Exchange Rate Volatility and the two Margins of Trade: Evidence from Monthly Trade Data

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I - Introduction

The end of the Bretton Woods system in the early 1970's and the adoption of a floating exchange rate regime in 1973 raised the question of how the resulting increase in exchange rate volatility causes exchange rate risk and affects international trade and welfare. The EMU and the introduction of the Euro, associated with the abolition of several European currencies, lead to a huge debate among economists about the effects on trade.

Very recently, the global financial crisis as well as the catalyst of the debt crises and the massive central bank interventions, especially in Europe and the U.S. have increased exchange rate volatility again and brought the topic back on the agenda.

In the light of the recent events, especially the case of Europe and the Euro is worth a second glance. The question whether joining a currency union and thereby eliminating exchange rate volatility with various other countries is boosting trade significantly is a very relevant question for many Central and Eastern European countries. Countries like Poland postponing their accession to the Euro are a strong indicator for that.

As theoretical predictions concerning the impact of uncertainty induced by exchange rate volatility on trade have ambiguous results, empirical investigations are expedient to validate or to reject the various existing theories.

The aim of this paper is to provide further evidence on the relationship between exchange rate volatility, common currencies and trade by presenting several novelties with respect to previous research. Higher frequency trade data is used to take into account the short term effects of volatility. Disaggregated trade data is used to deal with differences among industries, especially between agricultural and manufactures and intermediates and final products. In contrast to many other studies, several econometric problems including the existence of zero trade values are taken into account. Investigating the impact of exchange rate volatility and the Euro at the same time allows to disentangle the effect of a common currency beyond the elimination of any variation in the exchange rate with other members.

Furthermore, due to a large dataset including very recent data, the developments of the past years with the financial crisis and the EU enlargement to the east is covered, yielding additional findings and policy implications.

Our results show a positive effect on trade for a EU membership and negative impact of exchange rate volatility, but ambiguous results for a Euro membership and. We also found different effects for the intensive and extensive margin of trade.

II - Literature

This chapter briefly introduces theoretical predictions and findings and the applied econometric approaches to investigate the relationship between exchange rate volatility and trade. This issue has been examined very intensively, thus a broad range of theoretical and empirical literature exists and several survey papers provide a good overview (Côté 1994; McKenzie 1999; Ozturk 2006; Bahmani-Oskooee & Hegerty 2007; Auboin & Ruta 2011).

Furthermore, the literature on the very related but distinct Euro-effect with the paper of Rose (2000) being the initial is brought into a common context.

II.I - Theory

As mentioned before, theoretical studies have shown mixed effects. Most describe negative effects for an increase of exchange rate volatility on trade due to rising levels of uncertainty. Clark (1973) describes the case of a single firm with no market power producing under perfectly competitive conditions a single good without imported components that is entirely exported to one foreign market. The firm gets paid in the foreign currency and has to convert the proceeds at the current exchange rate. As movements of the exchange rate are unpredictable and access to currency hedging is assumed to be limited, the proceeds vary. High costs for adjustments to the scale of production keep the firm from altering output in advance of the realization of the exchange rate. Thus, uncertainty about future exchange rates directly translates into uncertainty about future receipts in domestic currency.

Under the assumption that the firm is risk averse and maximizes profits, the firm has to determine a level of output that incorporates this uncertainty. In this situation, the variability of profits depends completely on changes in the exchange rate. Thus, an increase in volatility of the

exchange rate – while the average level remains unchanged – leads to a decrease in production, and hence in exports, due to the increased exchange rate risk. This very simple theoretic model was later refined by Hooper & Kohlhagen (1978), yielding the same clear negative result for exchange rate volatility and trade.

However, these theoretical findings are based on rather strong assumptions, notably no hedging opportunities either through the forward exchange market or through offsetting transactions, no imported inputs, risk aversion of the exporter, no ability to pile up stocks, no adjustments to the scale of production and perfect competition are assumed.

Importing intermediates from the export destination partly offsets negative effects in case the foreign currency depreciates, as prices for the inputs decline as well. Multinational firms are engaged in trade and financial transactions of different nature across various countries with independently floating exchange rates. This allows them to exploit movements in the exchange rates by holding a portfolio of assets and liabilities in different currencies (Makin 1978).

Furthermore, exchange rates have the tendency to adjust quickly to changes in inflation rates. Lower revenues due to a depreciating foreign currency are then at least partly offset by the higher nominal export price (Cushman 1983; Cushman 1986).

When the assumption that firms cannot alter the scale of production and adjust at least some of the factors of production is relaxed, firms can even profit in terms of higher average revenues from higher volatility by increasing production when the currency depreciates (Canzoneri & Clark 1984). The effect depends on the ability of the firm to adjust inputs and switch export markets and the degree of risk aversion. The risk for the exporter consists of to components: There is the currency risk that firms can diversify by mixing local and foreign currency invoicing and there is a price risk as the quantity demanded is uncertain because the price facing the buyer is itself uncertain. The higher variability of expected profits in times of stronger volatility will lead to lower production when risk aversion is high. If risk aversion is relatively low, the positive effect of greater price variability on expected profits outweighs the negative impact of the higher variability of profits, and the firm will raise the average capital stock and the level of output and exports.

Unambiguous positive effects were confirmed by Broll & Eckwert (1999), at least for firms that are flexible and can reallocate their products among markets in the short term according to changes in

the exchange rates. At the same time, the firms need strong domestic demand for their products they can rely on. The authors see the home market as the save harbour and exporting as an option for additional revenues with the domestic price for their products being the “strike” price. Still, as higher volatility leads to higher risks, the effect in the end depends on the degree of risk aversion. Nevertheless, volatility is increasing the value of a firm's options to export by increasing the potential gains from trade.

Paradoxically, very risk averse firms could export more when exchange rate volatility rises to compensate expected falls in revenues. This is described for the case, that the income effect of reduced utility derived from higher uncertainty of revenues overcompensates the substitution effect of higher exchange rate risk (De Grauwe 1988). Furthermore, positive effects depend on the aggregate exposure to risk (Viaene & de Vries 1992) and the type of shocks firms are exposed to (Barkoulas et al. 2002).

Financial hedging via exchange markets can reduce uncertainty generated by fluctuations the nominal exchange rates. Unfortunately, it is not available for all firms to due to different stages of development of the financial markets (Baron 1976). Furthermore, contracts are typically cover rather large amounts, maturities are short and costly. Coverage is usually very restricted, only a limited share of possible fluctuations is covered and only during the proposed maturities. These characteristics make hedging more available for bigger exporting firms as they are less likely to face liquidity constraints (Baldwin & Krugman 1989). Obstfeld & Rogoff (1998) find that risk-adverse firm use hedging instruments and that utilizing those instruments leads to higher export prices. This results in lower (world) output and consumption.

Another aspect is the role of “sunk costs” in international trade relations that came up with the hysteresis literature and better fits modern trade patterns (Krugman 1986; Franke 1991; Dixit 1989). The concept is that a large share of international trade consists of differentiated manufactured goods that typically require significant investment by firms to set up marketing and distribution networks, to adapt their products to foreign markets, and to set up production facilities specifically designed for export markets. Hence, fixed costs are large and if spent once, firms will stay in the foreign market when revenues fall, as long as they can recover the variable costs. Firms are less reactive and tend to a “wait-and-see” attitude and wait for the exchange rate to turn around to recoup the entry costs or “sunk costs”. For the firms however, larger fluctuations

are an incentive to stay out of foreign markets they are not active in yet and to stay in markets they have already invested in. Thus, for firms more volatile exchange rates can be seen as an encouragement towards inertia.

To take into account complex interactions of the variables in the models, the relationship between exchange rate volatility on trade was examined in a general equilibrium framework. This allows, in contrast to the partial equilibrium framework, all variables that may have an impact on the level of trade to change. Bacchetta & van Wincoop (2000) employed a two-country, general equilibrium model where uncertainty arises from monetary, fiscal, and technology shocks, and compared the level of trade and welfare for fixed and floating exchange rate arrangements. In their model trade is determined by the certainty equivalent of a firm's revenue and costs in the domestic market relative to the foreign market, whereas the welfare of the country is determined by the volatility of consumption and leisure. Their main conclusion is, that no clear relationship between the level of trade and the type of exchange rate arrangement exist, as the result depends on consumer preferences with regard to consumption and leisure and the rules for monetary policy followed. Therefore, if a monetary stimulus in a country leads to the depreciation of the currency, the effect on trade might be little. Certainly, the depreciation reduces imports, but due to monetary stimulus domestic demand may boost imports and offset the effect. The net effect depends on various factors like demand elasticities for imports, price stickiness and the ability of the supply side to match demand.

