on high elasticities of substitution illustrate how the increases are consistent with modest reductions in transaction costs, not unlike those predicted ex ante (European Commission, 1990). The estimates are also more conservative than previous findings. Our results indicate that the effect has been increasing gradually over time, and perhaps that the introduction of notes and coins contributed significantly, although we are not able to state this with certainty. Revealing large differences across countries, we are still able to conclude that the total effect is not due to a limited experience by a sub-set of our sample. Furthermore, the effect on debt holdings appears much greater for the countries with the least developed financial markets, whereas the relationship seems to be the reversed for equity holdings. We can not find that exchange rate volatility matters for international investments. However, there are strong reasons to believe that this is the case either way, and a part of the euro effect that we estimated is probably due to reduced currency risk. Regardless, it seems unlikely that a risk reduction of that magnitude could be achieved by anything less than an irrevocable commitment to adopt a common currency. The extensive robustness checks we performed do not severely damage the euro effect, although it is clear that our model is not optimal. Our model and estimation technique are not able to wholly account for neither endogenous decisions nor previous integration effects. We still believe these issues to be of less importance.

Our model has also yielded other important results, albeit secondary in our study. Our estimated euro effect on goods trade corresponds well with previous studies in this area, revealing an effect of up to 20 percent. In line with the results of Aviat and Coeurdacier (2007) and the theory by Coeurdacier and Guibaud (2006) we find that the effect of financial integration is greater than the concern for return correlation, and thereby that stock market correlation is endogenously decided in the model. We also propose a solution to the distance-puzzle, revealing that holdings actually increase in physical distance, but only insofar as distance is negatively correlated with return correlation. When we control for return correlation in the regression on equity holdings, the effect of distance becomes insignificant. As expected, distance in and of itself has no effect on holdings. The model explains a large part of international portfolio investments; using the full set of fixed effects, we explain around 90 percent of the variability in holdings, and our variables alone explain around 50 percent. The gravity model has thereby proven its worth in international finance, in addition to explaining goods trade.

Linking our results to the available theoretical framework provides some interesting insights. The euro appears to have alleviated some obstacles to the international diversification predicted by the ICAPM. Firstly, we conclude that poor market development plays a significant role in hindering international investments and that this was improved by the euro. This is based on the

observation that the euro effect is largest for the financially less developed countries. For equity markets on the other hand, this seems to have been of less importance, perhaps revealing that other considerations are more important when investing on the stock market.

Secondly, we do not believe that the euro reduced quantitative capital regulations. All such barriers had already been abolished within the EU prior to our sample period. The effect of EU membership – which had a greater effect on debt holdings than the euro – is most likely due in part to the capital liberalisation under the first stage of the EMU.

Thirdly, it seems probable that the euro has primarily brought a reduction of certain direct transaction costs and the elimination of currency risk. Although our attempts at distinguishing between the two were not successful, the importance of exchange rate volatility might be quite large.

Fourthly, our two proxies for information asymmetries – common legal origin and language – do not show up as statistically significant. This might be the result of multicollinearity. Most likely, the EU dummy also represents some reductions of information asymmetries, such as harmonised legislation. It is difficult to say to what extent the euro effect is also a result thereof, although there are reasons to believe that it facilitates price comparisons and simplifies financial reporting.

Fifthly, given that the assumptions behind the CAPM do not hold, we would have expected to see investments concentrated to countries with low correlation with the home market. However, we find the opposite to be true, revealing that stock market correlation is in itself caused by increasing investments. This integration effect dominates any negative effect from diversification considerations.

9.1 Suggestions for Future Research

Ours was not the first, nor will it be the last study to investigate the effects of the euro on international capital markets. It is an interesting, vast and topical research field and many questions remain unanswered. Importantly, our results give little guidance to policy makers facing the difficult decision of whether or not to adopt the euro; most notably in Denmark, Sweden and the U.K.

Firstly, we have not measured the dynamic effect of adopting the euro which is what decision makers would be interested in. We have only looked at how the euro has affected those countries which are already using the euro. To answer the relevant policy question, one would need data on holdings from before the euro was introduced. To recreate data equivalent to the CPIS data ex post will likely prove impossible, but as more and more countries adopt the currency – Cyprus and Malta as of 2008 – new data will eventually make it possible to analyse the effect of adopting the euro.

Secondly, our understanding of what causes the large observed effect is limited. Most likely, it is to some extent caused by a reduction in exchange rate volatility. If so, the irrevocable commitment of adopting a new currency and the abandonment of monetary sovereignty might not be necessary in order to attain at least some of the additional inflow of capital. Furthermore, the effect has been very different for different countries. Although we have outlined some of this heterogeneity, further analysis will be needed to better understand the phenomenon if one is to make accurate predictions for the effect of the euro for a specific candidate country.

