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Abstract

The paper analyzes the effect of European financial integration, especially of the EMU, on gross portfolio flows between Germany and 47 countries from 1987 to 2002. A gravity model of bilateral asset trade is estimated. The results reveal that there is substantially more portfolio trade between Germany and countries also participating in the EMU. This effect evolves smoothly over time. In particular in 2002, cross-border portfolio flows between Germany and EMU countries are significantly larger compared to flows between Germany and Denmark, the UK, and Sweden which are part of the EU-15 but not of the Euro area. Moreover, changes in exchange rate volatility, financial market development and increased real economic integration among EMU countries have significant effects on German gross portfolio flows, but they can not account for the positive effect on German gross portfolio flows due to the formation of the EMU. Finally, the EMU effect on gross portfolio flows is revealed to be larger for countries with more developed banking and equity markets and for country pairs with more correlated business cycles.

Keywords: *European financial market integration, EMU, gravity model of bilateral asset trade, gross portfolio flows*

JEL classification: F21, F36, G15

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1 Introduction

The formation of the European Economic and Monetary Union (EMU) has been the most important development affecting European financial markets in the last two decades. Starting in 1990, twelve participating countries committed themselves to remove all obstacles to financial integration.[1] Finally, eleven countries gave up their national currencies on January 1, 1999, Greece following in 2001, thereby eliminating any exchange rate risk among themselves. In order to analyze this process, three main questions are addressed in this paper: (1) How large is the effect of European financial integration and the EMU on German cross-border portfolio flows?[2] More specifically: Are portfolio transactions between Germany and EMU countries significantly larger over time compared to trade with Denmark, the UK and Sweden that have not introduced the Euro? (2) What kind of reforms or underlying country characteristics can explain (part of) this effect? (3) Are there heterogeneous responses to increased European financial market integration with respect to portfolio investment?

These research questions are of interest because learning more about the underlying factors and driving forces of financial integration helps to understand determinants of international asset trade. In the last two decades, the volume of capital flows has increased dramatically. In light of economic globalization, financial market integration is very likely to further increase over time and across countries. Especially the investigation of question (3) sheds light on changes in German asset trade with European countries in the course of future enlargements of the EMU.

Several studies empirically investigate the impact of European financial integration on stock market returns using time-series methods (Baele (2005), Bartram, Taylor and Wang (2005), Fratzscher (2002)). There is also a growing literature on the effects of the EMU on the real economy, e.g., on goods trade (Rose and van Wincoop (2001) and Micco, Stein and Ordonez (2003)) and business cycles (e.g., Boewer and Guillemineau (2006)). In contrast, the present paper investigates the role of European financial integration and the EMU on German cross-border portfolio flows. The estimates are based on a gravity model of asset trade à la Martin and Rey (2004) using annual data on gross portfolio flows between Germany and 47 countries for the period of 1987 to 2002. As shown in the literature, the gravity framework has performed very well in explaining volumes

[1] Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, Netherlands in 1990; Ireland, Portugal and Spain in 1993, and Greece in 1998.

[2] Portfolio flows include equity, mutual funds, bonds and money market papers.

of bilateral cross-border asset trade in earlier studies.[3] So far, it has not yet been employed to analyze the effects of European financial integration and the EMU.

Based on this approach and data, the present paper empirically describes the differences of German portfolio flows to and from EMU countries compared to the other trading partners. Gross flows mirror the volume of assets transacted on financial markets. If frictions are present ceteris paribus less asset trading is taking place. In this respect, gross flows may point at the degree of segmentation between markets. However, this measure does not have any implications for diversification across countries. The data set used refers to cross-border portfolio flows with Germany only. Panel data on bilateral portfolio flows within a broader set of countries is not yet publicly available. As Germany is economically the largest country within the EMU and accounted for 19 percent of total portfolio investment within the EMU in 2002,[4] it is a promising starting point to analyze the effects of European financial market integration.

Referring to the questions posed in the beginning, the following results are revealed in the present paper: First, there is substantially more portfolio trade between Germany and countries also participating in stage one and three of the EMU. Investigations over time show that trade with the Euro area has become more and more important. For 2002 cross-border portfolio flows between Germany and EMU countries are significantly larger compared to flows between Germany and Denmark, the UK, and Sweden which are part of the EU-15 but not of the Euro area.[5] Second, developments intertwined with the formation of the EMU such as changes in exchange rate volatility, financial market development and increased real economic integration among EMU countries have an impact on German portfolio flows. However, these factors are not able to explain the effect of the EMU on German portfolio transactions in the framework employed in this paper. Third, the EMU effect on gross portfolio flows is larger for countries with more developed banking and equity markets, and for countries with more correlated business cycles. Whether countries are more market-based or more bank-based or whether countries are geographically further away from Germany does ceteris paribus not lead to different country responses.

The paper is organized as follows: Section 2 reviews important results of the literature on financial market integration in Europe. In Section 3 the estimation approach based on a gravity model of bilateral asset trade and the data are

[3] See, e.g., Buch (2005), Portes and Rey (2005), Portes, Rey and Oh (2001).

[4] This number is based on the *Coordinated Portfolio Investment Survey* (CPIS) issued by the IMF.

[5] Note that the sample employed in the present paper ends in 2002. It includes observations for the years 1987-2002.

described. Section 4 summarizes and discusses the empirical results which are concluded in Section 5.

2 Financial Market Integration in Europe - Related Literature

A number of recent papers give a broad overview of the degree of capital market integration in Europe by using different price and quantity measures of financial integration. Baele et al. (2004) present a comprehensive assessment of these measures and find a rising degree of equity market integration over time in Europe. A comparison of the European equity market with other market segments reveals that while the money market has almost fully converged after the introduction of the single currency, important barriers to international investment still remain in the equity market. The markets for government and corporate bonds as well as the credit market lie in between these two extremes. Despite being characterized by different levels of integration, all sectors have shown a marked increase in integration, underlining the hypothesis that monetary unions facilitate cross-border asset flows (Baele et al. (2004), Adam et al. (2002)).

A more indirect measure of financial market integration looks at investment savings correlations as pioneered by Feldstein and Horioka (1980). In a world of perfect capital markets the two macroeconomic variables should be independent of each other. Empirically, this is not the case - a phenomenon that is well know in the literature as the so called Feldstein-Horioka puzzle. Blanchard and Giavazzi (2002) show that the correlation between domestic saving and investment has declined over time, especially in the Euro area, suggesting higher integration in financial markets.

While the above mentioned studies give a broad and general overview of financial integration in the Euro area, other papers more specifically look at certain market segments. Pagano and von Thadden (2004) focus on the impact that the monetary union has on the markets for Euro area sovereign and private bonds. They find that primary and secondary bond markets have become increasingly integrated and that bond yields have converged dramatically during the formation of the EMU. Still existing small yield differentials reflect differences in fundamental risk rather than persistent market segmentation. In this respect, the sequence of policy actions in the wake of the EMU removed most remaining obstacles in this market and, therefore, facilitated a huge improvement of bond market integration.

Baele (2005), Bartram, Taylor and Wang (2005) and Fratzscher (2002) focus on European equity markets. They investigate the degree of financial integration within Europe by analyzing stock market returns across countries using high frequency data and time-series methods. Baele (2005) investigates the effect of globalization and regional integration on the intensity by which global and regional market shocks are transmitted to local equity markets. He finds that the interdependence of 13 European equity markets with the US, and especially within European countries increased over the 1980s and 1990s. According to his findings, equity market development, trade integration and price stability enhance the extent of interdependence within European equity markets. Bartram, Taylor and Wang (2005) conjecture that the degree of dependence between equity markets of countries within the Euro area increased in late 1997 or early 1998 after the Euro membership had been determined and announced. Similarly, Fratzscher (2002) suggests that European equity markets have become more integrated since 1996. He also shows that reduced exchange rate uncertainty as well as monetary policy convergence of interest rates and inflation rates have been the central driving forces behind the financial integration process in Europe.

From a microeconomic perspective, Guiso, Haliassos and Japelli (2003) find that households' equity market participation has increased. They analyze the current state of equity ownership in several European countries. However, considerable country-specific differences remain, which they explain by different levels of participation costs in the Euro area. This finding suggests that there are still a number of barriers existent that need to be overcome before full integration of European equity markets will be realized.

As shown in the cited papers, financial market integration altogether increased substantially in Europe over the last two decades. Different levels of integration among financial market segments exist, though, in which still some institutional, legal and fiscal barriers remain. Integration of European equity markets increased especially in the late 1990s, but is still lower compared to other segments.