As Bacchetta & van Wincoop (2000) point out, the level of trade does not provide a good index of the level of welfare in a country, and thus there is no one-to-one relationship between levels of trade and welfare in comparing exchange rate systems. Obstfeld & Rogoff (1998) find that the elimination of exchange rate volatility could result in a welfare gain of up to one percent of GDP by extending the new open economy macroeconomic model to an explicitly stochastic environment where price-setting decisions of firms are affected by risk. The model was extended by Bergin & Tchakarov (2003) to allow for incomplete asset markets and investment by firms. They find that the welfare costs are generally quite small, on the order of one tenth of one percent of consumption but can under certain certain conditions reach the order of the results of Obstfeld & Rogoff (1998). Therefore, consumers need to exhibit considerable persistence in their pattern of consumption, such that welfare is adversely affected by sudden changes in consumption, and

asset markets are asymmetric in the way that there is only one international bond, thus that the country without its own bond is adversely affected. Barkoulas et al. (2002) state that in open economies fluctuations of trade flows can significantly impact the variability of the overall level of economic activity resulting in financial sector illiquidity, reductions in real output or heightened inflationary pressures.

More recently, (Broll et al. 2006) study the optimum production decision of an international firm employing the mean-standard deviation model. They find that an increase in the exchange rate risk has an unambiguous impact on trade. The result depends on the elasticity of risk aversion with respect to the standard deviation of the firm's random profit.

Taking into account the heterogeneity of firms in the light of the "new-new" trade models, Berman et al. (2009) analyse differences in the reaction of firms to changes in the exchange rate. In their model, firms differ in terms of performance which is measured by a mix of productivity and quality benchmarks. It is assumed that only the best performing firms in terms of low fixed costs export, but exchange rate depreciation is an incentive to enter export markets. Their findings suggest that while high productivity firms optimally raise their markup rather than the volume of exports, low productivity firms choose the opposite strategy and thus, pricing to market is both endogenous and heterogenous. Due to the fixed costs to export only high productivity firms can export, hence those firms which precisely react to an exchange rate depreciation by increasing their export price rather than their sales. This leads to a very limited impact of exchange rate movements on aggregate trade volumes because of the "natural" selection process. They test the main predictions of the model on a French firm level data set with destination-specific export values and volumes on the period from 1995 to 2005 and the results confirm the theoretical predictions.

II.II - Empirical Findings

The empirical findings reflect the above mentioned ambiguous theoretical results.

Investigating the results of the empirical literature for the years 1978 to 2003, Ćorić & Pugh (2010) find that the empirical literature on exchange rate variability and trade reveals a modestly negative relationship with pronounced heterogeneity.

Recent studies are more likely to yield significant results. Klein & Shambaugh (2006) find significant positive effects examining exchange rate volatility within the gravity framework and controlling for exchange rate regimes with a sample of 181 countries and the period of 1973-1999.

For the period of 1980-2005 Ozturk & Kalyoncu (2009) find significant negative effects for Republic of Korea, Pakistan, Poland and South Africa, but a positive effect for Turkey and Hungary in the long using an Engle-Granger residual-based cointegrating technique. Rahman & Serletis (2009) find that exchange rate uncertainty has a generally negative and significant effect on U.S. exports, but that exports responded asymmetrically to positive and negative exchange rate shocks.

In a gravity model using quarterly instead of yearly data, Chit et al. (2010) examined the impact of exchange rate volatility on exports among five East Asian countries and their exports to thirteen industrialized countries. They find statistically negative effects for absolute volatility for their sample of countries. Additionally, they provide evidence that the relative volatility is important as well by testing for the impact of the volatility between third countries.

Eicher & Henn (2011) investigate the impact of currency unions and employ the gravity equation for a huge panel of countries. They include exchange rate volatility as a control variable which has no robust effects, while they find a significant positive effect for currency unions.

For the very specific case of Norway with several changes in monetary policy regime, Boug & Fagereng (2010) find no effect for exchange rate volatility on export performance using cointegrated Vector Autoregression framework.

Baum & Caglayan (2010) examine the case of numerous industrial countries for the period 1980-1998, but cannot determine a significant effect for exchange rate uncertainty on bilateral trade flows. However, the impact of exchange rate volatility on the volatility of bilateral trade flows is significant and positive. Using quarterly data from 1977-2003, Hondroyiannis et al. (2008) investigate the relationship between exchange rate volatility and aggregate export volumes for 12 developed economies in a model that includes real export earnings of oil-producing economies as a determinant of industrial-country export volumes. The find no evidence for a significant impact at any time of their sample.

In order to deal with the aggregation bias, that results from estimating the gravity equation with aggregate data when the trade costs and elasticities vary at a sectoral level, Anderson & van

Wincoop 2004, suggest that employing the gravity equation at a sectoral level can improve the reliability of the results. Furthermore, since the currency and timeframe of contracting, the openness to international trade, the degree of homogeneity or the storability of goods vary over sectors, it is important to take industry related differences into account and to control for them. Empirical studies find robust evidence for a downward bias (e.g. Anderson & Yotov 2010), thus there is evidence that usage of data that is disaggregated at an appropriate level is preferable.

Investigating the impact of the exchange rate on trade relations between China and the U.S. from 1978-2002 for 88 sectors, Bahmani-Oskooee & Y. Wang (2007) show that sectors react very differently to changes in the real exchange rate and that thus employing disaggregated trade data yields better results trade patterns. To examine the impact of the volatility of the exchange rate, trade relations between the U.S. and Japan for 117 industries for the period from 1973 to 2006 was studied by Bahmani-Oskooee & Hegerty (2008) in a similar fashion. What they find is that some industries are influenced by exchange rate volatility in the short-run, although this effect is often ambiguous. In the long-run, trade shares of most industries are relatively unaffected by exchange rate uncertainty, while some industries experience a relative shift in their proportion of overall trade. A study on sectoral bilateral trade with Malaysia by Bahmani-Oskooee & Hanafiah (2011) yields similar results. Confirming the importance of sectoral differences, K.-L. Wang & Barrett (2007) find that exchange rate volatility only has a significant impact on agricultural exports from Taiwan to the U.S., leaving all other sectors unaffected. Cho et al. (2002) also find negative long term effects for agricultural products with a panel of ten OECD countries and the period from 1974 to 1995.

Byrne et al. (2008) find a negative impact on US im- and exports from and to several European countries. The effect is strongest and only robust for differentiated goods what they attribute to bigger importance of knowledge for the these type of goods. As gaining the necessary knowledge about a certain market is expensive, switching markets is more difficult when the needed amount of knowledge per market is higher.

For trade flows of China, the Euro area and the United States in two sectors, namely agriculture and manufacturing and mining, Huchet-Bourdon & Korinek (2011) find that that exchange volatility impacts trade flows only slightly with little differences between the two sectors. However, they state that these results may change when small or developing countries are

examined. Changes in the level of the exchange rate affect both sectors significantly, but do not completely explain the trade imbalances in the three countries examined.

Another important aspect is how the relationship between exchange rate volatility and trade is affected by the stage of development of the countries investigated. Caglayan & Di (2010) investigate monthly sectoral bilateral US trade flows with the thirteen biggest trading partners. They find evidence that developing countries are more likely to be affected than developed countries but they find no evidence for differences between sectors. As Grier & Smallwood (2007) point out, results for developing countries could be more likely to be significant as a well developed financial market is necessary to provide firms with adequate hedging instruments at a reasonable price. In a study investigating the impact on nine developed and nine developing countries they find that real exchange rate volatility is more likely to have a significant negative impact on international trade for developing countries, than on advanced economies. Contrary to that, Wei (1999) finds no empirical evidence for the hypothesis that the availability of hedging instruments reduces the impact of exchange rate volatility on trade.

In a very broad study covering 39 countries, several volatility measures and different econometric specifications, Clark et al. (2004) investigate the impact of exchange rate volatility on trade flows. Their findings are mixed and depend heavily on the empirical specification. In most cases the authors find a negative relationship for short-run and long-run volatility, but when allowing for time-varying country fixed effects, results turn insignificant. While they find the choice of the volatility measure not to have a significant impact on the result, the sample choice of countries has it. Exchange rate volatility appears to have bigger impact on developing than advanced economies. They conclude that in case "exchange rate volatility has a negative effect on trade, this effect would appear to be fairly small and is by no means a robust".

To provide an overview of the empirical literature, Corić & Pugh (2010) conduct a meta-regression analysis (MRA) for 58 studies. They find the relationship between exchange rate volatility and trade to have modestly negative relationship with pronounced heterogeneity and little evidence of publication bias together with mainly positive evidence that this relationship is an authentic empirical effect. Their results show that uncertainty arising from exchange rate volatility should be a serious concern for least developed countries. This suggests that the availability of hedging instruments is important.

Another potential bias emerges from a volatility measure constructed with low frequency exchange rate data. This "temporal aggregation" of quarterly or monthly exchange rates tends to reduce the variability of the exchange rates (K.-L. Wang et al. 2002) and thus hinder identifying the true relationship between exchange rate uncertainty and trade. Since trade contracts in many industries include an agreement on delivery within 90 days, even quarterly data may bias results and make it impossible to identify short-term fluctuations in bilateral trade volumes as a consequence of changes in the volatility of the bilateral exchange rate (Auboin & Ruta 2011).