Thirdly, we have not said a word about the welfare implications of increased cross-border portfolio investments. Many would argue that increased foreign ownership entails several negative consequences, such as reduced consideration for local employment. Intuitively, from a

strictly economic perspective, it seems likely that increased market liquidity and international diversification of risk would be a good thing. Fact of the matter is that we do not know exactly what increased cross-border holdings brings in terms of welfare.

Finally, we let Andrew K. Rose (2000, p. 33) give the closing words of wisdom for the people and governments deciding whether to adopt the euro or not: "The decision to enter a currency union is based on many criteria. This paper has ignored nearly all of them."

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A APPENDICES

A.1 Data Description and Sources

Below, we further describe the variables used and list our data sources. All data has been compiled during 2007 and except for the CPIS data, they are unlikely to be subsequently revised. The complete dataset is available through Stockholm School of Economics for a limited period of time.

Bilateral exports and imports of goods are obtained from the U.N. Commodity Trade Statistics Database (COMTRADE). [http://comtrade.un.org] The respective flows cover all commodities traded and figures are in current U.S. dollars. The recommendation to the countries is to record exports in FOB and imports in CIF values, but the chosen method varies between countries. Due to differences in collecting and reporting the statistics, the export from country *i* to country *j* is not exactly the same as the import to *j* from *i*. We use the reported statistics for import and export and do not adjust for this fact. Typically, the differences are small. There are cases were goods are exported only to be imported again shortly thereafter. This is called re-imports and is reported as imports from oneself. We disregard these figures, although all such observations in our data are reported in Table 21 appendix A.3.

Bilateral cross-border portfolio holdings are gathered from the International Monetary Fund's (IMF) Coordinated Portfolio Investment Survey (CPIS) Data. The data cover year-end holdings of debt, equity and total securities respectively, in U.S. dollars. CPIS compiles each country's residences' investments in securities issued by non-residents. Residence does not necessarily coincide with nationality, but is rather the centre of an entity's economic interest. For corporate entities, the country of legal incorporation is used to determine residence. A person who has resided abroad for more than one year is considered a non-resident. CPIS distinguishes between direct and portfolio investments and only includes portfolio investments. A direct investment is one made with the objective of obtaining a lasting interest and includes both the initial purchase as well as all subsequent transactions between the parties. This translates into holding ten percent or more of ordinary shares or voting power. Debt transactions between such entities are also considered as direct investments and are thus excluded from CPIS. The data used are downloaded during the first half of 2007. The IMF may come to revise data as indicated on their website. The data for 2003 and 2005 are classified as preliminary. The data are available at [http://www.imf.org/external/np/sta/pi/cpis.htm]. For a detailed description of these data see [http://www.imf.org/external/pubs/ft/cpis/2002/pdf/cpis_index.pdf].

Data on *land area, islands*, *borders, landlocked countries* and *languages,* are gathered from CIA's World Factbook. [https://www.cia.gov/cia/publications/factbook] The figures for France do not include French Guiana, Guadeloupe, Martinique and Reunion. We choose to count both the U.K. and Ireland as islands although their joint border in Northern Ireland means that this, technically, is questionable. The selection of languages cannot be made without using judgement and is thus somewhat open to critique. We therefore illustrate our selection of languages in Table 2.

Information on *FTAs* comes from WTO's website under the RTA Gateway. [http://www.wto.org/english/tratop_e/region_e/region_e.htm] Determining what FTAs to consider is not entirely unproblematic. The WTO lists a vast number of both bi- and multilateral agreements as regional trade agreements (RTA). Among these are agreements between two FTAs or between one FTA and some partner country. In this paper, we consider those FTAs we

believe to be most relevant for our selection of countries, namely; (i) the North American Free Trade Agreement (NAFTA) between the U.S., Canada and Mexico; (ii) the Australia and New Zealand Closer Economic Relations Trade Agreement (ANZCERTA); (iii) the European Community (EC) between the EU member states; (iv) the European Free Trade Association (EFTA) between Iceland, Liechtenstein, Norway and Switzerland; and (v) the European Economic Area (EEA) between Iceland, Liechtenstein, Norway and the EU member states. (Switzerland thus has an agreement only with Iceland and Norway in our sample, whereas Iceland and Norway are part of the same FTA as the EU member states.) There exists other RTAs, especially in the form of agreements between these FTAs and other states, but none that we feel should be considered as an FTA. All these agreements were entered before the start of our sample period (2001) and any subsequent revisions during the period are likely of minor significance.