3 Data and Methodology

3.1 A Gravity Model of Bilateral Asset Trade - Empirical Framework

Martin and Rey (2004) propose a theory of asset trade based on a general equilibrium model from which a gravity equation emerges.[6] The resulting gravity equation and its intuition are similar to gravity equations in the literature on international trade in differentiated goods. The model is characterized by three key assumptions: (i) assets are imperfect substitutes, (ii) cross-border asset trade entails transaction and/or information costs, (iii) the supply of assets is endogenous. The model is made up of risk-averse agents that develop an optimal number of Arrow-Debreu projects. The projects correspond to different assets, which are traded on the market. Prices are determined by aggregate demand at home and in foreign countries. Agents set up more risky projects if asset prices are higher. Consequently, a country's market capitalization evolves endogenously. The model's main implication is that gross flows of asset trade between two countries depend inversely on transaction and/or information costs and proportionally on market sizes. The equation for transactions between country i and country j, T_{ij}, that is the sum of purchases and sales, takes, in logarithms, the following form:

$$log(T_{ij}) \quad = \quad a_0 + a_1 log(M_i M_j) + a_2 log(\tau_{ij}). \tag{1}$$

M_i and M_j are measures for the economic masses of country i and j. τ_{ij} denotes transaction and/or information costs that occur with asset trade. The model by Martin and Rey (2004) implies that $a_1 > 0$ and $a_2 < 0$; a_0 is a constant.

In empirical work, the model has proven to work very well.[7] As noted in Martin and Rey (2000) and Portes and Rey (2005), who are the first to use the present model for empirical work, one major limitation of the model, however, is its static nature. However, no dynamic theoretical models that are able to replicate the transaction volumes observed in financial data are available so far.

[6] An empirical gravity model equation also emerges from a model by Obstfeld and Rogoff (2000) that introduces transaction costs solely in the goods market. Thereby it generates substantial amounts of home bias. See Lane and Milesi-Ferretti (2004) for an N-country extension of the Obstfeld and Rogoff (2000) model.

[7] E.g. Buch (2005) applies a gravity model to bank lending data, Portes and Rey (2005) to cross-border portfolio investment, Di Giovanni (2005) to M&A activity and Portes, Rey and Oh (2001) to corporate, government bonds and equities.

When going to the data, economic masses of country i and j are generally measured by GDP per capita.[8] In order to leave coefficients unrestricted, GDP and population size of country i and j enter the regression in separate terms. Transaction or information costs, τ_{ij}, are measured by two variables: geographical distance between country i and j, $distance_{ij}$, and the percentage of foreigners of nationality i or j living in Germany, $foreigner_{ij,t}$.[9] As Portes and Rey (2005) have shown, geographical distance between two countries is a very good proxy for information costs. The variable $foreigner_{ij,t}$ depicts a proxy of familiarity and network effects between countries. It is an inverse measure of τ_{ij} and expected to have a positive influence on transactions through lower information costs, i.e., $\beta_6 > 0$. It complements the distance proxy of information asymmetries in so far as that it varies not only across country pairs but also over time. This is in line with French and Poterba (1991), who stress the importance of cultural familiarity as an explanation for international investment.

To summarize, the basic estimation equation becomes:

$$\begin{aligned} log(T_{ij,t}) &= \beta_0 + \beta_1 log(gdp_{i,t}) + \beta_2 log(gdp_{j,t}) + \beta_3 log(pop_{i,t}) \\ &\quad + \beta_4 log(pop_{j,t}) + \beta_5 log(distance_{ij,t}) + \beta_6 log(foreigner_{ij,t}) \\ &\quad + \sum_{n=7}^{N} \beta_n Z_{ij,t}^n + \epsilon_{ij,t}, \end{aligned} \tag{2}$$

where i denotes the source or transacting country, j the country invested in and t time. The dependent variable, $T_{ij,t}$, is defined as country i's transactions of country j's portfolio investment. As derived from the theoretical model, the dependent variable and all explaining variables mentioned above enter in logarithms.[10] Additional variables, $Z_{ij,t}^n$, are included that account for time and country-fixed effects: a full set of time dummies, dummies for financial centers as well as a dummy variable describing whether a banking crisis is present in country i or country j in the relevant or precedent year ($crisis_{i,t}$ and $crisis_{j,t}$). β_0 is a constant and $\epsilon_{ij,t}$ is an error term, which captures all factors that have

[8] Alternatively, stock market capitalization relative to GDP is used to measure market size (e.g. Portes and Rey (2005)). However, as the data employed in this paper does not only entail equity but also bonds, a country's GDP and population size are used as scaling variables. Anyhow, the use of stock market capitalization leads to qualitatively similar results.

[9] This variable always refers to foreigners living in Germany. Data on the percentage of Germans living in foreign countries is unfortunately very difficult to obtain.

[10] When taking the model to the data, reported zero transactions are replaced by very small values, namely 500 US Dollar. Note that the smallest reported positive transaction volume amounts to about 7 million US Dollar.

not explicitly been accounted for. In order to account for heteroscedasticity, the error term is assumed to be distributed $N(0, \sigma_{ij}^2)$.

The basic specification of the gravity model described above is subsequently augmented in the following regression analysis in order to analyze different hypotheses concerning the course of European integration and its underlying driving forces. The estimation strategy is as follows: First, effects of the formation of the EMU are identified by adding dummy variables that stand for the starting point of the EMU in 1990 and the final fixation of exchange rates in 1999. Moreover, German asset trade with EMU countries is investigated over time in comparison to trade with EU-15 countries that are not part of the Euro area, namely Denmark, the UK and Sweden. Second, variables that proxy financial reforms or changes and real economic integration are added in order to account for (part of) the EMU effect. Third, heterogeneous responses to increased European financial market integration are investigated by adding interaction effects with variables that measure financial market development and structure, information costs and business cycle synchronization.

In order to measure the impact of financial market integration - which is a continuous process over time - the time-series dimension is of interest. Therefore, not only standard pooled ordinary least squares (POLS) estimates but also fixed effects estimations are undertaken.[11] In this respect, the static nature of the model is a limiting assumption. Still, countries' market sizes proxied by GDP and population size are likely to explain asset transactions between countries also over time, given that shocks, new information and structural changes within countries lead to continued shifts in overall portfolio composition. However, in order to test the robustness of the estimation equation, additional regressions are undertaken: GDP growth in country i and country j are used as additional scaling variables.[12] The underlying hypothesis is that not the size of the market in levels generates asset demand but that changes in the size of the market lead to adjustments in international asset portfolios. This consideration is in line with the traditional Capital Asset Pricing Model (CAPM) by Sharpe (1964), Lintner (1965) and Mossin (1966) which states that portfolio shares should correspond to assets' market shares.

[11] See Cheng and Wall (2005) for a comparison of different panel estimation methods for the estimation of bilateral goods trade as well as Baldwin and Taglioni (2006) for further details on the estimation of gravity models.

[12] Results of these regressions and further robustness checks can be found in Appendix C).

3.2 Data and Descriptive Statistics

This study investigates German cross-border portfolio investment. The dependent variable, $T_{ij,t}$, includes the amount of foreign purchases and sales of German portfolio assets - with i referring to the foreign transacting country and j to German assets - as well as the amount of German sales and purchases of foreign portfolio investment - in this case i refers to Germany and j to assets of the foreign country. The data in use was provided by the Deutsche Bundesbank. Portfolio investments are part of the balance of payments and include equity, mutual funds, bonds and notes as well as money-market papers.[13] The data is available for 47 countries from 1987 to 2002.[14] The period covers the three stages of the formation of the EMU from 1990 to 1999. Further financial and macroeconomic variables are necessary for the empirical analysis. Table 1 summarizes their definitions and sources. Summary statistics for all variables are provided in Appendix B.

Table 1: Variable definitions and sources

Variable	Description
$T_{ij,t}$	The volume of portfolio transactions refers to sales and purchases of assets from country j undertaken by Germans, or sales and purchases of German assets undertaken by residents from country i; Portfolio investment includes equity, mutual funds, bonds and notes as well as money market papers. *Source: Deutsche Bundesbank*
$gdp_{i,t}$, $gdp_{j,t}$	GDP in current US $. *Source: WDI (2004)*
$distance_{ij}$	Geographical distance between capitals of country i and j. *Source: Frankel, Stein and Wei (1995)*
$foreigner_{ij,t}$	Percentage of foreigners of country i or j living in Germany; This variable only refers to foreigners living in Germany but not to Germans living in the foreign country i or j. *Source: Statistisches Bundesamt*

Table continues on the next page.

[13] See Deutsche Bundesbank, Monthly Reports, www.bundesbank.de/volkswirtschaft/vo.php.
[14] For a list of countries see Table 9 in Appendix A.

