



Cross-border investment and the decline of exchange rate volatility: implications for Euro area bilateral investments

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Abstract

Exchange rate volatility has undergone a secular decline since the collapse of the Bretton Woods system. We conjecture that this phenomenon may have led to a generalized decreased need for risk exchange hedging in financial markets. Indeed, we find that the negative association between bilateral foreign portfolio investments and the volatility of the exchange rate has markedly weakened over time. This finding, which is particularly significant for large countries and in the post-crisis period, can also help explain the decline in bilateral investments among EMU member countries. We observe, in fact, that, after 2012, the distinctive fall of Euro-area bilateral equity investments is significantly explained by the global declining effect of exchange rate volatility on financial markets. A lower exchange rate volatility, associated with the ensuing generalized reduction in the perceived exchange rate risk, may have posed a challenge to the economic relevance of the full exchange risk hedging system represented by the common currency area, and hence to the attractiveness of reciprocal investments.

Keywords Exchange rate volatility · Common currency · Euro area · Foreign portfolio investment

JEL Classification F21 · F30 · F36 · G11 · G15

1 Introduction

The impact of the exchange rate on international trade has been widely investigated in the literature. Some studies have emphasized the risks associated with exchange rate variability, which should discourage economic agents from international

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trading. Other studies have emphasized that exchange rate volatility should have no impact on cross-border transactions because of the availability of instruments with which to hedge against risks of this type. The question of the effect of exchange rate variability on trade is therefore an empirical matter.

The literature dealing with cross-border trade in goods and services has been rather mixed (McKenzie, 1999; Tenreyro, 2007), and, also in regard to financial markets, empirical analyses have reported controversial results (Jorion, 1991; Fidora et al., 2007; Sandoval & Vàsquez, 2009; Borensztein & Loungani, 2011; Caporale et al., 2015; Dyakov & Wipplinger, 2018).

The above-mentioned literature encompasses analyses that rely on different exchange rate volatility measures, bilateral or effective exchange rates, nominal or real exchange rates, and that span different time periods and country samples.¹

The first contribution of this paper is its investigation of the impact of exchange rate volatility on financial transactions across borders in a wide perspective. Indeed, we analyze the role played by bilateral nominal and real exchange rate volatility in bilateral foreign portfolio equity investments, in 68 developed and emerging markets, in the period 2001–2017, which encompasses a pre-crisis, a crisis, and a post-crisis period.

We find that exchange rate volatility negatively and significantly affected cross-border portfolio investments, when considering either nominal or real exchange rates, using either a continuous or a dichotomic definition of volatility with different time lags.

The literature studying the impact of the exchange rate on cross-border trade of goods and services has identified a multi-dimensional heterogeneity in this effect. The survey by McKenzie (1999) concluded that exchange rate volatility may have a different impacts on different markets. Exchange rate volatility has been found to affect trade flows asymmetrically, with a very different impact of extremely large versus extremely small changes in volatility (Chang et al., 2020). The effect is found to be larger for smaller and developing economies (Micco et al., 2003; Baldwin, 2006; Santos Silva & Tenreyro, 2010), and to vary over time (De Sousa, 2012). In particular, Sandoval & Vàsquez (2009) highlighted an asymmetry in pricing exchange rate risk, with a small and insignificant risk premium of exchange rate exposure in up-market periods, and a significant one in down-market periods.

The paper's second contribution is therefore its search for the presence of heterogeneity in the impact of exchange rate volatility on financial markets, as already found in regard to trade of goods. Indeed, the controversial results in financial markets may hide a significant heterogeneity which might have generated an aggregation bias similar to the one found, across countries or sectors, in the trade literature (Péridy, 2003; Bahmani-Oskooee & Hegerty, 2007).

The empirical evidence points to the presence of a source of heterogeneity between emerging and developed economies: the exchange rate has become more volatile in the major emerging market economies, as a consequence of the global financial stress (Coudert et al., 2011; Ilzetzki et al., 2019), while major currency exchange volatility has substantially decreased. Ilzetzki et al. (2019), for instance,

¹ This literature will be surveyed in more detail in the next section.

demonstrate a visible secular decline in exchange rate volatility in the dollar-Deutschmark cross-rate from the end of the Bretton Woods system to 2018, despite the volatility's counter-cyclical nature.

We find that the negative association between bilateral foreign portfolio investments and the volatility of the exchange rate crucially depends upon both the time period and the groups of countries considered. Indeed, it significantly weakened after 2012—that is, after the crisis—with an especially strong and significant effect for large economies, the ones experiencing the most visible decline in exchange rate volatility.

These findings may have had important implications also in regard to bilateral cross-border portfolio equity holdings within the European Monetary Union. The assumption of a negative nexus between exchange rate volatility and trade was one of the pillars of the creation of the European Monetary Union (Commission, 1990): the adoption of a common currency was indeed expected to lead to an increase in the volume of trade among member countries, as reviewed in Glick & Rose (2016).²

Interestingly, De Sousa (2012) found that the currency union's impact on trade was decreasing over time. Similarly, Giofré & Sokolenko (2022), for equity holdings, highlighted that the crisis has drastically weakened the linkages among the original members: a marked decline of economic development and, more importantly, a deterioration of the control of corruption standards by periphery countries, those hardest hit by the European sovereign debt crisis, induced a sharp decrease of their inward investments from the Euro area as a whole.