In general, studies employing the gravity equation in international trade models are more likely to find a negative relationship between exchange rate volatility and trade (Ćorić & Pugh 2010). However, Clark et al. (2004) argue that most of these findings are not robust to a more general specification of the gravity equation that embodies the recent theoretical advances. As awareness about potential biases within the gravity framework rises, more recent results tend to be ambiguous (Eicher & Henn 2011). Disaggregated trade data is more likely to yield robust results, but not for all countries and all sectors. Sample choice may also affect results as countries tend to react differently to exchange rate shocks (Baum et al. 2004) and the effect might have changed over time.

II.III - The Euro Effect

In January 1999, eleven European countries entered into currency union, that can be seen as one of the most ambitious political and economic projects in the past decades. While common currency arrangements in general are rather prevalent, the Euro is unique in terms of the number of countries, their economic power and the fact that no single country has an unambiguous leading role.

The question is how does the introduction of the Euro affect trade relations of the member states and whether or not there is an effect beyond the afore discussed elimination of the nominal exchange rate volatility.

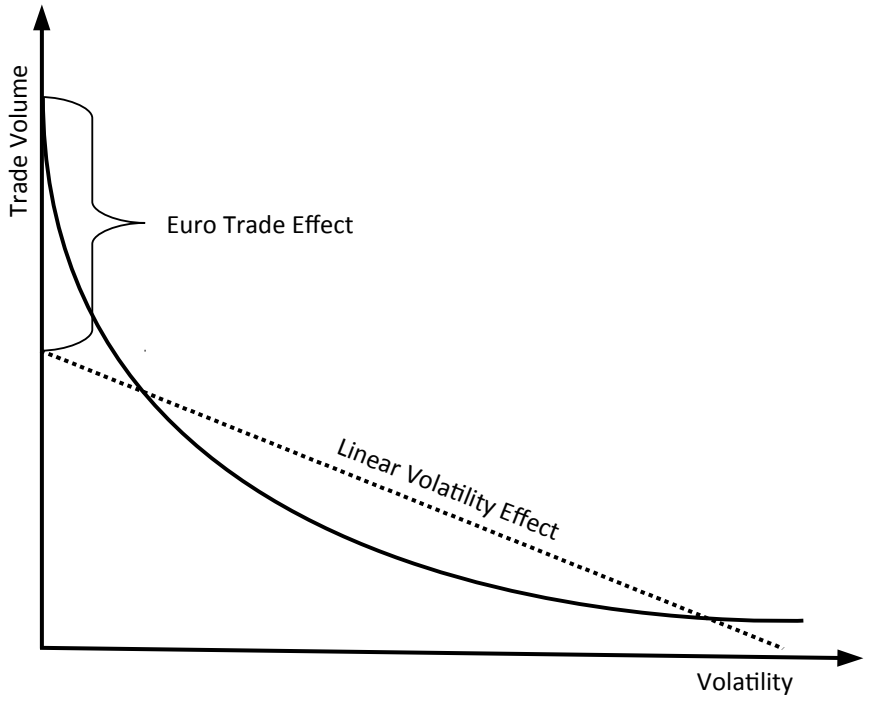
Baldwin et al. (2005) contribute a model that puts explanations about how the euro could have promoted trade beyond the effect of eliminated exchange rate volatility on a theoretical basis. It predicts a convex relationship between trade volumes and exchange rate uncertainty meaning that a marginal increase in trade as volatility falls gets progressively larger as volatility approaches

zero. They explain the non-convexity of the trade-volatility link with the fact that small firms are affected more than large firms. Reductions in exchange rate volatility lead to increasing sales per exporting firm and a higher number of exporting firms, thus intensive and extensive margin of trade are affected. The second stems from the fact that the distribution of firms is skewed heavily towards small firms, especially in Europe. In their model, the effect of volatility on trade depends on the marginal costs faced by exporting firms and they therefore suggest the use of disaggregated trade data to reflect differences in the cost structure among industries.

The basic idea of a convex relationship between exchange rate volatility is portrayed in Figure 1. At high levels of volatility in the nominal exchange rate, trade is affected only slightly and changes in total trade are mainly driven by the intensive margin, big firms expanding their exports as volatility goes down. As volatility approaches zero, a large number of small firms starts exporting what boosts trade via the extensive margin (Mongelli & Vega 2006).

Furthermore, currency unions are expected to reduce trade costs between its members by eliminating the need to engage resources in handling currency exchange and facilitating price comparisons.

Figure 1: Convex Relationship between Volatility and Trade



The literature studying the effect of Euro on trade empirically can be divided in studies investigating currency union effects in general and studies employing Eurozone data. While the latter suffer from the rather small time frame of the Euro existence, the biggest drawback of the pre-Euro studies is that the number of currency unions in the history is rather small and that the unions usually consist of only two countries.

The initial spark for the empirical pre-Euro literature was the paper by Rose (2000) who estimated a gravity equation with bilateral trade data for 186 countries and includes controls for exchange rate volatility. He finds that countries that join into a currency union together trade about 3 times more with each other than we would expect otherwise. This was the starting point for an intensive discussion about the employed estimation methodology and the interpretation of the ensuing results.

In a theoretical derivation of the gravity model, Baldwin (2006) points out that the previous literature including the paper of Rose (2000) neglects to control simultaneously for general equilibrium effects[1] and unobserved bilateral heterogeneity among the trade partners. Beyond technical problems, there are many other reasons why early studies can hardly deliver a good estimate of theEuro effect on trade. Among others, the aforementioned small number currency unions and the fact that most unions consist of large economy and one or more very small economies. Furthermore, many currency unions in the world before the Euro can be described has hub-and-spoke currency arrangements and consist of a former colonial power (e.g. USA, France, Britain, Australia, New Zealand and Denmark) and several of its former colonies. The decision to start or end a currency union or Dollarization usually must be seen in the context of political and economic changes that drive the decision. These can be for example revolutions, external pressure in the time of the cold war or struggles after independence and are very likely to have a severe impact on trade relations with the (former) partner country and thus to bias estimation results. As a currency union between an african country with its former colonizer is in its nature different to a currency union among similar western countries, results can hardly be transferred and it shows how exceptional the case of the Eurozone is.

When testing their aforementioned theoretical model empirically with a gravity equation and controls for exchange rate volatility and a Eurozone-membership both included, Baldwin et al.

1 often referred to as multilateral resistance

(2005) find the effect of exchange rate volatility on trade to be negative and the effect of the common currency to be positive and large (still much smaller than the effect found by Rose (2000) and both to be significant.

In a broad meta-regression analysis, Havránek (2010) finds that when correcting for publication bias results for a Euro effect are insignificant, while other currency unions yield significant positive effects of more than 60%.

In order to evaluate the importance of the problems in the econometric specification of the early study by Rose (2000) that were raised by Baldwin (2006), Eicher & Henn (2011) implement Baldwin's econometric specification to provide an updated benchmark. They find that the proper use of controls reduces omitted variable bias and lowers the magnitudes but not the significance of average currency union trade effects, effects vary to a great extent between different unions and the effect to be smaller than the effect of preferential trade agreements.

One of the first studies to estimate the Euro effect with a proper data for the eurozone was conducted by Flam & Nordström (2007). They use highly disaggregated trade data for the period 1995-2005 and 20 countries within the gravity framework. According to their results the level of trade within the eurozone in 2002-2005 was 26% higher than the average level in 1995-1998 and trade between the eurozone and the ten outsiders has increased by about 12% in both directions. They find the increase in the extensive margin to be greater than in the intensive margin of trade, thus the trade increase is driven rather by higher number of goods traded and goods been traded between more countries than by an increase in the volume of trade that already existed before the introduction of the Euro. This of course, can be seen as evidence for convex trade effects as portrayed in Figure 1.

In one of the more recent attempts to explain high effects on trade found in other studies, Berger & Nitsch (2008) use a dataset for 22 industrial countries for the years 1948 to 2003. They argue that once they control for the positive trend in trade integration, the Euro has no significant impact on trade. Furthermore, that measurable policy changes in areas such as exchange rate policy and institutional integration have influenced the positive trend significantly and were probably driving the effects in early studies. To similar results with respect to trade effects come Santos Silva & Tenreyro (2010) using a differences-in-differences specification to compare the

exports of the first twelve Euro-countries to those of similar groups of trading partners. They do not find statistically significant effects on trade between Eurozone members following the introduction of the Euro.

II.IV - Summary

While studies investigating the relationship between exchange rate volatility and trade show a very pronounced heterogeneity in the results, one can say that the empirical literature on Euro effects has seen quite some evolution in a little more than ten years. Starting with very high results in early pre-Euro studies and lower and lower results as methods evolved. Studies employing Euro data have found small or even insignificant effects, but usually covered only the early members.

Studies employing early Eurozone data can assumed to be biased due to the boom in imports in the periphery countries from other Eurozone members that, as we know today, was a consumption and housing bubble that led to what is usually referred to as the European "debt crises". Trade effects for the early years, especially for final goods, can therefore be expected to be overestimated. New Eurozone members with a different cultural and economic background may face different effects on trade.

One has also to differentiate between studies that introduce exchange rate volatility and a dummy for currency unions both into the same equation. When assuming a convex relationship between trade and exchange rate volatility (Figure 1), studies are more likely to yield significant results for exchange rate volatility when common currencies are controlled for to account for the convexity. At the same time, the introduction of separate variables allows to disentangle the effect of common currencies that goes beyond the elimination of exchange rates.