$crisis_{i,t}$, $crisis_{j,t}$	Dummy variable equal to one if a banking crisis exists in the relevant or precedent year in country i or j respectively. *Source: Caprio and Klingebiel (2003)*
$d1990_{ij,t}$	Dummy variable equal to one since the first stage of the EMU if both countries are part of stage one of the EMU. It started in 1990 for Austria, Belgium, Finland, France, Germany, Italy, Luxembourg and the Netherlands. Ireland, Spain and Portugal followed in 1993, Greece in 1998.
$d1999_{ij,t}$	Dummy variable equal to one since stage three of the EMU if both countries are part of stage three of the EMU, i.e., the fixation of the Euro exchange rate. It started in 1999 for all EMU countries except Greece that followed in 2001.
$dEMU_{ij}$	Dummy variable equal to one during the whole sample period if both countries are in 2001 part of the EMU.
$dEUnonEMU_{ij}$	Dummy variable equal to one during the whole sample period if one of the countries is part of the EU-15 but not part of the EMU (i.e., Denmark, the UK, Sweden).
$exratevol_{ij,t}$	Exchange rate volatility between country i and j is calculated as the standard deviation of the mean monthly exchange rate over its mean in year t. *Source: IFS, own calculations*
$mcap_{i,t}$, $mcap_{j,t}$	Value of listed shares for country i and j relative to GDP. *Sources: Demirgüc-Kunt and Levine (2001), WDI (2004)*
$credit_{i,t}$, $credit_{j,t}$	Private credit by deposit money banks relative to GDP. *Sources: Demirgüc-Kunt and Levine (2001), WDI (2004)*
$gdpcorr_{ij,t}$	GDP growth correlation in country i and j in the past 5 years, calculated as rolling windows for each year t. *Source: WDI (2004)*
$market_{i,t}$, $market_{j,t}$	Dummy variable equal to one if a country's financial market is more market-based, and zero if it is more bank-based. *Source: Demirgüc-Kunt and Levine (2001)*

Descriptive statistics of portfolio investments by direction of investment are presented in Table 2 for single years. Starting from the early 1990s, there is a very strong increase in overall portfolio investment (purchases and sales) for both

directions, i.e., German assets purchased and sold by foreign countries as well as foreign assets purchased and sold by Germans. Moreover, percentage shares of portfolio investment within OECD, EU-15 and EMU countries are reported. About 98 percent of investments in either direction are undertaken with OECD countries. This share stays constant throughout the entire sample period. This is contrasted by an increase in the shares of investments with EU-15 and EMU countries.

Table 2: Descriptive statistics

	1987	1990	1993	1995	1998	2000	2002
	German sales and purchases of foreign portfolio assets						
(in Bn. US$)	200.5	290.5	768.5	947.8	2,677.5	4,112.8	5,002.7
OECD (in %)	98.7	98.6	98.8	98.3	97.2	98.7	99.2
EU-15 (in %)	44.9	62.6	73.3	64.9	64.1	70.0	72.4
EMU (in %)	27.4	44.5	57.6	47.8	47.1	54.4	65.5
	Foreign sales and purchases of German portfolio assets						
(in Bn. US$)	385.9	549.4	2,200.7	2,979.7	4,441.4	4,269.9	5,042.2
OECD (in %)	97.8	98.1	98.7	97.5	98.1	99.3	99.5
EU-15 (in %)	74.4	77.0	89.1	86.7	84.1	87.5	90.4
EMU (in %)	21.1	17.1	19.4	22.7	28.0	29.9	30.2

Source: Own calculations based on Deutsche Bundesbank

Level and timing of this increase depend on the direction of investment: The share of German investment (again purchases and sales) in EU-15 and EMU countries increases strongly in the late 1980s and early 1990s. The EU-15 share rises from 45 percent in 1987 to 72 percent in 2002. The EMU share grows even more strongly, namely from 27 percent to 66 percent. A slightly different pattern arises for the other direction: Investment in German portfolio assets by EU-15 countries is also rising mainly in the early 1990s but less significantly: from 74 percent in 1987 to 90 percent in 2002. Investments undertaken by EMU countries increase later, in the mid-1990s, and both less dramatically, from 21 percent in 1987 to 30 percent in 2002.

Overall, the main difference between the two directions is due to a large share of foreign investment in German portfolio assets by EU-15 countries whereas the share of German sales and purchases of EMU and EU-15 portfolio assets is relatively low. This is partly driven by a large share of German portfolio assets purchased and sold by the UK due to its importance as a leading financial

center. The empirical analysis accounts for this fact by including financial center dummies[15].

4 Empirical Results

First, the impact of European financial integration on German portfolio investment is investigated in general. Second, potential underlying forces driving European integration are explicitly taken into account. It is very likely that countries' responses to European financial integration differ. This issue is addressed in the last part of this section. Additional robustness checks can be found in Appendix C.

4.1 German Portfolio Investment and the EMU

The standard gravity regression equation described in Section 3.1 is used to identify the effect of European financial integration on portfolio investment. The effect is modeled by different dummy variables that mirror the formation of the EMU or, more generally, EMU membership. The effect of EU-15 versus EMU financial integration is disentangled and further robustness checks are undertaken.

4.1.1 The Formation of the EMU

To start with, results of the standard gravity model are compared with results in the existing literature. The coefficients of the first column in Table 3 are based on pooled OLS estimates with White-heteroscedasticity robust standard errors. Specification (1) includes the scaling variables, the percentage of foreigners and distance. Additional year dummies, dummies for financial centers, and dummies for financial crises in the transacting country i or the country invested in, country j, are added in all specifications but not explicitly reported.[16]

The results are consistent with earlier estimates of gravity models in the literature.[17] The distance coefficient is - as expected - negative and ranges in absolute size between 0.34 and 0.43. Portes and Rey (2005) report a coefficient

[15]Financial centers are Hong Kong, Ireland, Luxembourg, UK, Singapore and Switzerland. For each of these countries separate dummies enter that refer to country i and j.

[16]In order to take German reunification into account an additional dummy variable is considered. As the effect turns out to be insignificant, specifications without this additional dummy are presented in the following.

[17]Note that the R^2 amounts to 74 percent, which shows that the model performs very well in explaining the variation in the data.

around minus 0.6 estimating bilateral portfolio flows between 14 countries from 1989 to 1996. Buch (2005) considers assets and liabilities of commercial banks from five countries (France, Germany, Italy, UK and the US) for 1983 and 1999 and estimates a distance coefficient between minus 0.3 and 1.25 depending on the respective estimation sample.

Table 3: Basic regression results I

	(1)	(2)	(3)	(4)	(5)
$gdp_{i,t}$	2.209***	2.161***	0.581	2.192***	0.437
	[0.069]	[0.069]	[0.375]	[0.069]	[0.374]
$gdp_{j,t}$	3.002***	2.953***	1.201*	2.985***	1.028
	[0.130]	[0.131]	[0.716]	[0.130]	[0.722]
$pop_{i,t}$	-1.274***	-1.244***	-0.633	-1.261***	-0.377
	[0.080]	[0.078]	[0.424]	[0.079]	[0.429]
$pop_{j,t}$	-2.061***	-2.031***	1.859**	-2.049***	2.157**
	[0.142]	[0.141]	[0.941]	[0.142]	[0.952]
$distance_{ij}$	-0.429***	-0.343***		-0.407***	
	[0.046]	[0.054]		[0.047]	
$foreigner_{ij,t}$	0.053***	0.054***	-0.024	0.054***	-0.019
	[0.006]	[0.006]	[0.057]	[0.006]	[0.058]
$d1990_{ij,t}$		0.572***	0.275*		
		[0.123]	[0.145]		
$d1999_{ij,t}$				0.584***	0.646***
				[0.167]	[0.130]
Obs.	1440	1440	1440	1440	1440
R^2	0.74	0.74	0.51	0.74	0.51
No. of pairs			94		94

Notes: robust standard errors in brackets; dependent variable: gross portfolio flows, $T_{ij,t}$; *, **, *** denote 10%, 5% and 1% significance levels respectively; specifications (1), (2) and (4) are estimated using pooled OLS with White-heteroscedasticity robust standard errors, specifications (3) and (5) are estimated using country-pair fixed effects, R^2 refers to 'within' values in this case; a constant, year dummies as well as dummies for banking crises and for financial centers (Hong Kong, Ireland, Luxembourg, United Kingdom, Singapore and Switzerland) are included but not reported.

The estimated coefficients of the remaining variables in specification (1) are in line with the theoretical considerations mentioned in Section 3.1: The coefficients of the scaling variables, $gdp_{i,t}$, $gdp_{j,t}$, $pop_{i,t}$ and $pop_{j,t}$ have the expected positive and negative effects. The percentage of people of the respective foreign

country living in Germany, $foreigner_{ij,t}$, is associated with a positive effect on transactions. This result suggests that familiarity between two countries plays a role.

Table 4: Basic regression results II

	(6)	(7)	(8)	(9)
$gdp_{i,t}$	2.159***	0.417	2.146***	2.063***
	[0.069]	[0.374]	[0.069]	[0.070]
$gdp_{j,t}$	2.951***	1.01	2.940***	2.859***
	[0.131]	[0.725]	[0.128]	[0.127]
$pop_{i,t}$	-1.242***	-0.334	-1.234***	-1.154***
	[0.078]	[0.434]	[0.079]	[0.079]
$pop_{j,t}$	-2.029***	2.196**	-2.023***	-1.943***
	[0.141]	[0.956]	[0.140]	[0.138]
$distance_{ij}$	-0.343***		-0.310***	-0.197***
	[0.054]		[0.058]	[0.064]
$foreigner_{ij,t}$	0.054***	-0.01	0.053***	0.059***
	[0.006]	[0.057]	[0.006]	[0.007]
$d1990_{ij,t}$	0.498***	0.155		
	[0.126]	[0.146]		
$d1999_{ij,t}$	0.295*	0.609***		
	[0.167]	[0.129]		
$dEMU_{ij}$			0.615***	0.988***
			[0.121]	[0.149]
$dEUnonEMU_{ij}$				1.228***
				[0.158]
Obs.	1440	1440	1440	1440
R^2	0.74	0.51	0.74	0.74
No. of pairs		94		
$F-test$				5.25
$p-value$				0.02

Notes: see Table 3; specifications (6), (8) and (9) refer to pooled OLS with White-heteroscedasticity robust standard errors, (7) refers to country-pair fixed effects, R^2 refers to 'within' values in this case.