For *Distance* we obtain coordinates from CIA's World Factbook which give the approximate geographic centre of each country. [https://www.cia.gov/cia/publications/factbook] We then use GPS Visualizer's online calculator to compute Great Circle distances in kilometres between these points. [http://www.gpsvisualizer.com/calculators]

GDP is taken from OECD's Statistical Country Profiles. [http://stats.oecd.org/WBOS] We use nominal GDP at current prices expressed in U.S. dollars using current exchange rates.

Legal origin is discussed and developed in La Porta et al. (1998). In the original paper however, Iceland was not included. Later, in La Porta et al. (2002), Iceland's legal system was classified as being of Scandinavian origin. All sample countries' legal origins are shown in Table 2.

Stock market return correlation is the correlation coefficient between the two respective stock market return series, calculated on monthly data from the months of the year in question. The returns are computed from the Morgan Stanley Capital International Indices (MSCI) when available. The MSCI indices include 85 percent of the free float adjusted market capitalisation in each industry group, within each country, thus accurately reflecting the economic diversity of each market. For Iceland the OMX Iceland All Share index is used, which includes all shares weighted by market capitalisation. The Greek market return is calculated on the basis of S&P BMI Greece, which includes all listed shares of companies with a market capitalisation of at least the local equivalent of USD 100 million. For Luxembourg the Luxembourg SE General is used. The data comes from Datastream and

Nominal exchange rate volatility is the sample variance of a monthly nominal exchange rate series divided by the mean during the same year. We divide by the mean value in order to make the dataset comparable across different currency units. Defining e_{ij} as the nominal exchange rate between countries i and j, we compute the mean for a given year t and the sample variance during the same year t over the months $k = 1,2,\ldots,12$.

$$\bar{e}_{ij,t} = \frac{1}{k}\sum_{k=1}^{12} e_{ij,k} \qquad Var(e_{ij,t}) = \frac{1}{k-1}\sum_{k=1}^{12}(e_{ij,k} - \bar{e}_{ij,t})^2$$

Our variable is then defined as

$$Var(NER)_{ij,t} \equiv \frac{Var(e_{ij,t})}{\bar{e}_{ij,t}} = \frac{k}{k-1} \times \frac{\sum_{k=1}^{12}(e_{ij,k} - \bar{e}_{ij,t})^2}{\sum_{k=1}^{12} e_{ij,k}}$$

Real exchange rate volatility is the yearly sample variance of the relative change in real exchange rates on a month to month basis. If e_{ij} is the nominal exchange rate expressed as number of i-country currency units per j-country currency units and P_i and P_j are the price levels in the two

countries respectively, then the real exchange rate between *i* and *j* is defined as

$$E_{ij} = e_{ij} \times \frac{P_j}{P_i}$$

The relative factor of change during month *k* can then be expressed as

$$\Delta E_{ij,k} \equiv \frac{E_{ij,k+1}}{E_{ij,k}} = \frac{e_{ij,k+1}}{e_{ij,k}} \times \frac{P_{j,k+1}/P_{j,k}}{P_{i,k+1}/P_{i,k}} = \frac{e_{ij,k+1}}{e_{ij,k}} \times \frac{1+\pi_{j,k}}{1+\pi_{i,k}}$$

where π denotes inflation rate. Our variable is then the sample variance during year *t* as

$$Var(RER)_{ij,t} \equiv Var(\Delta E_{ij,t}) = \frac{1}{k-1}\sum_{k=1}^{12}(\Delta E_{ij,k} - \Delta\overline{E}_{ij,t})^2$$

The data for exchange rates comes from Datastream and OANDA [http://www.oanda.com]. Inflation is calculated based on monthly CPI taken from Datastream.