III - Empirics

The empirical analysis of our study is based on the standard gravity approach, where trade between two countries is modelled as function of their "economic mass" and the distance between them.

We estimate the effect of our exchange rate volatility measure and the dummies for mutual EU and Euro membership on exports by following the literature that employs an extended version of the standard gravity equation in international trade with time varying country-fixed effects. In

order to control for cultural and institutional similarity and geographical position, we introduce the corresponding dummy variables. Furthermore, we introduce a measure of exchange rate movements to control for changes in the exchange rate and its implications on competitiveness (Table 3). The exchange rate and exchange rate volatility measure is always constructed for the past six month. In addition, to see whether previous movements in the variables affect results, three lags for both variables are included.

Table 1: Variables

Variable	Description
Y_{ijt}	Nominal GDP crossproduct
$Dist_{ij}$	Distance between capitals of reporter and partner
EU_{ijt}	Dummy whether (1) or not (0) reporter and partner are member of the EU
$EURO_{ijt}$	Dummy whether (1) or not (0) reporter and partner have the Euro as a common currency
$Border_{ij}$	Dummy whether (1) or not (0) reporter and partner share a common border
$Language_{ij}$	Dummy whether (1) or not (0) reporter and partner share a common official language
$Landlocked_{i}$	Dummy whether (1) or not (0) the reporter is landlocked
$Island_{i}$	Dummy whether (1) or not (0) the reporter is located on an island
$Colony_{ij}$	Dummy whether (1) or not (0) the reporter is landlocked
$Volatility_{ijt}$	Bilateral volatility measure for reporter and partner
$Exch.\ Rate_{ijt}$	Bilateral nominal exchange rate
$Corruption_{ijt}$	Corruption measure crossproduct
$\hat{Z}$	Linear prediction of exports down-weighted by its standard error
IMR	Inverse Mills Ratio

To control for unobserved heterogeneity we introduce several control variables including country fixed effects (Table 3). Allowing for a yearly time variation in country fixed effects is more consistent with the theoretical concept of "multilateral resistance" proposed by Anderson & van Wincoop (2003), as such multilateral resistance indices are likely to vary over time. As our data is at monthly level and has strong seasonal effects (Figure 2), we need to control seasonality with dummies for each month of the year. Furthermore, we included dummies for each BEC category of goods to control for product specific differences.

Estimations are conducted for three groups[2]: capital goods, intermediates and consumption goods. The idea is that these three groups differ significantly in terms of contracting patterns and that our variables of interest might affect differently or to a different extent trade flows.

Table 2: Control Variables

Effect	Control Dummies
Seasonality	Dummy for each month of the year
Product heterogeneity	Dummy for each BEC product category
Time and country specific effects	Dummy for each reporter/partner and year combination

III.I - Equation

First we are conducting year-varying country fixed-effects and random-effects regressions on the log of the volume of bilateral exports. Therefor we are estimating the following equation:

$$\begin{aligned}\ln X_{ijkt} = {} & \beta_0 + \beta_1 \ln(Y_{it} * Y_{jt}) + \beta_2 \ln(Distance_{ij}) + \beta_3 EU_{ijt} + \beta_4 Euro_{ijt} + \\ & \beta_5 Border_{ij} + \beta_6 Language_{ij} + \beta_7 Landlocked_i + \beta_8 Island_i + \beta_9 Colony_{ij} + \\ & \beta_{10} Volatility_{ijt} + \beta_{11} \ln(ExRate_{ijt}) + \beta_{12} Corruption_{ijt} + \alpha_{it} + \nu_{jt} + \varepsilon_{ijkt}\end{aligned} \quad , \quad (1)$$

where the explained variable X_{ijt} denotes nominal exports from the reporter to the partner country. The simultaneous inclusion of the measure of nominal exchange rate volatility and the dummy variable for mutual Euro membership allows us to capture convex effects (in case there are any), although the volatility measure alone only captures linear effects.

A widely accepted treatment for the problems arising from zero trade flows os delivered by Helpman et al. (2008) and also employed in this study: a two stage estimation including a Probit on the likelihood that two countries trade (extensive margin), followed by a FGLS and a fixed-effects estimation of the gravity equation to quantify the volume (intensive margin). The Inverse Mills Ratio to control for sample selection bias and the linear prediction of exports down-weighted by its standard error as proxy for firm heterogeneity are then included in the second stage regression.

The first step estimation then is:

2 The groups were build following the classification of the United Nations Department of Economic and Social Affairs from 2007.

$$P_{ijkt} = \beta_0 + \beta_1 \ln(Y_{it} * Y_{jt}) + \beta_2 \ln(Distance_{ij}) + \beta_3 EU_{ijt} + \beta_4 Euro_{ijt} + \beta_5 Border_{ij} + \beta_6 Language_{ij} + \beta_7 Landlocked_i + \beta_8 Island_i + \beta_9 Colony_{ij} + \beta_{10} Volatility_{ijt} + \beta_{11} \ln(ExRate_{ijt}) + \beta_{12} Corruption_{ijt} + \alpha_{it} + \nu_{jt} + \varepsilon_{ijkt} \quad , \quad (2)$$

followed by the second step:

$$\ln X_{ijkt} = \beta_0 + \beta_1 \ln(Y_{it} * Y_{jt}) + \beta_2 \ln(Distance_{ij}) + \beta_3 EU_{ijt} + \beta_4 Euro_{ijt} + \beta_5 Border_{ij} + \beta_6 Language_{ij} + \beta_7 Landlocked_i + \beta_8 Island_i + \beta_9 Colony_{ij} + \beta_{10} Volatility_{ijt} + \beta_{11} \ln(ExRate_{ijt}) + \beta_{12} ZHAT + \beta_{13} IMR + \alpha_{it} + \nu_{jt} + \varepsilon_{ijkt} \quad . \quad (3)$$

III.II - Data

We have build a dataset with monthly bilateral trade for 35 countries for the 15 years from January 1996 till December 2010. The countries included are EU countries and their mayor trading partners (Table 3).[3]

Table 3: Coverage

Countries				
Austria	Estonia	Ireland	Netherlands	Slovenia
Belgium	Finland	Italy	*Norway*	Spain
Bulgaria	France	*Japan*	Poland	Sweden
Cyprus	Germany	Latvia	Portugal	*Switzerland*
China	Greece	Lithuania	Romania	*Turkey*
Czech Republic	Hungary	Luxembourg	*Russia*	United Kingdom
Denmark	*India*	Malta	Slovakia	*USA*

Non-EU members in italic letters

The nominal monthly bilateral trade data is disaggregated according to the BEC classification[4] (Table 4) with Eurostat being the source. Unfortunately Eurostat does not deliver data on bilateral trade between two non-EU members. We assign the BEC sectors to three categories of goods, namely capital goods, intermediates and final goods, as recommended by the United Nations Department of Economic and Social Affairs (2007).

3 Data for Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Luxembourg, Malta, Poland, Romania, Slovakia and Slovenia is missing in the years from 1996-1999.

4 A thorough description of the BEC classification is available from the United Nations Department of Economic and Social Affairs (2007).

Table 4: BEC Categories

BEC Code	Description
111[2]	Food and beverages / primary / mainly for industry
112[3]	Food and beverages / primary / mainly for household consumption
121[2]	Food and beverages / processed / mainly for industry
122[3]	Food and beverages / processed / mainly for household consumption
210[2]	Industrial supplies n.e.s. / primary
220[2]	Industrial supplies n.e.s. / processed
310[2]	Fuels and lubricants / primary
321	Fuels and lubricants / processed / motor spirit
322[2]	Fuels and lubricants / processed / other
410[1]	Capital goods (except transport equipment)
420[2]	Capital goods / parts and accessories
510	Transport equipment and parts and accessories thereof / passenger motor cars
521[1]	Transport equipment and parts and accessories thereof / other / industrial
522[3]	Transport equipment and parts and accessories thereof / other / non-industrial
530[2]	Transport equipment and parts and accessories thereof / parts and accessor.
610[3]	Consumer goods n.e.s. / durable
620[3]	Consumer goods n.e.s. / semi-durable
630[3]	Consumer goods n.e.s. / non-durable
700	Goods not elsewhere specified

Superscript denotes whether the category is [1] capital, [2] intermediate or [3] consumption good

Nominal GDP data is taken from the World Development Indicators database (WDI) at an annual level. To construct the bilateral exchange rates[5] and the volatility measure, we used Daily nominal middle exchange rates by Datastream from the WM Company/Reuters.[6]

Variables identifying specific geographical or cultural links are taken from the CEPII datasets.

III.III - Exclusion Restriction

To satisfy the exclusion restriction we need to exclude one variable from the second stage that has no significant impact on the trade volume, but rather on the probability to export.

Most authors choose a dummy whether or not to countries share the same religion as the excluded variable (Helpman et al. 2008). In the European context, we do not consider it a good choice, as all countries share a christian heritage and only some of their trading partners differ from that[7].