In addition to the scaling variables and proxies for information costs, specifications (2) to (5) include dummy variables for stage one or three of the EMU. For each specification, two estimates are reported: pooled OLS and country pair fixed

effects.[18] Fixed effects capture omitted variables that are specific and constant in cross sectional units. Most of these effects are not random but deterministically associated with certain historical, political or geographical facts (Egger 2000). The pooled OLS estimator captures both the effect over time and the cross sectional effect of higher trade with EMU countries.

In the fixed effects model the coefficients on GDP and population size are not always significant and, in case of population size, yield different signs compared to the pooled OLS estimation. This may have different reasons: First, the inclusion of country pair fixed effects and year dummies may already account for a large part of the variation of these variables. Second, in the fixed effects estimation GDP and population size rather seem to influence portfolio transactions in the same direction whereas in the pooled OLS regression they do not. Third, as the sub-sample estimates in Table 11, Appendix C, show, effects are not as homogeneous across sub-samples as in the pooled OLS case and might therefore be even less significant in the aggregate full sample.

In specification (2) to (5), Table 3, the dummies for stage one and three of the EMU are highly significant. Based on these results, Germany experiences higher portfolio investment volumes since 1990 with countries that are also part of the first stage of the EMU. Specifications (2) and (3) suggest that ceteris paribus gross flows with EMU countries are on average more than 57 percent larger in the pooled OLS estimation and 28 percent higher in the fixed effects estimation. The third stage of the EMU is ceteris paribus associated with portfolio investments that are on average 58 percent higher in the pooled OLS and 65 percent higher in the fixed effects estimation (specifications (4) and (5)).[19]

When both dummies enter simultaneously (specifications (6) and (7), Table 4), the dummy for stage one is only significant in the pooled OLS estimation, whereas the coefficient of stage three is only highly significant and large in the fixed effects estimation. These results suggest that transactions increased over time especially after 1999 whereas for the first stage since 1990 only cross sectional differences can be observed. As specification (8) shows, there exists also a positive level effect of enhanced portfolio flows over the entire estimation period from 1987-2002: German cross-border portfolio investment with EMU countries is on average 62 percent higher compared to trade with countries not being part of the EMU.

[18]Separate country pair fixed effects for each direction are considered, i.e., country pair ij is distinguished from country pair ji.

[19]For further robustness checks refer to Appendix C.

4.1.2 EMU versus EU-15

The question arises whether the results are really driven by increased integration in the wake of the EMU formation or rather by increased economic and financial integration within all EU-15 countries. Therefore, an additional dummy for EU-15 countries that are not part of the EMU, namely Denmark, the UK and Sweden, is considered in the regression analysis, $dEUnonEMU_{ij}$.

When both the EMU dummy, $dEMU_{ij}$, and $dEUnonEMU_{ij}$ enter simultaneously the regression equation, the coefficient of $dEUnonEMU_{ij}$ is larger compared to the EMU dummy (specification (9)). The hypothesis of both coefficients being equal can be rejected at the 5 percent level, though not at the one percent level.[20] On average across the whole time period under consideration, transactions between Germany and Denmark, the UK and Sweden respectively tend to be larger compared to trade with EMU countries.

Next, these effects are estimated separately for each year. Interaction terms between the EMU dummy variable and year dummies as well as the dummy variable for EU-15 countries that are not part of the EMU and year dummies enter the regression. As stated in the *Delors Report* of 17 April 1989, the EMU was achieved in three "*discrete but evolutionary steps.*" Therefore, one expects a smooth impact of the EMU formation on financial indicators.

The estimated coefficients of the interaction terms plotted in Figure 1 are in line with this notion.[21] In the late 1980s, the estimated coefficients of the EMU-countries are smaller compared to the coefficients referring to Denmark, the UK and Sweden. Until 1998 the difference between the two coefficients decreases and it finally reverses. As the standard error bands show, the coefficients are always significantly different from zero, except for the EMU dummy in 1987 and 1988. F-tests reveal that the estimated yearly coefficients are significantly different from one another for the years up to 1992 and for the year 2002.[22]

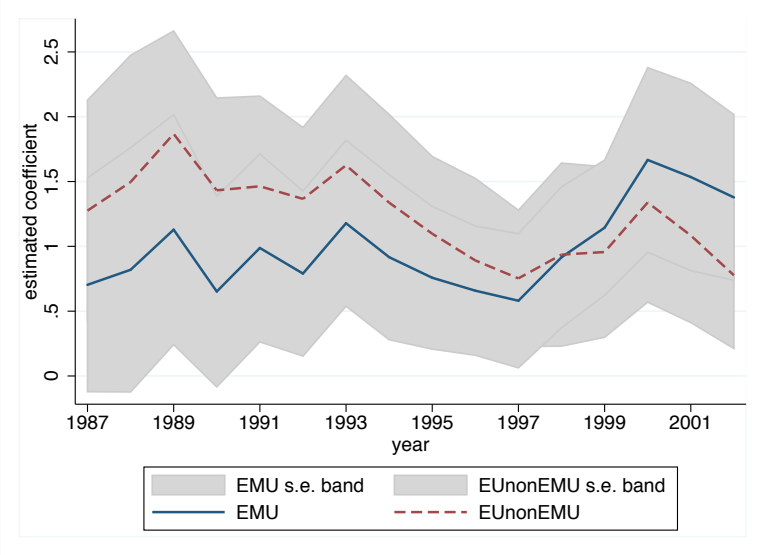
The results suggest that German transactions with EMU countries are significantly lower compared to trade with Denmark, the UK and Sweden until the early 1990s. However, since the beginning of the new millennium this relationship seems to have reversed. The comparison between Euro area and non-Euro area countries suggest, that this might be due to the final step of the EMU, the abolishment of exchange rate risk. However, with one observations for 2002 only, this result is not robust but only an indication. It is left to future research using updated data to confirm or modify this indication.

[20] Refer to the documented F-test statistics in Table 4.

[21] Full regression results are documented in Table 15, Appendix C.

[22] F-tests are also documented in Table 15, Appendix C.

Figure 1: Estimated coefficients



Note: Estimated coefficients of interactions between year dummies and $dEMU_{ij}$ and $dEUnonEMU_{ij}$ respectively. Full regression results are documented in Table 1, Appendix C.

4.2 Accounting for European Financial Integration

The dummy variables reflecting stage one and three of the EMU capture the effect of increased financial integration. What exactly are its driving forces? In this section, financial and real economic factors are investigated that might account for at least part of the effect.

4.2.1 Financial Factors

The introduction of the Euro has resulted in the elimination of exchange rate risk within the Euro area. The absence of exchange rate risk allows corporations to raise funds across countries with fewer constraints and costs. This can in general have a large effect on financial integration because exchange rate risk is an important source of risk priced on capital markets (e.g. Dumas and Solnik (1995) and Hardouvelis et al. (2006)). In addition, the launch of the common European currency is associated with lower costs of cross-country transactions, improved liquidity and better developed European capital markets (Fratzscher (2002) and Danthine, Giavazzi and von Thadden (2001)).

In order to investigate whether financial factors such as the abolition of ex-

change rate risk or financial market development and increased liquidity can explain part of the effect captured so far by the dummy variables for stage one and three of the EMU, measures for these factors are added to the regression analysis.

Exchange rate risk is measured as the standard deviation of the mean monthly bilateral exchange rate over its mean in year t, $exratevol_{ij,t}$. In order to account for enhanced financial development two commonly used measures are added to the regression: stock market capitalization relative to GDP for country i and j, $mcap_{i,t}$ and $mcap_{j,t}$, as well as private credit provided by the banking sector relative to GDP for country i and j, $credit_{i,t}$ and $credit_{j,t}$.[23] The two sets of variables refer to different aspects of financial development. The relative volume of private credit mirrors the development of the private banking sector and, therefore, reflects the ability of financial institutions to carry out national as well as international capital transactions. Stock market capitalization relative to GDP reflects the size and development of a country's equity market.

These additional variables are not always available for the full sample and time period.[24] Therefore, a benchmark regression is reported that is based on the same observations but excludes the variables of interest. Then, the variables of interest are added and the coefficients of the dummy variables, $d1990_{ij,t}$ and $d1999_{ij,t}$ respectively, can be compared across regressions. In order to account for potential endogeneity, lagged values of relative stock market capitalization and credit provided by the banking sector are used.

Table 5 shows results of pooled OLS and of fixed effects estimations. The table documents only the estimated coefficients of interest: the first part refers to estimates of $d1990_{ij,t}$ and $d1999_{ij,t}$ respectively in a regression excluding $exratevol_{ij,t}$. The second part refers to estimates inclusive this variable. In the pooled OLS case, exchange rate volatility has a large negative influence, though only at the ten percent significance level. The coefficients on the dummy variables decrease slightly, but not significantly.[25] Also in the fixed effects estimations exchange rate volatility does not lead to significant changes of the coefficients of $d1990_{ij,t}$ and $d1999_{ij,t}$. It has again only a weakly significant negative coefficient.