A.2 Additional Regression Results

Table 13 Pooled OLS estimation of the baseline model

	First stage		*Second stage*					
	lnTRADEijt		**lnEQTijt**		**lnDEBTijt**		**lnHOLDijt**	
lnAREAiAREAj	-0.00788							
	(0.01636)							
ISLANDij	0.35129	***						
	(0.11717)							
BORDERij	0.27889	***						
	(0.08483)							
LLOCKij	-0.57154	***						
	(0.14711)							
FTAij	0.32026	***						
	(0.11221)							
lnDISTij	-0.62079	***	-1.19675	***	-0.39170		-0.91907	***
	(0.04172)		(0.37023)		(0.36776)		(0.30968)	
lnTRADE_hatijt			-0.67564		0.35400		-0.23401	
			(0.50808)		(0.49427)		(0.41685)	
lnGDPitGDPjt	0.86810	***	1.35928	***	0.46491		0.98651	***
	(0.01644)		(0.44027)		(0.42939)		(0.36025)	
EUij	0.30849	***	0.20582		0.58977	**	0.33133	
	(0.10186)		(0.34303)		(0.29041)		(0.25903)	
EUtrendijt	-0.09631	***	-0.01603		0.10111	*	0.02443	
	(0.01351)		(0.06628)		(0.05673)		(0.05136)	
LEGALij	0.32933	***	0.12172		-0.15855		-0.02137	
	(0.05900)		(0.30847)		(0.26763)		(0.24506)	
LANGij	0.33879	***	1.62650	***	0.66497	**	1.10573	***
	(0.07620)		(0.27810)		(0.27423)		(0.22563)	
CorrRMijt	0.40860	***	1.44860	***	0.24349		0.63960	***
	(0.07026)		(0.31066)		(0.28750)		(0.24223)	
EUR11	-0.06364		0.10269		0.88191	***	0.72630	***
	(0.06396)		(0.22094)		(0.14812)		(0.15984)	
α^0 cons	-20.18147	***	-29.15376	***	-9.00584		-19.36676	**
	(0.83563)		(10.02732)		(9.71587)		(8.10936)	
N	2639		2506		2480		2662	
Adj R^2	0.88520		0.45290		0.55320		0.57940	
RMSE	0.70187		2.09060		1.78040		1.68790	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).*

Table 14 Random effects (RE) estimation of the baseline model

	First stage		*Second stage*					
	lnTRADEijt		**lnEQTijt**		**lnDEBTijt**		**lnHOLDijt**	
lnAREAiAREAj	0.06133	***						
	(0.01603)							
lSLANDij	0.21757							
	(0.13328)							
BORDERij	0.29719	**						
	(0.13911)							
LLOCKij	-0.73633	**						
	(0.30417)							
FTAij	-0.08001							
	(0.12090)							
lnDISTij	-0.75103	***	-2.86305	***	-2.50163	***	-2.73667	***
	(0.05219)		(0.36370)		(0.31488)		(0.29020)	
lnTRADE_hatijt			-2.83847	***	-2.49986	***	-2.67902	***
			(0.51077)		(0.44092)		(0.40751)	
lnGDPitGDPjt	0.75675	***	3.33634	***	2.95033	***	3.13606	***
	(0.01377)		(0.39981)		(0.34667)		(0.31841)	
EUij	0.48217	***	1.48021	***	2.06263	***	1.58419	***
	(0.11622)		(0.39064)		(0.33366)		(0.31186)	
EUtrendijt	-0.06565	***	-0.24696	***	-0.17154	***	-0.21351	***
	(0.00732)		(0.03967)		(0.03496)		(0.03152)	
LEGALij	0.36205	***	0.93264	***	0.99199	***	0.94391	***
	(0.08250)		(0.32184)		(0.27683)		(0.25891)	
LANGij	0.25300	**	2.51906	***	1.76621	***	2.05432	***
	(0.11145)		(0.35656)		(0.30567)		(0.28711)	
CorrRMijt	0.20647	***	0.68374	***	0.52404	***	0.59045	***
	(0.03007)		(0.12881)		(0.11451)		(0.10183)	
EUR11	-0.09916		-0.09922		0.60718	**	0.48511	*
	(0.10135)		(0.31127)		(0.26605)		(0.25118)	
α^0 cons	-14.65941	***	-74.96387	***	-64.19658	***	-67.44387	***
	(0.80614)		(7.87736)		(6.87165)		(6.24868)	
N	2757		2506		2480		2662	
R^2	0.88380		0.44500		0.56200		0.58330	

*Note: Standard errors are given in parenthesis. Stata cannot produce Newey-West standard errors for panel data regressions and these are hence regular GLS (generalized least squares) estimates. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively). Reported R^2 is the overall estimate.*

Table 15 Not instrumenting trade

	lnEQTijt		lnDEBTijt		lnHOLDijt	
lnDISTij	-0.20688	*	-0.19042	***	-0.26281	***
	(0.11060)		(0.07270)		(0.08284)	
lnTRADEijt	0.27718	***	0.10279	*	0.13286	**
	(0.08710)		(0.05469)		(0.06392)	
lnGDPitGDPjt	1.18772	***	1.94630	***	1.60753	***
	(0.32389)		(0.30400)		(0.27107)	
EUij	0.21246		1.03730	***	0.67309	***
	(0.15157)		(0.17612)		(0.14868)	
EUtrend	-0.07981	***	-0.05393	**	-0.06128	**
	(0.02911)		(0.02735)		(0.02471)	
LEGALij	0.35055	***	0.41306	***	0.30753	***
	(0.09120)		(0.08678)		(0.08273)	
LANGij	0.12002		0.18874	*	0.20000	**
	(0.11100)		(0.09978)		(0.09666)	
CorrRMijt	0.26840	**	-0.00210		0.06642	
	(0.11019)		(0.10742)		(0.09538)	
EUR11	0.87463	***	0.72765	***	0.97695	***
	(0.11301)		(0.13216)		(0.11408)	
N	2503		2477		2659	
Adj R^2	0.90320		0.89060		0.89920	
RMSE	0.87832		0.88078		0.82569	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are not shown here. lnTRADEijt is now the original trade variable.*