5 The bilateral exchange rate measure is the average exchange rate of the past six months.
6 This rate is the midpoint between the bid rate and the offered rate.
7 Namely China, India and Turkey.

In our eyes the crossproduct of the time varying measures of corruption for exporter and importer is appropriate. The channel through which it takes effect is by rising insecurity and associated extra fixed costs for the exporter in the form of authorities or criminals trying to extort bribes in their homeland or export destination (Crozet et al. 2008).

For firms in countries with very low levels of corruption this can be seen as a serious obstacle to start exporting as they are not used to this practices. But also positive effects for trade are conceivable: corrupt officials might allow firms to export or import even if their products don't meet technical, ethical, quality or safety standards. In overregulated countries this could lower fixed trade costs significantly (Rose-Ackerman 1999).

Either way, by influencing fixed-costs rather than variable costs, corruption can be thought of as an additional barrier to trade, that once firms have overcome it and know how to operate in a corrupt environment, has no significant impact of the volume of trade.

The corruption data is taken from the International Country Risk Guide (ICRG) published by "The PRS Group" and is a component of the Political Risk Dataset. It has a scale from 0 (extremely high level of corruption) to 6 and assesses corruption within the political system[8].

III.IV - Measuring Volatility

The measurement of exchange rate volatility can be conducted in many different ways. Most approaches have in common to measure the variance, but differ in the implementation. Examples are the standard deviation of a rate of change or the moving standard deviation. Other measures, like ARCH and GARCH models, have gained popularity among researchers in recent years. The latter model the variance of the disturbance term for each period as a function of the errors in the previous periods. All measures have drawbacks, like for instance the high persistence of real exchange rate shocks when moving average representations are applied, or low correlation in volatility when ARCH/GARCH models are the measure of choice (Baum et al. 2004). The introduction of new and more sophisticated measures has however not changed the results in the empirical literature on the impact of exchange rate volatility on trade significantly (Ćorić & Pugh 2010).

8 In our dataset the crossproduct ranges from 2 to 36.

Another important question is whether the volatility of the nominal or the real exchange rate is to be used. While as an advantage the real exchange rate captures the true relative price of the good, it also captures variation in the price levels, what is not desirable. Many studies use both exchange rates and compare the results. The differences they find are usually very small.[9]

We are employing the standard deviation of the first difference of logarithms, that has been used in various studies before (e.g. Clark et al. (2004)). If the exchange rate is on a consistent trend, which apparently could be forecasted and consequently would not be a source of uncertainty, the measure has the ability that it will equal zero.

To avoid bias from changes in price levels via spurious correlation, we use nominal exchange rates. The measure is constructed as a short-term volatility measure with bilateral exchange rates from the past six month. Different to many other studies, we are constructing our exchange rate volatility measure with daily exchange rates which allow more precise measures than end of the month values, as exchange rates tend to more extreme movements at the end of each month. High persistence of exchange rate shocks is less of a problem as we only measure very short-term volatility of the past six months with high frequency data. In contrast to studies investigating long- or mid-run volatility, we do not want to put weights on more recent volatility, as for a 6-month volatility measure the, we expect movements in the exchange rate at each point of time to be similarly important.

IV - Results

The estimation of the gravity equation yields the expected results for the standard variables. Estimates are always significant and positive for the GDP crossproduct and negative and significant for the distance between capitals. Controls for contiguity always yield significant positive estimates and for one or both countries being islands estimates are negative and significant. While the control variable for common official language yields mixed results, former colonial ties have negative impact on the probability to export, but a positive on the volume.

The excluded variable in the second stage, that we expect to have an impact only on the probability to trade, but not on the volume does a considerably good job. Our bilateral corruption

9 A very profound comparison of the effects real and nominal exchange rate volatility on exports was conducted by Cotter & Bredin (2011) finding that magnitude and direction are not changing, while timing effects can be different.

measure has an insignificant impact on trade volume and a significant impact on the probability. Only for capital goods, the impact on the volume is significant.

Table 5: Regression Results - Capital Goods

			1st Step	2nd Step	2nd Step
	FE	**RE**	**Probit**	**FE**	**RE**
GDP_{ijt}	0.447***	0.474***	0.462***	0.243***	0.467***
	(0.0395)	(0.0128)	(0.00222)	(0.0402)	(0.0127)
$Distance_{ij}$	-	-1.206***	-0.861***	-	-1.206***
		(0.0543)	(0.00653)		(0.0540)
EU_{ijt}	0.115***	0.112***	0.260***	0.122***	0.118***
	(0.0161)	(0.0161)	(0.0103)	(0.0161)	(0.0161)
$Euro_{ijt}$	-0.114***	-0.104***	-0.331***	-0.0708***	-0.0815***
	(0.0207)	(0.0204)	(0.0141)	(0.0214)	(0.0210)
$Border_{ij}$	-	0.606***	1.041***	-	0.659***
		(0.0976)	(0.0337)		(0.0984)
$Language_{ij}$	-	0.194*	0.0408*	-	0.207*
		(0.112)	(0.0243)		(0.112)
$Colony_{ij}$	-	0.539***	-0.138***	-	0.578***
		(0.118)	(0.0281)		(0.118)
$Island_{i}$	-	-0.698***	-0.247***	-	-0.723***
		(0.195)	(0.00772)		(0.194)
$Landlocked_{i}$	-	-1.989***	-0.0988***	-	-2.004***
		(0.251)	(0.00744)		(0.250)
$Volatility_{ijt}$	-2.805***	-2.758***	-1.688***	-1.518***	-2.231***
	(0.514)	(0.515)	(0.368)	(0.545)	(0.542)
$L1.Volatility_{ijt}$	-3.482***	-3.432***	-1.475***	-2.200***	-2.885***
	(0.612)	(0.614)	(0.363)	(0.638)	(0.636)
$L2.Volatility_{ijt}$	-3.527***	-3.425***	-1.430***	-2.244***	-2.901***
	(0.509)	(0.510)	(0.358)	(0.540)	(0.537)
$L3.Volatility_{ijt}$	-1.451***	-1.402***	-1.555***	-0.164	-0.735
	(0.531)	(0.533)	(0.364)	(0.559)	(0.556)
$ExRate_{ijt}$	-0.301***	-0.296***	-0.00373	-0.299***	-0.295***
	(0.0710)	(0.0712)	(0.0501)	(0.0709)	(0.0712)
$L1.ExRate_{ijt}$	0.0500	0.0578	-0.0924	0.0500	0.0571
	(0.0634)	(0.0636)	(0.0840)	(0.0634)	(0.0636)
$L2.ExRate_{ijt}$	0.271***	0.240***	-0.0426	0.271***	0.241***
	(0.0734)	(0.0732)	(0.0816)	(0.0734)	(0.0732)
$L3.ExRate_{ijt}$	0.0826	0.0751	0.0656	0.0804	0.0733
	(0.0547)	(0.0549)	(0.0471)	(0.0547)	(0.0548)
$Corruption_{ijt}$	-0.0089***	-0.0088***	0.0156***	-	-
	(0.00308)	(0.00304)	(0.000661)		
Zhat	-	-	-	0.0088***	0.0048***
				(0.00118)	(0.00109)
IMR	-	-	-	2.047***	5.926***
				(0.631)	(0.509)
Obs.	283,895	283,895	345,268	283,895	283,895
R^2	0.194	0.697	-	0.194	0.698
RMSE	1.171	1.176	-	1.171	1.175