Also, the inclusion of measures for financial development does not significantly alter the size of the dummy variables neither in the pooled OLS nor in the fixed effects estimations (Table 6). The variables themselves have the following

[23] As an alternative measure for private credit, M2 to GDP is often used, see e.g. Chinn and Ito (2006) and Di Giovanni (2005). This variable is only available for a much smaller number of countries and years and, therefore, not considered.

[24] For the availability of variables across years refer to Table 10 in Appendix B.

[25] Refer to the reported F-test statistics in Table 5.

Table 5: Accounting for European financial integration I

	POLS		*F.E.*	
$d1990_{ij,t}$	0.589***		0.288*	
	[0.124]		[0.147]	
$d1999_{ij,t}$		0.599***		0.652***
		[0.168]		[0.130]
$d1990_{ij,t}$	0.577***		0.290**	
	[0.125]		[0.147]	
$d1999_{ij,t}$		0.594***		0.646***
		[0.168]		[0.130]
$exratevol_{ij,t}$	-0.378*	-0.419*	-0.265*	-0.243
	[0.228]	[0.232]	[0.157]	[0.158]
$Obs.$	1425	1425	1425	1425
$F-test$	0.01	0.00	0.00	0.00
$p-value$	0.92	0.98	0.99	0.97

Notes: see Table 3; $distance_{ij}$, $foreigner_{ij,t}$, $gdp_{i,t}$, $gdp_{j,t}$, $pop_{i,t}$, $pop_{i,t}$ are included but not reported. The upper part of the table refers to a regression excluding the variable of interest, the lower part to a regression inclusive the variable of interest. POLS denotes pooled OLS estimations with White-heteroscedasticity robust standard errors, F.E. refers to country pair fixed effects estimations. F-test refers to the F-test statistic of the hypothesis of equal coefficients on $d1990_{ij,t}$ and $d1999_{ij,t}$ respectively.

effects in the pooled OLS regressions: Banking sector development in the transacting country, $credit_{i,t}$, is positively associated with cross-border transactions. This result is in line with the consideration that highly developed financial and banking institutions help to conduct international transactions. Stock market development at home, $mcap_{i,t}$, has a negative and much smaller influence. The finding suggests that less developed equity markets at home drive investors towards better developed foreign markets that offer more diversification and better investment possibilities. The positive coefficient on the stock market capitalization variable of the country invested in, $mcap_{j,t}$, supports this view. Countries with better developed equity markets tend to attract more portfolio transactions. In contrast, the development of the banking sector in in the country invested in, $credit_{j,t}$, has a negative effect. One reason for the strong negative effect might be the fact that the credit variable is strongly correlated with both stock market capitalization and GDP.[26]

[26]The two variables $mcap_{j,t}$ and $credit_{j,t}$ are positively correlated with a correlation coef-

In the fixed effects estimations only stock market capitalization in the country invested in, $mcap_{j,t}$, has a positive effect. This result suggests that over time larger and more developed capital markets lead to increased transaction volumes of assets located in these growing markets.

Table 6: Accounting for European financial integration II

	POLS		*F.E.*	
$d1990_{ij,t}$	0.601***		0.346**	
	[0.130]		[0.170]	
$d1999_{ij,t}$		0.745***		0.739***
		[0.212]		[0.159]
$d1990_{ij,t}$	0.595***		0.417**	
	[0.153]		[0.171]	
$d1999_{ij,t}$		0.782***		0.784***
		[0.200]		[0.151]
$credit_{i,t-1}$	0.853***	0.938***	0.00	0.066
	[0.127]	[0.119]	[0.192]	[0.191]
$credit_{ij,t-1}$	-0.583***	-0.499**	0.387	0.44
	[0.217]	[0.208]	[0.452]	[0.449]
$mcap_{i,t-1}$	-0.191***	-0.232***	-0.025	-0.049
	[0.072]	[0.069]	[0.078]	[0.076]
$mcap_{j,t-1}$	0.334**	0.294**	0.388**	0.367*
	[0.145]	[0.141]	[0.190]	[0.189]
Obs.	1159	1159	1159	1159
$F-test$	0.00	0.04	0.17	0.09
$p-value$	0.97	0.85	0.68	0.76

Notes: see Table 5.

4.2.2 Real Economic Integration

The empirical literature on real economic and financial integration has established the so called "quantity puzzle": A positive association between financial integration and GDP correlations is revealed in the data, whereas theory predicts

ficient of 0.75. This relation and also the estimation results point into a similar direction as findings in Berkel (2004). Also Di Giovanni (2005) finds that countries with better developed equity markets attract more M&A activity whereas countries with better developed banking markets do not.

a negative relation if anything.[27] There is growing evidence that real integration among EMU members has been strengthened in terms of real business cycle synchronization and trade.[28] As both developments, real economic and financial integration, intertwine, real economic integration might account for part of the financial integration measured by the dummy variables of stage one and three.

Using the same methodology as above, GDP growth correlation is included in the regressions, $gdpcorr_{ij,t}$, as a proxy for real economic convergence (Table 7). In order to account for the effect that GDP growth correlations has for EMU countries, it also enters interacted with the EMU dummy, $dEMU_{ij}$.

Table 7: Accounting for European financial integration III

	POLS		*F.E.*	
$d1990_{ij,t}$	0.552***		0.293*	
	[0.122]		[0.145]	
$d1999_{ij,t}$		0.587**		0.663***
		[0.167]		[0.130]
$d1990_{ij,t}$	0.421***		0.270*	
	[0.140]		[0.154]	
$d1999_{ij,t}$		0.428**		0.652***
		[0.167]		[0.128]
$gdpcorr_{ij,t}$	-0.28	-0.239	0.317	0.362*
	[0.173]	[0.170]	[0.194]	[0.188]
$gdpcorr_{ij,t} * dEMU_{ij}$	0.768***	0.945***	0.495*	0.352
	[0.233]	[0.233]	[0.254]	[0.242]
Obs.	1437	1437	1437	1437
$F-test$	0.87	0.91	0.02	0.01
$p-value$	0.35	0.34	0.88	0.93

Notes: see Table 5

The results of the pooled OLS regressions show that GDP growth correlations with EMU countries have a significant positive effect on transactions whereas they have no effect for the rest of the sample. In the fixed-effects case there is a weakly significant positive effect that is not significantly larger for EMU countries. The

[27] See Imbs (2004) and Imbs (2006) for a detailed discussion of the puzzle.

[28] Refer e.g. to Boewer and Guillemineau (2006) and Massmann and Mitchell (2004) with respect to business cycle synchronization as well as Frankel and Rose (1997) and Micco, Stein and Ordonez (2003) with respect to trade.

effect is smaller compared to the POLS estimation for EMU countries. This finding suggests that the link between real and financial integration is larger across countries than within countries over time. Moreover, the link within countries tends to be a more general phenomenon. The inclusion of GDP growth correlations leads to smaller coefficients of the stage one and stage three dummies. However, the F-test indicates that coefficients do not significantly change in size. Real integration proxied by GDP growth correlations in this empirical setting is not able to account for financial integration measured by $d1990_{ij,t}$ and $d1999_{ij,t}$.[29]

Estimated coefficients on GDP growth correlations in Table 7 might be biased due to endogeneity of GDP growth correlations, reflecting real economic integration, and transaction volumes, mirroring financial integration. Accounting for endogeneity would lead to a lower impact of business cycle correlations on transactions, thereby lowering also its ability to reduce the coefficients of the stage one and three dummies. As there is no significant reduction in the size of coefficients anyway, endogeneity does not affect the interpretation of the coefficients of interest on the dummy variables, $d1990_{ij,t}$ and $d1999_{ij,t}$.

Overall, none of the included variables in this section involve a decrease in the dummy variable effects measuring stage one and three of the EMU. Most strikingly, reduced exchange rate volatility does not even account for part of the effect.[30] Obviously, the effect of the formation of the EMU captures something more than is measured by the above mentioned explicit factors in this framework. As discussed in the conclusion this finding might be due to measurement or model specification issues.

4.3 Do Countries Respond Differently to the EMU?

European financial market integration and the formation of the EMU are likely to have a different impact in every country. One can easily think of differences that depend on countries' financial market development or structure and on how important costs associated with cross-border portfolio investment are. Countries with low transaction and information costs and relatively developed, efficient and large financial markets might see a large increase in gross flows induced by European financial market integration. At the same time, it is also possible that an increase in cross-border trading activity might be larger for countries starting with relatively high transactions costs as well as less developed, efficient and

[29]Similar results are obtained when using 10 year rolling correlations of GDP growth.

[30]Also lagged values of exchange rate volatility and two or three year averages have been used. Results do not change.

smaller financial markets. Ex ante, these effects are not clear. Countries can also be differentiated with respect to the extent of real economic integration. Given the results in Section 4.2.2, one expects countries with more synchronized business cycles, i.e., countries that are more integrated in real terms, to be more financially integrated in the sense that they experience larger transaction volumes.