Table 16 Excluding insignificant estimates

	lnEQTijt		lnDEBTijt		lnHOLDijt	
lnDISTij			0.65611	***	0.49567	***
			(0.15106)		(0.14363)	
lnTRADE_hatijt	0.64527	***	1.05680	***	0.98881	***
	(0.06195)		(0.12984)		(0.12918)	
lnGDPitGDPjt	1.04149	***	1.25881	***	1.03527	***
	(0.31355)		(0.29675)		(0.25609)	
EUij	0.05380		0.78820	***	0.39228	***
	(0.15443)		(0.15915)		(0.13349)	
EUtrend	-0.07404	**				
	(0.02935)					
CorrRMijt	0.22464	**				
	(0.11168)					
EUR11	0.90763	***	0.59026	***	0.82537	***
	(0.12237)		(0.13520)		(0.12151)	
N	2506		2480		2662	
Adj R^2	0.89910		0.89200		0.90080	
RMSE	0.89768		0.87544		0.81966	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are not shown here. The instrumented trade variable is the same as in the baseline regression, meaning that the now excluded variables are serving as additional instrumental variables.*

Table 17 Treating logs of zeros as zeros

	First stage		*Second stage*					
	lnTRADEijt		**XlnEQTijt**		**XlnDEBTijt**		**XlnHOLDijt**	
lnAREAiAREAj	0.24666							
	(0.27542)							
ISLANDij	0.02831							
	(0.10021)							
BORDERij	0.15009	**						
	(0.07573)							
LLOCKij	0.28203	**						
	(0.11616)							
FTAij	0.88710	***						
	(0.11751)							
lnDISTij	-0.76037	***	0.46015		1.38808	***	1.04519	**
	(0.05019)		(0.54229)		(0.49793)		(0.42298)	
XlnTRADE_hatijt			1.14121	*	1.92256	***	1.55982	***
			(0.59219)		(0.52769)		(0.45345)	
lnGDPitGDPjt	0.68864	***	1.33782		1.20675	*	1.10681	**
	(0.14786)		(0.82939)		(0.66909)		(0.44826)	
EUij	-0.28501	**	-0.16506		0.89662	**	0.43770	*
	(0.12934)		(0.48340)		(0.38583)		(0.25494)	
EUtrendijt	-0.03336	**	-0.04824		-0.01780		-0.04460	
	(0.01449)		(0.07698)		(0.06165)		(0.04258)	
LEGALij	0.34788	***	0.50759	*	0.03267		-0.06017	
	(0.04758)		(0.30251)		(0.22523)		(0.18690)	
LANGij	0.13845	**	-0.57260	**	-0.36909	*	-0.16674	
	(0.06872)		(0.26468)		(0.20623)		(0.15010)	
CorrRMijt	0.10122	*	-0.60189	*	-0.38591		-0.24825	
	(0.05327)		(0.31740)		(0.30751)		(0.19183)	
EUR11	0.21624	***	1.38993	***	0.43774		0.83843	***
	(0.06095)		(0.29271)		(0.27108)		(0.16960)	
N	2748		2590		2524		2681	
Adj. R^2	0.94620		0.71290		0.64750		0.74460	
RMSE	0.48831		2.46520		2.28120		1.60570	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively). The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are not shown reported. The Xs denote that the logged series has been transformed so that ln(0)=0.*

Table 18 Year by year cross-sectional estimation

lnHOLDijt	2001		2002		2003		2004		2005	
lnDISTij	0.39292		0.34131		0.61347	**	0.48213	*	0.64201	**
	(0.32085)		(0.29194)		(0.28020)		(0.29053)		(0.25044)	
lnTRADE_hatijt	0.92547	***	0.85058	***	1.12396	***	0.91435	***	1.08517	***
	(0.33963)		(0.32538)		(0.30433)		(0.30114)		(0.26616)	
lnGDPitGDPjt	0.28062		-0.26064		-0.10795		-0.39436	**	-0.77625	***
	(0.19763)		(0.18739)		(0.17546)		(0.17619)		(0.15367)	
EUij	0.07236		0.54573	***	0.34757	*	0.55980	***	0.44387	**
	(0.21896)		(0.20750)		(0.18851)		(0.18618)		(0.18873)	
LEGALij	-0.06340		0.10027		-0.09757		-0.02340		-0.08216	
	(0.15768)		(0.15886)		(0.15040)		(0.15783)		(0.15335)	
LANGij	0.07173		0.11836		0.07894		0.06355		0.03768	
	(0.13427)		(0.14544)		(0.13682)		(0.13774)		(0.13962)	
CorrRMijt	-0.68904	*	-1.08290		0.14125		-0.01888		0.12191	
	(0.36696)		(0.76762)		(0.28069)		(0.27947)		(0.31930)	
EUR11	0.83537	***	0.72543	***	0.74904	***	0.90939	***	0.95560	***
	(0.16693)		(0.17234)		(0.16500)		(0.17099)		(0.16240)	
N	536		526		536		536		528	
Adj R^2	0.90750		0.89530		0.90170		0.89650		0.89360	
RMSE	0.82533		0.86261		0.79063		0.82722		0.77848	