Standard errors in parentheses; significance levels: * 10% ** 5% ***1%

Table 6: Regression Results - Intermediates

			1st Step	2nd Step	2nd Step
	FE	**RE**	**Probit**	**FE**	**RE**
GDP_{ijt}	0.682***	0.510***	0.390***	0.660***	0.516***
	(0.0179)	(0.0105)	(0.000915)	(0.0143)	(0.0105)
$Distance_{ij}$	-	-1.544***	-0.708***	-	-1.562***
		(0.0489)	(0.00278)		(0.0488)
EU_{ijt}	0.0896***	0.0873***	0.341***	0.0912***	0.0890***
	(0.00902)	(0.00901)	(0.00449)	(0.00900)	(0.00900)
$Euro_{ijt}$	0.0942***	0.0894***	-0.257***	0.0785***	0.0705***
	(0.0116)	(0.0115)	(0.00613)	(0.0120)	(0.0119)
$Border_{ij}$	-	1.147***	1.096***	-	1.107***
		(0.0879)	(0.0125)		(0.0878)
$Language_{ij}$	-	0.0904	0.117***	-	0.0731
		(0.102)	(0.0102)		(0.101)
$Colony_{ij}$	-	0.284***	-0.137***	-	0.281***
		(0.106)	(0.0115)		(0.106)
$Island_{i}$	-	-0.570***	-0.193***	-	-0.582***
		(0.170)	(0.00348)		(0.170)
$Landlocked_{i}$	-	-2.071***	-0.243***	-	-2.092***
		(0.186)	(0.00326)		(0.186)
$Volatility_{ijt}$	-2.435***	-2.416***	-1.144***	-2.927***	-3.003***
	(0.285)	(0.285)	(0.174)	(0.299)	(0.298)
$L1.Volatility_{ijt}$	-2.560***	-2.522***	-0.868***	-3.033***	-3.090***
	(0.339)	(0.339)	(0.171)	(0.351)	(0.350)
$L2.Volatility_{ijt}$	-1.865***	-1.833***	-0.792***	-2.334***	-2.397***
	(0.282)	(0.282)	(0.169)	(0.296)	(0.296)
$L3.Volatility_{ijt}$	-0.617**	-0.594**	-2.426***	-1.086***	-1.153***
	(0.298)	(0.298)	(0.170)	(0.312)	(0.312)
$ExRate_{ijt}$	-0.0911**	-0.0904**	0.0503**	-0.0911**	-0.0904**
	(0.0394)	(0.0394)	(0.0230)	(0.0394)	(0.0394)
$L1.ExRate_{ijt}$	0.0820**	0.0820**	-0.0324	0.0824**	0.0824**
	(0.0349)	(0.0349)	(0.0385)	(0.0348)	(0.0349)
$L2.ExRate_{ijt}$	-0.0136	-0.0145	-0.0392	-0.0134	-0.0142
	(0.0409)	(0.0409)	(0.0374)	(0.0409)	(0.0409)
$L3.ExRate_{ijt}$	0.0191	0.0195	0.00306	0.0186	0.0188
	(0.0301)	(0.0301)	(0.0216)	(0.0301)	(0.0301)
$Corruption_{ijt}$	0.00117	0.00180	-0.0020***	-	-
	(0.00169)	(0.00168)	(0.000282)		
Zhat	-	-	-	-0.0013***	-0.0016***
				(0.000338)	(0.000329)
IMR	-	-	-	2.545***	2.833***
				(0.182)	(0.178)
Obs.	1,045,992	1,045,992	1,381,072	1,045,992	1,045,992
R^2	0.113	0.623	-	0.113	0.623
RMSE	1.243	1.244	-	1.243	1.244

Standard errors in parentheses; significance levels: * 10% ** 5% ***1%

Table 7: Regression Results - Final Goods

			1st Step	2nd Step	2nd Step
	FE	**RE**	**Probit**	**FE**	**RE**
GDP_{ijt}	0.416***	0.449***	0.451***	0.234***	0.450***
	(0.0152)	(0.00907)	(0.00131)	(0.0227)	(0.00901)
$Distance_{ij}$	-	-1.267***	-0.734***	-	-1.271***
		(0.0420)	(0.00381)		(0.0417)
EU_{ijt}	0.202***	0.201***	0.439***	0.202***	0.200***
	(0.00790)	(0.00789)	(0.00609)	(0.00787)	(0.00787)
$Euro_{ijt}$	0.0648***	0.0681***	-0.241***	0.0741***	0.0718***
	(0.00999)	(0.00993)	(0.00865)	(0.0104)	(0.0103)
$Border_{ij}$	-	0.857***	1.060***	-	0.865***
		(0.0760)	(0.0189)		(0.0758)
$Language_{ij}$	-	0.144*	-0.0883***	-	0.157*
		(0.0871)	(0.0135)		(0.0866)
$Colony_{ij}$	-	0.338***	-0.129***	-	0.349***
		(0.0922)	(0.0168)		(0.0916)
$Island_{i}$	-	-0.244*	-0.0110**	-	-0.252*
		(0.147)	(0.00456)		(0.146)
$Landlocked_{i}$	-	-0.665***	-0.233***	-	-0.668***
		(0.161)	(0.00424)		(0.160)
$Volatility_{ijt}$	-2.426***	-2.404***	-0.987***	-2.214***	-2.365***
	(0.234)	(0.234)	(0.200)	(0.248)	(0.247)
$L1.Volatility_{ijt}$	-2.186***	-2.167***	-1.487***	-1.932***	-2.088***
	(0.282)	(0.282)	(0.199)	(0.295)	(0.294)
$L2.Volatility_{ijt}$	-1.438***	-1.429***	-0.510***	-1.186***	-1.347***
	(0.235)	(0.235)	(0.197)	(0.250)	(0.249)
$L3.Volatility_{ijt}$	-0.968***	-0.957***	-2.208***	-0.724***	-0.879***
	(0.247)	(0.247)	(0.199)	(0.261)	(0.260)
$ExRate_{ijt}$	-0.276***	-0.276***	-0.268***	-0.274***	-0.275***
	(0.0347)	(0.0347)	(0.0297)	(0.0347)	(0.0347)
$L1.ExRate_{ijt}$	-0.0592*	-0.0591*	-0.0931*	-0.0600*	-0.0599*
	(0.0311)	(0.0312)	(0.0499)	(0.0311)	(0.0312)
$L2.ExRate_{ijt}$	0.0667*	0.0655*	-0.116**	0.0659*	0.0647*
	(0.0360)	(0.0360)	(0.0484)	(0.0360)	(0.0360)
$L3.ExRate_{ijt}$	-0.0589**	-0.0589**	0.410***	-0.0602**	-0.0593**
	(0.0268)	(0.0268)	(0.0278)	(0.0268)	(0.0268)
$Corruption_{ijt}$	0.0003	0.0006	0.0106***	-	-
	(0.00149)	(0.00148)	(0.000390)		
Zhat	-	-	-	0.0014***	0.00071**
				(0.000362)	(0.000353)
IMR	-	-	-	5.923***	6.156***
				(0.417)	(0.382)
Obs.	879,509	879,509	1,035,804	879,509	879,509
R^2	0.167	0.683	-	0.167	0.683
RMSE	1.006	1.007	-	1.006	1.007

Standard errors in parentheses; significance levels: * 10% ** 5% ***1%

IV.I - Exchange Rate Volatility and Trade

Our six month measure for exchange rate volatility yields significant negative estimates for all three categories of goods and also for all three lags.

Since comparing the impact of the volatility measure across goods and lags is difficult, we use the beta coefficients of the regressions (Table 8). Beta coefficients are all measured in standard deviations instead of the units of the variables. Thus, coefficients are all in the same standardized units and one can compare these coefficients to assess the relative strength of each of the predictors. A one standard deviation increase leads to a standard deviation increase in the dependent variable in size of the beta coefficient, with the other variables held constant.

The beta coefficients indicate that the effect of exchange rate volatility is rather small, a one standard deviation change in the volatility measure decreases trade volumes with between 0.0004 and 0.007 standard deviations.

The product categories seem to differ with respect to the timeframe of the effect on trade volumes. While for final goods the first measure has the biggest impact, it is the first lagged measure for intermediates and the second lagged measure for capital goods. Thus, final goods are more affected from very recent volatility from the past six month and other goods more from volatility longer ago.

The Heckman 2-stage approach changes results only slightly, yielding much lower estimates for capital goods, a little higher estimates for intermediates and slightly lower estimates for final goods.

Table 8: Beta Coefficients of the Volatility Measure

				1st Step	2nd Step	2nd Step
		FE	**RE**	**Probit**	**FE**	**RE**
Capital Goods	Volatility	-0.00650	-0.00639	-1.60E-010	-0.00352	-0.00517
	L1.Volatility	-0.00837	-0.00825	-1.44E-010	-0.00529	-0.00694
	L2.Volatility	-0.00857	-0.00832	-1.40E-010	-0.00545	-0.00705
	L3.Volatility	-0.00361	-0.00348	-1.53E-010	-0.000408	-0.00183
Intermediates	Volatility	-0.00500	-0.00497	-1.17E-010	-0.00601	-0.00617
	L1.Volatility	-0.00548	-0.00540	-9.15E-011	-0.00649	-0.00661
	L2.Volatility	-0.00404	-0.00397	-8.41E-011	-0.00506	-0.00519
	L3.Volatility	-0.00134	-0.00129	-2.58E-010	-0.00235	-0.00250
Final Goods	Volatility	-0.00612	-0.00607	-2.25E-010	-0.00559	-0.00597
	L1.Volatility	-0.00565	-0.00560	-3.49E-010	-0.00499	-0.00539
	L2.Volatility	-0.00380	-0.00377	-1.20E-010	-0.00313	-0.00356
	L3.Volatility	-0.00258	-0.00255	-5.22E-010	-0.00193	-0.00234

The volatility measure is modestly correlated with its lags. The correlation coefficients range between 0.14 and 0.23 (Table 9).

Table 9: Correlation between Volatility Measure and its Lags

	$Volatility_{ijt}$	$L1.Volatility_{ijt}$	$L2.Volatility_{ijt}$	$L3.Volatility_{ijt}$
$Volatility_{ijt}$	1.0000	0.2328	0.1637	0.1446
$L1.Volatility_{ijt}$	0.2328	1.0000	0.2268	0.1530
$L2.Volatility_{ijt}$	0.1637	0.2268	1.0000	0.2179
$L3.Volatility_{ijt}$	0.1446	0.1530	0.2179	1.0000

IV.II - Exchange Rate Movements

Results for the measure for exchange rate movements for the past six months show a significant negative impact, indicating that a depreciation of the foreign currency leads to lower export volumes. The effect is stronger for capital and final goods, lying around 0.27 and 0.30, than for intermediates lying around 0.09 all other variables held constant. Lags show mixed effects and only in case of final goods all are significant at least at a 10% level.