In order to explore differences in the effect of European financial integration on portfolio investment across countries, the basic regression is expanded by an interaction term between the dummy variable for the first stage of the EMU and the variable of interest:[31]

$$\begin{aligned} log(T_{ij,t}) &= \beta_0 + \beta_1 log(gdp_{i,t}) + \beta_2 log(gdp_{j,t}) + \beta_3 log(pop_{i,t}) \\ &\quad + \beta_4 log(pop_{j,t}) + \beta_5 log(distance_{ij,t}) + \beta_6 log(foreigner_{ij,t}) \\ &\quad + \beta_7 X_{ij,t} + \beta_8 d1990_{ij,t} + \beta_9 X_{ij,t} * d1990_{ij,t} + \sum_{n=10}^{N} \beta_n Z_{ij,t}^n + \epsilon_{ij,t}, \end{aligned}$$

where $X_{ij,t}$ refers to the variable of interest. The estimated coefficient of the dummy variable for the first stage of the EMU, β_8, the effect of the interaction term, β_9, as well as the own effect of the variable of interest, β_7, are reported in Table 8. As heterogeneous responses of countries are of interest, only pooled OLS regressions are undertaken. First, financial market structure and development are considered as factors of interest that differentiate the EMU effect on transactions across countries. Second, the role of information costs proxied by distance is explored. Finally, the link between the volume of transactions and real economic integration is investigated.

4.3.1 Financial Market Structure and Development

An indicator variable that equals one if a country is more market-based and zero if it is more bank-based, $market_{i,t}$ and $market_{j,t}$, is included. It is used to investigate whether economies with higher stock market or with higher banking activity respond differently. In bank-based systems, banks play a leading role in mobilizing savings and allocating capital whereas in market-based systems securities markets take the role of getting society's savings to firms, exerting corporate control and easing risk management. Demirgüc-Kunt and Levine (2001) find that financial systems tend to be more market-based in higher income countries where stock markets become more active and efficient than banks. The literature does

[31] Similar results can be obtained using interactions with $dEMU_{ij}$ or $d1999_{ij,t}$.

not reveal a clear support for either the market-based or the bank-based system to perform better in attracting capital and favoring growth (Levine 2002).

In order to proxy the development of financial markets again two different measures are used for country i and j: stock market capitalization relative to GDP and the amount of credit provided by the banking sector relative to GDP, $mcap_{i,t}$, $mcap_{j,t}$, $credit_{i,t}$ and $credit_{j,t}$.

Results in Table 8 show that, first, countries invested in, i.e., countries j, that are more market-based countries are associated with higher portfolio transactions (specification (1)). This result is consistent with the finding in Section 4.2.1 that relative stock market capitalization of country j has a positive impact on portfolio transactions. However, the effect of higher transactions due to stage one of the EMU is not linked to the classification of countries into more market-based and bank-based financial markets as the interaction terms are insignificant. In this respect there is no heterogeneity among countries.

Second, transacting countries with more developed financial markets, in terms of more private credit provided by the banking sector relative to GDP, experience higher transaction volumes during stage one of the EMU (specification (2)). The same finding applies to financial development measured by stock market capitalization relative to GDP (specification (3)).[32]

4.3.2 Distance

Information costs proxied by distance play a major role when explaining volumes of portfolio investment in gravity models. Portes and Rey (2005) document that geographical distance presents a good proxy for these costs. The question arises of whether countries closer to Germany are associated with a larger increase in transaction volumes in the wake of the formation of the EMU compared to countries further away. The results in Table 8, specification (4) suggest that there is no difference in the positive effect of the first stage of the EMU on transactions with respect to distance.

[32]If both interaction effects are investigated in one single regression, the same effects can be observed. Note that the estimated coefficients on $credit_{i,t}$ and $mcap_{j,t}$ correspond very well to the estimated coefficients estimated in a joint regression (Table 6). Now, $mcap_{i,t}$ and $credit_{j,t}$ are insignificant and do not yield negative signs as before. This finding suggests that the negative signs are likely to be driven by positive correlations among the two variables and with GDP.

Table 8: Heterogenous country responses

(1)		(2)	
$d1990_{ij,t}$	0.882***	$d1990_{ij,t}$	0.654***
	[0.149]		[0.173]
$market_{i,t}$	-0.237	$credit_{i,t-1}$	0.831***
	[0.146]		[0.096]
$market_{j,t}$	0.969***	$credit_{j,t-1}$	-0.171
	[0.178]		[0.209]
$d1990_{ij,t}$ * $market_{i,t}$	-0.185	$d1990_{ij,t}$ * $credit_{i,t-1}$	0.882***
	[0.222]		[0.238]
$d1990_{ij,t}$ * $market_{j,t}$	-0.157	$d1990_{ij,t}$ * $credit_{j,t-1}$	0.11
	[0.234]		[0.257]
(3)			
$d1990_{ij,t}$	1.197***		
	[0.246]		
$mcap_{i,t-1}$	0.042		
	[0.067]		
$mcap_{j,t-1}$	0.317***		
	[0.123]		
$d1990_{ij,t}$ * $mcap_{i,t-1}$	0.284**		
	[0.123]		
$d1990_{ij,t}$ * $mcap_{j,t-1}$	0.157		
	[0.120]		
(4)		(5)	
$d1990_{ij,t}$	0.032	$d1990_{ij,t}$	0.347**
	[0.640]		[0.149]
$distance_{ij}$	-0.393***	$gdpcorr_{ij,t}$	-0.204
	[0.060]		[0.166]
$d1990_{ij,t}$ * $distance_{ij}$	0.085	$d1990_{ij,t}$ * $gdpcorr_{ij,t}$	0.630**
	[0.088]		[0.252]

Notes: Pooled OLS regressions with White-heteroscedasticity robust standard errors in brackets; dependent variable: gross portfolio flows, $T_{ij,t}$; *, **, *** denote 10%, 5% and 1% significance levels; a constant, year dummies, dummies for financial centers, $distance_{ij}$, $foreigner_{ij,t}$, $gdp_{i,t}$, $gdp_{j,t}$, $pop_{i,t}$, $pop_{i,t}$, and dummies for banking crises are included but not reported.

4.3.3 Real Economic Integration

Results in Table 8, specification (5), show that countries participating in stage one of the EMU and countries having higher GDP growth correlations ceteris paribus experience larger portfolio investment compared to the rest of the sample. If larger portfolio investment signifies increased financial integration, it can be concluded that increased financial integration is associated with increased business cycle synchronization for EMU countries. This finding is in line with the "quantity puzzle" documented in the recent empirical literature on real integration.[33] Imbs (2004) shows that business cycles in financially integrated regions are significantly more synchronized, even though financial integration may also result in more specialized economies, and consequently less synchronized cycles.

5 Conclusion

Although there is a growing literature on the effects of the EMU on different segments of financial markets, no comprehensive empirical analysis of the effects on portfolio asset trade using a gravity model approach has yet been undertaken. This paper not only investigates the increase in gross portfolio flows induced by European financial market integration and the EMU but also potential underlying driving forces and the heterogeneity of responses to European financial integration.

The estimations indicate that there is a substantial increase in gross portfolio flows with Germany since the first and the third stage of the EMU. The latter marks the fixation of exchange rates with the Euro. The estimations indicate that ceteris paribus gross portfolio flows increased on average by about 60 percent for countries taking part in the third stage. These are time series effects remaining after country pair fixed effects have been taken into account. As has been shown, the positive effect induced by the formation of the EMU evolves smoothly over time. Since the end 1990s it increases relative to a group of countries including Denmark, the UK, and Sweden that are part of EU-15 but not of the Euro area. In 2002 it seems to be significantly larger for EMU countries compared to Denmark, the UK, and Sweden. Though it is left to future research using updated data to confirm whether this finding is indeed robust.

The formation of the EMU is intertwined with changes in financial markets

[33] Again one has to be aware of the fact that real economic and financial integration are likely to be interdependent in both directions. However, this section aims at characterizing country responses and does not draw conclusions about causality.

and real economic integration. In a second step, this paper examines to what extent these developments account for the estimated positive effect measured by dummy variables. Lower exchange rate volatility, higher financial market development, and increased business cycle correlations have significant effects on gross portfolio flows. However, they are not able to account for the positive effect induced by the formation of the EMU.

In the third part of the empirical analysis of the present paper, the coefficients of the dummies for different stages of the EMU are forced to be equal across countries. This paper also analyzes factors that lead to heterogeneous country responses. The EMU effect on gross portfolio flows is larger for transacting countries with more developed banking and equity markets and country pairs with more correlated business cycles. The latter result is in line with other empirical studies investigating real economic and financial integration (Boewer and Guillemineau (2006), Imbs (2006), and Imbs (2004)). There are no differences in countries' responses to the EMU depending on geographical distance to Germany or on whether countries are more market-based.

The gravity model is a useful approach to empirically reveal and describe the differences of German portfolio flows with EMU countries compared to the other trading partners. It does not explain the effects of a common currency union on asset trade, though. The present empirical analysis can not sufficiently reveal, which factors actually account for the EMU effect on portfolio flows measured by dummy variables for different stages of the EMU. On the one hand, this finding can be due to measurement problems. One would expected that at least exchange rate risk explains part of the EMU effect. However, it is very difficult to effectively measure *expected* exchange rate risk at an annual frequency. On the other hand, these insignificant results might be comparable to the pessimistic "Nothing is Robust" in the growth literature (Levine and Renelt 1992). Similar to the set up in this paper, growth theories are not explicit about what variables belong in the regression. When simply trying and adding variables, results may turn out to be inconclusive and not robust. As Sala-i-Martin (1997) suggests, using alternative and less restrictive means of testing the relationship between variables by modeling whole distributions of estimators may nevertheless yield strong and meaningful relationships between variables.