*Note: Newey-West HAC standard errors are given in parenthesis. Now, these do not allow for heteroscedasticity. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).The full set of dummy variables representing source and destination country specific effects as well as the overall intercept are not shown here. Year specific effects are not included. The instrumented trade variable is the same as in the baseline regression.*

Table 19 Excluding Greece, Luxembourg and Switzerland

	lnEQTijt		lnDEBTijt		lnHOLDijt	
lnDISTij	0.42735		1.09326	***	0.98010	***
	(0.35348)		(0.23359)		(0.29007)	
lnTRADE_hatijt	0.89960	***	1.36032	***	1.37207	***
	(0.34331)		(0.23638)		(0.29618)	
lnGDPitGDPjt	0.90354	**	1.24326	***	0.80387	**
	(0.39731)		(0.36306)		(0.33246)	
EUij	0.45976	***	1.35516	***	0.90143	***
	(0.17851)		(0.19423)		(0.16119)	
EUtrend	-0.10088	***	-0.01861		-0.04484	*
	(0.03065)		(0.02907)		(0.02551)	
LEGALij	0.26102		0.05870		-0.06292	
	(0.16541)		(0.12525)		(0.13599)	
LANGij	-0.10949		0.05431		0.00737	
	(0.12687)		(0.12485)		(0.11768)	
CorrRMijt	0.07522		-0.18258		-0.05610	
	(0.12107)		(0.12086)		(0.10294)	
EUR11	0.91755	***	0.64431	***	0.79937	***
	(0.13214)		(0.14240)		(0.12871)	
N	1907		1903		2017	
Adj R^2	0.91520		0.90370		0.91740	
RMSE	0.81436		0.83584		0.74721	

*Note: Newey-West HAC standard errors are given in parenthesis. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).The full set of dummy variables representing source, destination and year specific effects as well as the overall intercept are not shown here. Greece, Luxembourg and Switzerland have all been excluded as both source and destination country. The instrumented trade variable is the same as in the baseline estimation and these countries were thus included in the first stage regression.*