When not controlling for exchange rate movements, coefficients for the dummies for EU and Euro membership remain almost unchanged and coefficients for exchange rate volatility move slightly (Table 11, Table 12 and Table 13).

IV.III - The European Union

Mutual EU membership has significant positive effect on the probability to trade and the trade volume. The estimates for the impact on the probability are much higher and range from 0.26 for capital goods over 0.34 for intermediates to 0.44 for final goods. Thus, mutual EU membership increases the number of industries from which goods are traded significantly, especially for industries producing final goods.

Trade volume sees a smaller impact of 0.09 on intermediates, about 0.11 on capital goods and 0.2 on final goods. Hence, final goods face the biggest boost in the probability to trade and volume when both countries are EU members.

IV.IV - The Euro

The results for mutual Euro membership are more ambiguous than for the EU, but still very significant. The probability to trade is negatively affected with estimated coefficients around -0.25 for final goods and intermediates and -0.33 for capital goods. Trade volume is affected negatively for capital goods with estimates around -0.10 and positively with estimates around 0.08 for intermediates and around 0.07 for final goods.

In percentage points, the impact of the Euro on trade volume lies according to our estimations at around 9% for Intermediates and 7% for final goods. When not controlling for exchange rate volatility, the impact of the Euro on exports rises only slightly (Table 10).

Table 10: Impact of Euro in Percentage Change

			1st Step	2nd Step	2nd Step
	FE	**RE**	**Probit**	**FE**	**RE**
Capital Goods	-12.1% (-10.5%)	-11.0%	-39.2%	-7.3%	-8.5%
Intermediates	9.9% (11%)	9.4%	-29.3%	8.2%	7.3%
Final Goods	6.7% (7.3%)	7%	-27.3%	7.7%	7.4%

In parentheses impact without controls for exchange rate volatility

V - Conclusion

In contrast to many previous studies, we do not find unambiguous results for exchange rate volatility. Instead, we find evidence for a significant negative impact, admittedly small in size. We find sectors to react differently with regard to the timeframe and size of the impact. While mutual

EU membership promotes trade via the extensive and intensive margin for most goods, Euro membership does so only via the intensive margin and not for capital goods. This is evidence for a pronounced specialization process in the Eurozone at the industry level, which results in countries exporting goods from less industries, but higher overall volumes. According to our results, the effect is slightly stronger for intermediates than final goods.

Negative trade effects for the Euro for capital goods can probably be attributed to the massive capital flows with the start of the Euro from members in central Europe to the periphery, that fuelled a consumption/housing bubble in the periphery and led to less investments in capital goods in the centre and the periphery of the Eurozone and therefore lower trade of capital goods between the Eurozone members.

The introduction of controls for firm heterogeneity and sample selection bias only very slightly affects the results. Nonetheless, extensive and intensive margin are affected very differently by our variables of interest.

V.I - Policy Implications

Policy implications stemming from our results are manifold. Policymakers should keep in mind, that currency unions come at great costs with regard to the flexibility of the domestic monetary policy, but positive trade effects may be very limited and not for all types of goods. The elimination of exchange rate volatility can also be achieved by a fixed peg. Although we find trade effects to be small, it still may be the better choice to avoid negative impacts as experienced currently in Eurozone and grants greater flexibility.

The question whether or not stabilizing the exchange rate is a desirable objective for policymakers is unclear and it is also unclear to which extent the real exchange rate is a variable that policymakers should be able to influence or actually can influence, besides establishing a currency union, a fixed peg or Dollarization (Eichengreen 2007; Rodrik 2008).