As far as known by the author, no theoretical model yet exists in the literature that structurally links the formation of currency unions and asset trade and that provides testable empirical hypotheses. In line with the methodology stated in Deaton (2000),[34] this lack of theory motivates the descriptive characterization of

[34]Rf. to p. 3ff.

the effects of the EMU in the present paper. Based on the results, it is desirable to advance future theoretical and related empirical research that clarifies the channels through which a common currency union, e.g., the EMU, affects asset trade, financial and real economic integration.

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6 Appendix

6.1 Appendix A - Countries by Regions

Table 9: Countries by regions

Western Europe	*Southern Europe*	*Eastern Asia*
Belgium	Greece	Japan
France	Italy	Korea
Luxembourg	Portugal	China
The Netherlands	Spain	
Austria		*South-central Asia*
Switzerland	*Northern Africa*	India
	Egypt	Pakistan
Northern Europe	Morocco	Sri Lanka
Denmark	South Africa	
Finland		*South-eastern Asia*
Ireland	*Northern America*	Indonesia
Norway	Canada	The Philippines
Sweden	USA	Singapore
The UK		Thailand
	Central America	
Eastern Europe	Mexico	*Western Asia*
Czech Republic	Argentina	Israel
Poland	Brazil	Jordan
Russian Federation	Chile	Turkey
Hungary	Colombia	
	Peru	*Oceania*
	Venezuela	Australia
		New Zealand

6.2 Appendix B - Summary Statistics

Table 10: Summary statistics

Variable	Obs.	Mean	Std. Dev.	EMU		Non-EMU	Years
$T_{ij,t}^{a),b)}$	1440	45.9	202.2	70.3	**	38.1	1987-2002
$gdp_{i,t}^{a),b)}$	1440	1180	1160	1130		1196	1987-2001
$pop_{i,t}^{b)}$	1440	63.4	52.7	54.2	**	66.3	1987-2001
$foreigner_{ij,t}$	1440	1.548	4.5	2.281	**	1.311	1987-2002
$distance_{ij}^{b)}$	1440	5365	4795	950	**	6794	-
$mcap_{i,t}^{b)}$	1410	0.414	0.4	0.443	**	0.405	1987-2001
$credit_{i,t}^{b)}$	1319	0.793	0.3	0.876	**	0.766	1987-2001
$exratevol_{ij,t}$	1426	0.062	0.2	0.023	**	0.075	1987-2002
$market_{i,t}$	1039	0.184	0.4	0.108	**	0.208	1989-2001
$gdpcorr_{ij,t}$	1437	0.121	0.4	0.497	**	-0.001	1987-2002

Note: a) in US$ bn, b) no logarithms; EMU refers to the mean in a sample with only EMU countries; Non-EMU refers to the mean in a sample without EMU countries; ** denotes that the mean in the EMU sample is significantly different at the 5 percent level from the mean in a sample excluding EMU countries.

6.3 Appendix C - Further Robustness Checks

Further regressions have been undertaken to check the robustness of the results. First, the regressions discussed so far are reproduced for two sub-samples in order to check whether results are driven by one or the other: German investment in foreign portfolio assets is separated from investment in German assets undertaken by foreigners (see Table 11). Employing pooled OLS one finds that the effect of European financial integration measured either by $d1990_{ij,t}$ or $d1999_{ij,t}$ is larger for foreign purchases and sales of German assets compared to the full sample. Qualitatively, the results are very similar for both sub-samples in the pooled OLS regressions. In the fixed-effects estimations one main difference exists: There is no significant effect of stage one of the EMU for German transactions of foreign assets, whereas the effect for foreign transactions of German assets is highly significant and large in size. Changes over time with respect to stage two of the EMU are now larger for foreign transactions of German portfolio assets. Differences in size depending on whether pooled OLS or fixed effects estimations are used remain as in the full sample.

Second, the regressions described in Table 3 are redone for samples excluding the US and financial centers respectively, because these countries account for a large volume of transactions and might drive part of the results. The estimations are robust with respect to the two dummy effects. Size and significance levels of the estimated coefficients of interest increase if financial centers are excluded (Table 12).

Third, as discussed in Section 3.1, GDP growth in country i and j are added as additional scaling variables, $gdpgrowth_{i,t}$ and $gdpgrowth_{j,t}$, (Table 13). However, as the results in specification (1) show, ceteris paribus these variables have no significant explanatory power. Fourth, in order to address a potential endogeneity problem, lagged values for the scaling variables, $gdp_{i,t}$, $gdp_{j,t}$, $pop_{i,t}$, and $pop_{j,t}$, are used instead of contemporaneous values. The estimated coefficients on these variables hardly change (specification (2), Table 13).

Fifth, one might also ask, whether other country linkages that are not accounted for by the empirical model drive the results. Standard variables employed in gravity models that might capture such effects are added: a dummy equal to one if both countries share a common border, $adjacency_{ij,t}$, and a dummy equal to one if both countries speak the same language, $language_{ij,t}$. The coefficient on $adjacency_{ij,t}$ is highly significant and results with respect to the other coefficients are unchanged, except for the distance coefficient, which decreases in absolute size (specifications (3) and (4), 13). $language_{ij,t}$ has no significant impact on portfolio transactions.

Sixth, as some cross-border portfolio flows are reported with zero values, estimating a linear model might lead to biased coefficients. In total only less than 5 percent of all observations are reported zero flows, though. In order to investigate the sensitivity of the estimated coefficients towards nonlinearities, a Tobit model is estimated for comparison (Table 14). As specifications (1) and (2) show, the estimated effects, especially on the various dummy variables measuring the financial integration within EMU and EU-15 countries, do hardly change.

Seventh, variables such as transaction volumes, GDP, market capitalization and bank credit might not be non-stationarity. If these variables are not stationary and not co-integrated, inference is screwed. Panel unit root tests by Im, Pesaran and Shin (2003) and Levin, Lin and Chu (2002) have been undertaken.[35] The tests suggest that non-stationarity is not a problem. As the power of panel unit root tests is often criticized, a time trend that may capture the persistence in time series of transactions, GDP, market capitalization and bank credit, is entered (specifications (3) to (6)). The time trend is significant in the fixed effects

[35]Test statistics are not reported, but can be obtained from the author upon request.

regressions (specification (5) and (6)), however, this does hardly affect the other estimated coefficients.

Finally, single year regressions are run in order to reproduce Figure 1.[36] In this case, the estimated coefficients on the non-interacted variables are not restricted to be constant over time. The estimated size and significance of the dummy variables do not change, however.

[36]These results are not reported in the Appendix, but can be obtained from the author upon request.

Table 11: Regression results for sub-samples

	Foreign investment in German portfolio assets				*German investment in foreign portfolio assets*			
$gdp_{i,t}$	1.774***	0.764**	1.804***	0.714*				
	[0.072]	[0.382]	[0.073]	[0.386]				
$gdp_{j,t}$					3.392***	0.955	3.420***	0.669
					[0.152]	[0.763]	[0.150]	[0.775]
$pop_{i,t}$	-1.067***	-0.494	-1.086***	-0.404				
	[0.083]	[0.405]	[0.083]	[0.416]				
$pop_{j,t}$					-2.226***	1.774*	-2.238***	2.270**
					[0.156]	[0.967]	[0.156]	[0.994]
$distance_{ij}$	-0.512***		-0.572***		-0.181*		-0.237***	
	[0.051]		[0.047]		[0.092]		[0.077]	
$foreigner_{ij,t}$	0.043***	-0.101	0.043***	-0.119*	0.065***	0.063	0.064***	0.095
	[0.008]	[0.064]	[0.008]	[0.062]	[0.009]	[0.089]	[0.009]	[0.087]
$d1990_{ij,t}$	0.613***	0.581***			0.481**	-0.055		
	[0.110]	[0.164]			[0.218]	[0.245]		
$d1999_{ij,t}$			0.726***	0.564***			0.495*	0.755***
			[0.146]	[0.130]			[0.258]	[0.229]
Obs	737	737	737	737	703	703	703	703
R^2	0.83	0.61	0.82	0.61	0.72	0.48	0.72	0.49
No. of pairs		47		47		47		47

Notes: robust standard errors in brackets; dependent variable: gross portfolio flows, T_{ij}; *, **, *** denote significant at the 10%, 5% and 1% significance level; odd columns are estimated with pooled OLS using White-heteroscedasticity robust standard errors, even columns with fixed effects, R^2 refers to 'within' values in this case; a constant, year dummies, and dummies for financial centers are included but not reported.