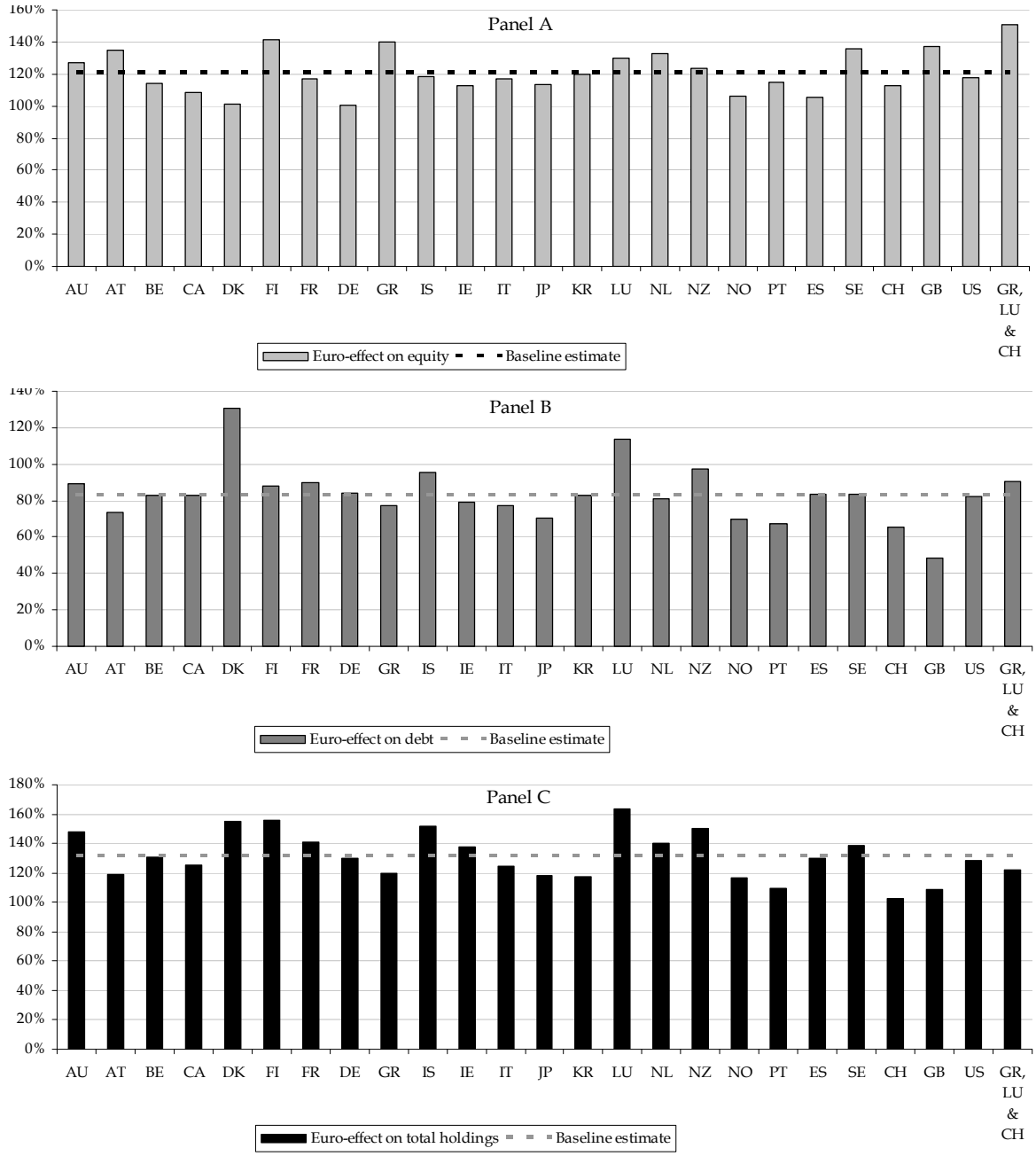

Figure 7 Estimates of the euro-effect when excluding one country at the time

Note: The reported figures give the percentage increase in Eurozone countries' holdings in other Eurozone countries due to the euro for a given year, ceteris paribus. The reported figures should not be viewed together as estimates of the euro's effect by country, but as separate estimates of the total effect. The corresponding regressions are not reported. The dashed lines show the baseline estimates. All estimated coefficients are significant at the two percent level.