VI - Bibliography

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VII - Appendix

Figure 2: Share of total exports by BEC category, 1996-2010

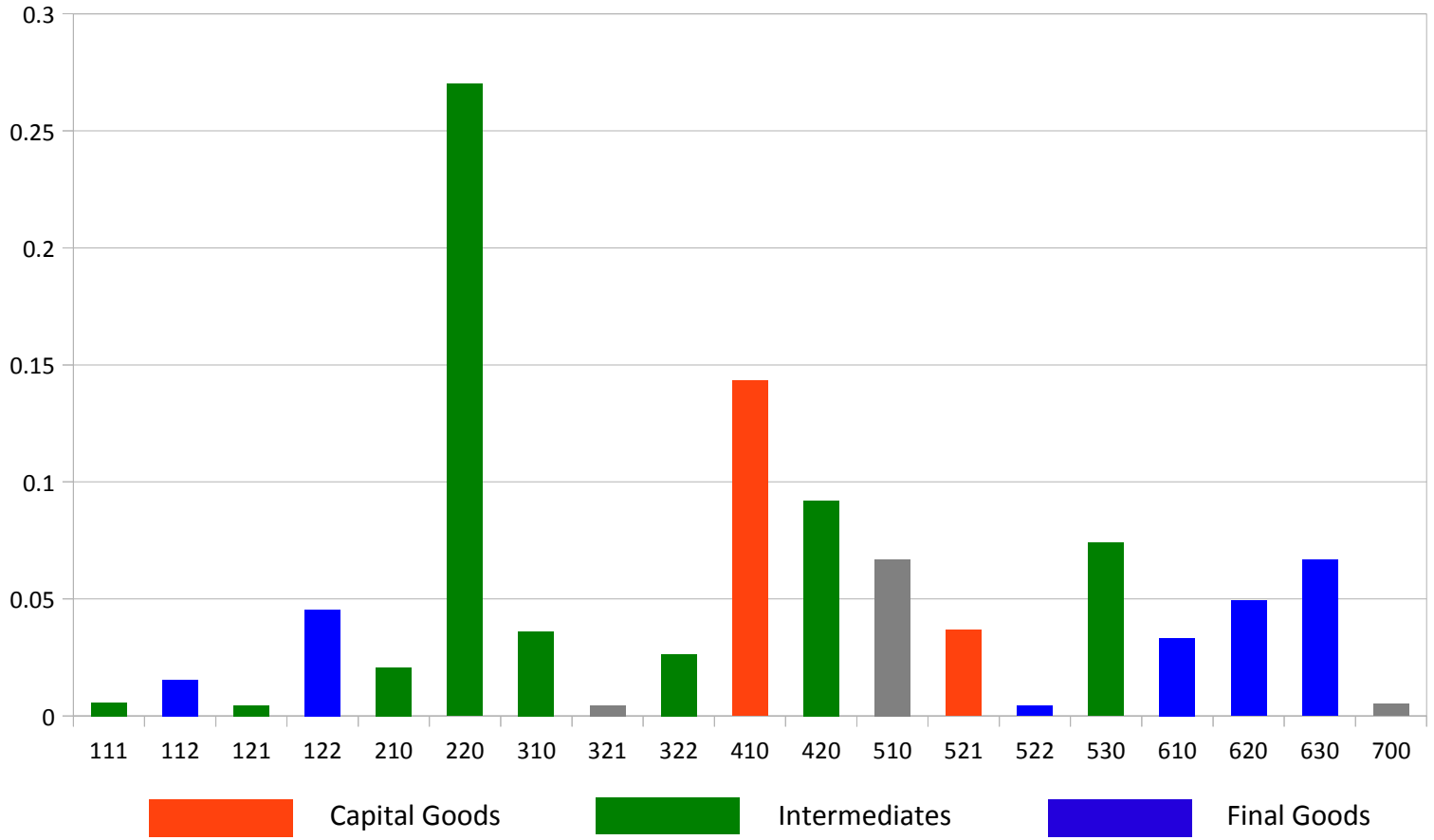

Figure 3: Log of Total Trade Volumes

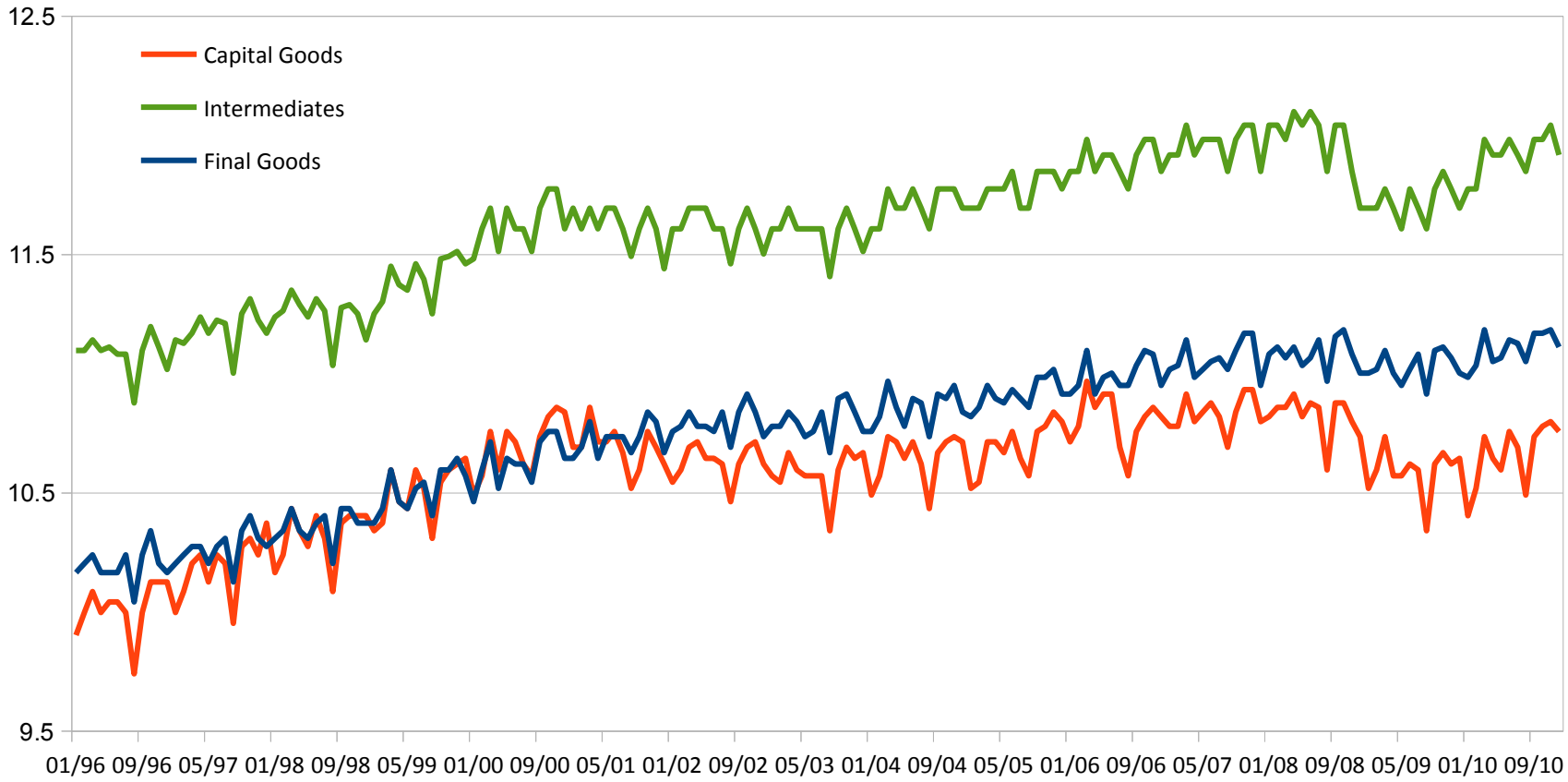

Table 11: Fixed Effects Regressions - Capital Goods

	(1)	(2)	(3)	(4)	(5)	(6)
GDP_{ijt}	0.426***	0.504***	0.632***	0.575***	0.446***	0.457***
	(0.0300)	(0.0313)	(0.0291)	(0.0207)	(0.0382)	(0.0272)
EU_{ijt}	0.119***	0.119***	0.138***	0.143***	0.113***	
	(0.0160)	(0.0160)	(0.0159)	(0.0159)	(0.0160)	
$Euro_{ijt}$	-0.112***	-0.112***	-0.100***	-0.0923***		-0.101***
	(0.0207)	(0.0207)	(0.0206)	(0.0204)		(0.0207)
$Volatility_{ijt}$	-2.805***	-2.923***			-2.656***	-3.091***
	(0.514)	(0.513)			(0.513)	(0.512)
$L1.Volatility_{ijt}$	-3.485***	-3.520***			-3.286***	-3.879***
	(0.612)	(0.612)			(0.611)	(0.610)
$L2.Volatility_{ijt}$	-3.528***	-3.459***			-3.370***	-3.965***
	(0.509)	(0.508)			(0.508)	(0.505)
$L3.Volatility_{ijt}$	-1.468***	-1.455***			-1.323**	-1.505***
	(0.531)	(0.531)			(0.530)	(0.531)
$ExRate_{ijt}$	-0.301***		-0.332***		-0.302***	-0.300***
	(0.0710)		(0.0689)		(0.0710)	(0.0710)
$L1.ExRate_{ijt}$	0.0499		0.0849		0.0499	0.0486
	(0.0634)		(0.0612)		(0.0634)	(0.0634)
$L2.ExRate_{ijt}$	0.271***		0.241***		0.272***	0.274***
	(0.0734)		(0.0730)		(0.0734)	(0.0734)
$L3.ExRate_{ijt}$	0.0825		0.0933*		0.0823	0.0809
	(0.0547)		(0.0544)		(0.0547)	(0.0547)
Obs.	283,895	283,895	287,010	291,256	283,895	283,895
R^2	0.194	0.194	0.198	0.200	0.194	0.194

Standard errors in parentheses; significance levels: * 10% ** 5% ***1%

Table 12: Fixed Effects Regressions - Intermediates

	(1)	(2)	(3)	(4)	(5)	(6)
GDP_{ijt}	0.506***	0.560***	0.473***	0.606***	0.493***	0.631***
	(0.0325)	(0.0131)	(0.0159)	(0.0104)	(0.0199)	(0.0174)
EU_{ijt}	0.0891***	0.0890***	0.101***	0.103***	0.0936***	
	(0.00898)	(0.00898)	(0.00888)	(0.00887)	(0.00897)	
$Euro_{ijt}$	0.0939***	0.0939***	0.104***	0.100***		0.101***
	(0.0116)	(0.0116)	(0.0115)	(0.0115)		(0.0116)
$Volatility_{ijt}$	-2.435***	-2.450***			-2.559***	-2.659***
	(0.285)	(0.284)			(0.284)	(0.284)
$L1.Volatility_{ijt}$	-2.560***	-2.534***			-2.722***	-2.866***
	(0.339)	(0.338)			(0.338)	(0.337)
$L2.Volatility_{ijt}$	-1.865***	-1.875***			-1.993***	-2.203***
	(0.282)	(0.282)			(0.282)	(0.280)
$L3.Volatility_{ijt}$	-0.615**	-0.613**			-0.738**	-0.648**
	(0.298)	(0.298)			(0.297)	(0.298)
$ExRate_{ijt}$	-0.0911**		-0.115***		-0.0910**	-0.0904**
	(0.0394)		(0.0383)		(0.0394)	(0.0394)
$L1.ExRate_{ijt}$	0.0820**		0.0892***		0.0820**	0.0809**
	(0.0349)		(0.0337)		(0.0349)	(0.0349)
$L2.ExRate_{ijt}$	-0.0136		-0.0217		-0.0139	-0.0122
	(0.0409)		(0.0407)		(0.0409)	(0.0409)
$L3.ExRate_{ijt}$	0.0191		0.0192		0.0195	0.0185
	(0.0301)		(0.0299)		(0.0301)	(0.0301)
Obs.	1,045,992	1,045,992	1,057,399	1,073,052	1,045,992	1,045,992
R^2	0.113	0.113	0.116	0.119	0.113	0.113

Standard errors in parentheses; significance levels: * 10% ** 5% ***1%

Table 13: Fixed Effects Regressions - Final Goods

	(1)	(2)	(3)	(4)	(5)	(6)
GDP_{ijt}	0.417***	0.352***	0.639***	0.538***	0.439***	0.456***
	(0.0127)	(0.0140)	(0.0134)	(0.0132)	(0.0109)	(0.0128)
EU_{ijt}	0.202***	0.202***	0.209***	0.209***	0.205***	
	(0.00787)	(0.00787)	(0.00778)	(0.00780)	(0.00785)	
$Euro_{ijt}$	0.0648***	0.0647***	0.0705***	0.0722***		0.0813***
	(0.00999)	(0.00999)	(0.00996)	(0.00992)		(0.00997)
$Volatility_{ijt}$	-2.426***	-2.492***			-2.502***	-2.896***
	(0.234)	(0.234)			(0.234)	(0.233)
$L1.Volatility_{ijt}$	-2.186***	-2.193***			-2.288***	-2.846***
	(0.282)	(0.282)			(0.282)	(0.281)
$L2.Volatility_{ijt}$	-1.438***	-1.420***			-1.518***	-2.189***
	(0.235)	(0.235)			(0.235)	(0.233)
$L3.Volatility_{ijt}$	-0.967***	-0.979***			-1.045***	-1.001***
	(0.247)	(0.247)			(0.247)	(0.247)
$ExRate_{ijt}$	-0.276***		-0.291***		-0.276***	-0.275***
	(0.0347)		(0.0338)		(0.0347)	(0.0347)
$L1.ExRate_{ijt}$	-0.0592*		-0.0582*		-0.0591*	-0.0615**
	(0.0311)		(0.0301)		(0.0311)	(0.0311)
$L2.ExRate_{ijt}$	0.0667*		0.0654*		0.0665*	0.0713**
	(0.0360)		(0.0359)		(0.0360)	(0.0360)
$L3.ExRate_{ijt}$	-0.0589**		-0.0447*		-0.0587**	-0.0614**
	(0.0268)		(0.0267)		(0.0268)	(0.0268)
Obs.	879,509	879,509	889,410	902,978	879,509	879,509
R^2	0.167	0.166	0.170	0.171	0.167	0.166

Standard errors in parentheses; significance levels: * 10% ** 5% ***1%