Table 12: Additional robustness checks I

	excluding the US				*excluding financial centers*[a]			
$gdp_{i,t}$	2.209***	0.564	2.245***	0.418	2.167***	0.717	2.200***	0.694
	[0.076]	[0.377]	[0.076]	[0.375]	[0.069]	[0.483]	[0.069]	[0.484]
$gdp_{j,t}$	3.005***	1.191*	3.042***	1.017	2.965***	1.972**	2.998***	1.925**
	[0.139]	[0.717]	[0.137]	[0.723]	[0.131]	[0.972]	[0.130]	[0.966]
$pop_{i,t}$	-1.252***	-0.632	-1.269***	-0.376	-1.251***	-0.651	-1.268***	-0.49
	[0.079]	[0.428]	[0.079]	[0.431]	[0.079]	[0.514]	[0.080]	[0.515]
$pop_{j,t}$	-2.049***	1.872**	-2.066***	2.169**	-2.045***	1.256	-2.063***	1.451
	[0.141]	[0.949]	[0.141]	[0.959]	[0.141]	[1.150]	[0.142]	[1.145]
$distance_{ij}$	-0.337***		-0.391***		-0.325***		-0.389***	
	[0.054]		[0.048]		[0.055]		[0.048]	
$foreigner_{ij,t}$	0.054***	-0.025	0.053***	-0.018	0.054***	-0.01	0.054***	-0.005
	[0.006]	[0.057]	[0.006]	[0.058]	[0.006]	[0.058]	[0.006]	[0.060]
$d1990_{ij,t}$	0.515***	0.254*			0.652***	0.333**		
	[0.128]	[0.147]			[0.128]	[0.159]		
$d1999_{ij,t}$			0.541***	0.638***			0.861***	0.801***
			[0.170]	[0.132]			[0.179]	[0.137]
Obs	1408	1408	1408	1408	1280	1280	1280	1280
R^2	0.73	0.5	0.73	0.51	0.7	0.5	0.7	0.5
No. of pair		92		92		84		84

Notes: see Table 11

[a]Financial centers include Hong Kong, Ireland, Luxembourg, the UK, Singapore and Switzerland.

Table 13: Additional robustness checks II

	(1)	(2)	(3)	(4)
$gdp_{i,t}$	2.009***		2.137***	2.164***
	[0.068]		[0.067]	[0.068]
$gdp_{j,t}$	3.148***		2.931***	2.959***
	[0.145]		[0.129]	[0.128]
$pop_{i,t}$	-1.239***		-1.240***	-1.253***
	[0.077]		[0.078]	[0.079]
$pop_{j,t}$	-2.039***		-2.029***	-2.042***
	[0.149]		[0.140]	[0.140]
$gdpgrowth_{i,t}$	0.026			
	[0.020]			
$gdpgrowth_{j,t}$	-0.018			
	[0.032]			
$distance_{ij}$	-0.444***	-0.428***	-0.162**	-0.221***
	[0.047]	[0.046]	[0.079]	[0.072]
$foreigner_{ij,t}$	0.056***	0.056***	0.065***	0.065***
	[0.007]	[0.007]	[0.007]	[0.007]
$d1990_{ij,t}$			0.547***	
			[0.128]	
$d1999_{ij,t}$	0.610***			0.562***
	[0.152]			[0.171]
$gdp_{i,t-1}$		2.205***		
		[0.071]		
$gdp_{j,t-1}$		2.980***		
		[0.130]		
$pop_{i,t-1}$		-1.280***		
		[0.082]		
$pop_{j,t-1}$		-2.058***		
		[0.143]		
$language_{ij}$			-0.159	-0.023
			[0.147]	[0.121]
$adjacency_{ij}$			0.913***	0.909***
			[0.172]	[0.171]
Obs.	1421	1356	1440	1440
R^2	0.75	0.74	0.74	0.74

Notes: see Table 11

Table 14: Additional robustness checks III

	(1)	(2)	(3)	(4)	(5)	(6)
$gdp_{i,t}$	2.163***	2.194***	2.161***	2.192***	0.581	0.437
	[0.081]	[0.080]	[0.069]	[0.069]	[0.375]	[0.374]
$gdp_{j,t}$	2.965***	2.997***	2.953***	2.985***	1.201*	1.028
	[0.084]	[0.083]	[0.131]	[0.130]	[0.716]	[0.722]
$gdp_{i,t}$	-1.245***	-1.262***	-1.244***	-1.261***	-0.633	-0.377
	[0.100]	[0.100]	[0.078]	[0.079]	[0.424]	[0.429]
$gdp_{j,t}$	-2.039***	-2.057***	-2.031***	-2.049***	1.859**	2.157**
	[0.102]	[0.102]	[0.141]	[0.142]	[0.941]	[0.952]
$distance_{ij}$	-0.344***	-0.407***	-0.343***	-0.407***		
	[0.053]	[0.048]	[0.054]	[0.047]		
$foreigner_{ij,t}$	0.054***	0.054***	0.054***	0.054***	-0.024	-0.019
	[0.011]	[0.011]	[0.006]	[0.006]	[0.057]	[0.058]
$d1990_{ij,t}$	0.568***		0.572***		0.275*	
	[0.161]		[0.123]		[0.145]	
$d1999_{ij,t}$		0.581**		0.584***		0.646***
		[0.247]		[0.167]		[0.130]
$year_{ij,t}$			-0.022	-0.024	0.134***	0.144***
			[0.018]	[0.018]	[0.038]	[0.039]
Obs.	1440	1440	1440	1440	1440	1440
R^2	0.25	0.25	0.74	0.74	0.51	0.51
No. of pairs					94	94

Notes: robust standard errors in brackets; dependent variable: gross portfolio flows, T_{ij}; *, **, *** denote 10%, 5% and 1% significance levels; column (5) and (6) refer to Tobit estimations, columns (3) and (4) refer to pooled OLS, and (5) and (6) to country-pair fixed effects estimations; a constant, year dummies, and dummies for financial centers are included but not reported.

Table 15: Regression and F-tests of Figure 1

variable	coefficient	std. err.	variable	coefficient	std. err.	F-test	p-value
$gdp_{ij,t}$	2.058***	0.070					
$gdp_{ij,t}$	2.853***	0.128					
$pop_{ij,t}$	-1.147***	0.080					
$pop_{ij,t}$	-1.934***	0.139					
$distance_{ij}$	-0.199***	0.064					
$foreigner_{ij,t}$	0.059***	0.007					
$dEMU_{ij} * 1987$	0.703*	0.421	$dEUnonEMU_{ij} * 1987$	1.276 ***	0.435	2.77	0.096
$dEMU_{ij} * 1988$	0.819*	0.481	$dEUnonEMU_{ij} * 1988$	1.496***	0.499	2.87	0.091
$dEMU_{ij} * 1989$	1.129**	0.452	$dEUnonEMU_{ij} * 1989$	1.868***	0.405	7.29	0.007
$dEMU_{ij} * 1990$	0.652*	0.375	$dEUnonEMU_{ij} * 1990$	1.432***	0.363	7.9	0.005
$dEMU_{ij} * 1991$	0.988***	0.370	$dEUnonEMU_{ij} * 1991$	1.464***	0.355	3.77	0.053
$dEMU_{ij} * 1992$	0.790**	0.325	$dEUnonEMU_{ij} * 1992$	1.366***	0.281	5.39	0.020
$dEMU_{ij} * 1993$	1.179***	0.327	$dEUnonEMU_{ij} * 1993$	1.626***	0.354	2.29	0.131
$dEMU_{ij} * 1994$	0.917***	0.325	$dEUnonEMU_{ij} * 1994$	1.337***	0.347	2.9	0.089
$dEMU_{ij} * 1995$	0.758***	0.281	$dEUnonEMU_{ij} * 1995$	1.097***	0.304	1.6	0.206
$dEMU_{ij} * 1996$	0.658**	0.254	$dEUnonEMU_{ij} * 1996$	0.891***	0.323	0.71	0.399
$dEMU_{ij} * 1997$	0.580**	0.264	$dEUnonEMU_{ij} * 1997$	0.753***	0.268	0.83	0.362
$dEMU_{ij} * 1998$	0.916***	0.277	$dEUnonEMU_{ij} * 1998$	0.936***	0.360	0.000	0.949
$dEMU_{ij} * 1999$	1.144***	0.266	$dEUnonEMU_{ij} * 1999$	0.956***	0.336	0.41	0.524
$dEMU_{ij} * 2000$	1.667***	0.363	$dEUnonEMU_{ij} * 2000$	1.339***	0.392	1.22	0.270
$dEMU_{ij} * 2001$	1.535***	0.369	$dEUnonEMU_{ij} * 2001$	1.084***	0.343	2.54	0.111
$dEMU_{ij} * 2002$	1.378***	0.326	$dEUnonEMU_{ij} * 2002$	0.777***	0.288	3.97	0.047
Obs.	1440						
R2	0.75						

Notes: Pooled OLS regressions with White-heteroscedasticity robust standard errors; dependent variable: gross portfolio flows, T_{ij}; *, **, *** denote 10%, 5% and 1% significance levels; F-test and corresponding p-values refer to F-tests of equality of both dummy variables in the respective year, i.e., $H_0 : dEMU_{ij} * 1997 = dEUnonEMU_{ij} * 1997$; a constant, year dummies, and dummies for financial centers are included but not reported.

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