Table 20 Fixed effect estimates from the baseline model

	First stage		*Second stage*					
	lnTRADEijt		**lnEQTijt**		**lnDEBTijt**		**lnHOLDijt**	
λ2002	-0.07000	**	-0.25417	***	0.08188		-0.00008	
λ2003	-0.14602	*	-0.23699		-0.27709	*	-0.17060	
λ2004	-0.14629		-0.17636		-0.49009	**	-0.34452	*
λ2005	-0.03966		-0.19531		-0.70868	**	-0.48098	**
α^1CA	-0.56699		1.44333	*	1.33717	*	1.89053	***
α^1DK	0.43561		2.15050	*	4.91395	***	3.65725	***
α^1FI	-0.07072		1.67227		5.20931	***	3.69528	***
α^1FR	-0.12200		-0.09301		3.12688	***	1.80590	***
α^1DE	0.48112		-0.62917		2.05090	***	0.79446	*
α^1GR	-0.79574		-1.15714		3.61762	***	1.73806	
α^1IS	-0.72066	**	3.79409	*	6.81970	***	5.77680	***
α^1IE	0.45310		3.27213	**	7.32913	***	5.42020	***
α^1IT	0.08784		-0.03880		2.27898	***	1.22123	**
α^1JP	0.48560		-0.65646	*	2.36685	***	1.18357	***
α^1KR	1.38545		-4.33499	***	-0.00615		-1.91800	**
α^1LU	-0.24342		8.00106	***	12.58960	***	10.50175	***
α^1NL	0.68815		1.57262		4.24284	***	2.97519	***
α^1NZ	0.56485	*	1.30911		4.67567	***	2.74038	**
α^1NO	-0.46538		2.61075	**	6.35416	***	4.59673	***
α^1PT	-0.10628		0.53170		5.34136	***	3.26951	***
α^1ES	-0.19866		-0.72001		2.98639	***	1.48535	**
α^1SE	0.25429		2.23705	*	4.26422	***	3.27813	***
α^1CH	0.61059		2.85338	**	6.56145	***	4.64165	***
α^1GB	0.38300		1.35056	**	3.33728	***	2.32638	***
α^1AU	-0.22115		0.95415		2.62696	***	1.91433	**
α^1AT	-0.15865		1.13277		5.53773	***	3.72709	***
α^1BE	1.14927		0.72334		4.70419	***	2.87166	***
α^2CA	-0.70025	*	0.47298		2.69815	***	1.73317	**
α^2DK	0.40444		1.33794		4.58771	***	3.33031	***
α^2FI	0.03718		2.62721	*	4.51016	***	3.58390	***
α^2FR	-0.14180		0.49106		1.99861	***	1.39029	**
α^2DE	0.40835		-0.53276		1.55773	***	0.68933	
α^2GR	-0.73162		0.73422		4.96286	***	3.47007	***
α^2IS	-0.78918	***	1.50082		9.76387	***	7.20965	***
α^2IE	0.57413		3.12323	**	5.32854	***	4.32673	***
α^2IT	-0.01723		-0.22898		2.05326	***	1.12834	*
α^2JP	0.51832		0.02011		-0.88966	**	-0.16096	
α^2KR	1.20350		0.32817		0.68893		0.65385	
α^2LU	0.00000		7.72201	***	9.93353	***	9.13191	***
α^2NL	0.82446		1.54487		3.95405	***	2.92515	***
α^2NZ	0.65242	**	0.70087		4.84040	***	3.20054	**
α^2NO	-0.54222		1.18378		4.71211	***	3.29245	***
α^2PT	-0.04169		1.06230		4.67763	***	3.22767	***
α^2ES	-0.20233		0.52841		2.50879	***	1.67123	**
α^2SE	0.20748		1.87540		4.14808	***	3.13832	***
α^2CH	0.60024		3.11171	***	3.23730	***	3.71944	***
α^2GB	0.34706		1.57092	**	2.26094	***	1.98141	***
α^2AU	-0.12167		0.95680		3.32757	***	2.33743	***
α^2AT	-0.21105		0.17781		4.54726	***	2.98223	***
α^2BE	0.98793		0.30908		3.35434	***	2.00603	**
α^0 cons	-15.82060	***	-51.99769	***	-87.06149	***	-67.88141	***
N	2639		2506		2480		2662	
Adj R^2	0.94560		0.90020		0.89210		0.90080	
RMSE	0.48314		0.89294		0.87490		0.81962	

*Note: These estimates correspond to the regression of the baseline models (4) and (5) and the results shown in Table 7. Dummies for year 2000 and the U.S. have been excluded to avoid perfect multicollinearity. For ease of display, standard errors are not reported, but Newey-West HAC standard errors have been used to calculate the significance level. Statistical significance at the 10 percent level (5 and 1 percent respectively) are indicated by * (** and *** respectively).*

A.3 Abnormal Observations in the Data

Table 21 Re-imports in the COMTRADE data

Period	Trade Flow	Reporter (i)	Partner (j)	Trade Value USD
2005	Export	Italy	Italy	14.331.633
2005	Import	Australia	Australia	418.271.916
2005	Import	Canada	Canada	2.926.426.849
2005	Import	France	France	5.001.563.295
2005	Import	Ireland	Ireland	638.129.301
2005	Import	Italy	Italy	566.670
2005	Import	New Zealand	New Zealand	109.521.278
2005	Import	United Kingdom	United Kingdom	6.610.220.538
2004	Import	Ireland	Ireland	529.279.470
2004	Import	United Kingdom	United Kingdom	5.420.236.731

Table 22 Negative entries in the CPIS data (MUSD)

Year	Reporter (i)	Partner (j)	Equity holdings	Debt holdings	Total holdings
2004	Denmark	Portugal	99	-11	87
2001	Germany	Canada	-412	4.926	4.513
2002	Germany	Canada	-886	6.173	5.286
2003	Germany	Canada	-1.356	7.400	6.043
2004	Germany	Canada	-54	8.678	8.623
2001	Ireland	Canada	-220	4.630	4.410
2001	U.K.	Canada	-6.958	22.140	15.180
2002	U.K.	Canada	-1.426	20.640	19.210
2004	U.K.	Canada	-11.520	26.380	14.860

Table 23 Observations for which equity, debt and total holdings are all zero

Year	Source (i)	Destination (j)
2002	Canada	Iceland
2003	Canada	Iceland
2003	Greece	Korea
2003	Greece	New Zealand
2001	Korea	Finland
2001	Korea	Iceland
2001	Korea	New Zealand
2001	Korea	Portugal
2002	Portugal	Greece
2002	Portugal	Korea
2003	Portugal	Korea
2004	Portugal	Korea
2005	Portugal	Korea
2002	Portugal	New Zealand
2003	Portugal	New Zealand
2004	Portugal	New Zealand
2005	Portugal	New Zealand
2002	Portugal	Norway
2001	Australia	Iceland