The third contribution of the paper lies in the investigation and discussion of this specific point. We conjecture that the declining global effect of exchange rate volatility in the post-crisis period can be adduced as one of the main drivers of the fall in bilateral equity investment in the Euro area in that period. The data do not reject this hypothesis: it is indeed likely that a lower responsiveness of international investment to exchange rate volatility challenged the relevance of the full exchange risk hedging system represented by the common currency area in the post-crisis period, when the countercyclical spikes of exchange rate volatility were absorbed.

The rest of the paper is structured as follows. Section 2 briefly reviews the literature on the linkage between exchange rate volatility and trade in goods and financial transactions. In Sect. 3, we outline the estimable equation. In Sect. 4, we describe the data and discuss some descriptive statistics. In Sect. 5, we perform the empirical analysis. Section 6 summarizes and concludes.

2 Exchange rate volatility and trade: a short review

Theoretically, transaction costs, and especially currency risks, constitute a barrier to trade which dampens the volume of the exchange of goods and services. The elimination of these costs and exchange rate variability should expand

² Since currency unions represent a permanent commitment to a fixed exchange rate, they extend beyond the simple elimination of exchange rate volatility, and likely change the perceptions and expectations of economic agents, thereby further affecting goods and financial trade (Rose, 2000; Tenreyro, 2007; Auboin & Ruta, 2013).

cross-border transactions and produce greater integration. On the other hand, sceptics stress that, even in a turbulent currency environment, there are various financial instruments that enable exporters and importers to hedge against exchange risks, so that the potential increase in trade deriving from the elimination of exchange rate volatility is at best small. The counter-argument is that exchange rate risk hedging cannot be complete, and it is in any case costly, especially for small-size exporting firms: if exchange rate movements are not fully anticipated, an increase in exchange rate volatility may induce risk-averse agents to reduce their international trading activities (De Nardis & Vicarelli, 2003).

Empirically, the evidence in support of the hypothesis of a negative link between exchange rate volatility and trade remains somewhat ambiguous (see (McKenzie, 1999; Auboin & Ruta, 2013), for a review). These mixed conclusions are illustrated in an IMF study on exchange rate volatility and trade flows (IMF, 2004), which explores various dimensions, such as type of volatility (short- and long-run, real and nominal), country groups (by regions and income levels), and type of trade (different types of goods).

The impact of exchange rate volatility on financial markets has also been widely investigated by the literature (Biger, 1979; Cushman, 1985; Doidge et al., 2001; Gorg & Wakelin, 2002; Brzozowski, 2006; Mishra, 2011), considering both the nominal (Biger, 1979; Doidge et al., 2001; Gorg & Wakelin, 2002; Brzozowski, 2006) and the real exchange rate (Cushman, 1985; Mishra, 2011). Also in the case of financial markets, the empirical evidence remains mixed.

Biger (1979) studied the importance of the exchange risk on the portfolio allocation from 1966 to 1976 for 13 industrialized countries and found that exchange risk matters much less than would be expected for international portfolios. Jorion (1991) found that the exchange rate risk is diversifiable, and his empirical findings provide little evidence that US investors require compensation for bearing the exchange rate risk. Gorg & Wakelin (2002) studied the impact of the level of the exchange rate, volatility in the exchange rate, and exchange rate expectations on outward US foreign direct investment in 12 developed countries from 1983 to 1995, and found no evidence of an effect on either US outward investment or inward investment in the USA. Conversely, exchange rate volatility increases the costs of international financial transactions, thus reducing potential gains from international diversification by making the acquisition of foreign equities more risky (Solnik & McLeavey, 2004; Caporale et al., 2015). Indeed, Fidora et al. (2007) and Borensztein & Loungani (2011) found that exchange rate volatility is an essential factor for bilateral equity and bond portfolio home bias in developed and emerging economies. When dealing more specifically with foreign equity investment, Thapa & Poshakwale (2011) found that investors tend to invest less in countries experiencing higher movement in their exchange rates, and, more recently, Dyakov & Wipplinger (2018) have shown that international equity mutual funds underweight equity markets with risky currencies and overweight equity markets with less risky ones.

3 Estimable equation

Our baseline estimation builds on the following specification:³

$$\begin{aligned} \log(FPE_{sh}) = & \alpha + \sum_{j=1,\dots,J} \beta^j X_h^j + \sum_{k=1,\dots,K} \varphi^k Y_s^k + \sum_{l=1,\dots,L} \delta^l Z_{sh}^l + \sum_{m=1,\dots,M} \theta^m \log(Q_h^m) \\ & + \sum_{n=1,\dots,N} \rho^n \log(T_s^n) + \sum_{p=1,\dots,P} \sigma^p \log(W_{sh}^p) + \gamma D + \varepsilon_{sh} \end{aligned} \tag{1}$$

The dependent variable $\log(FPE_{sh})$ is the logarithm of the foreign portfolio equities (FPE) invested by source country s in host country h .

Our regression specification accounts for pair-specific regressors (Z_{sh} or W_{sh}), such as the bilateral exchange rate volatility, country-specific variables (X_h, Y_s, Q_h, T_s), such as size variables, and time factors (D).

Among these covariates, continuous regressors (Q_h, T_s and W_{sh}) are expressed in logarithmic terms, so that their coefficients can be easily interpreted in elasticity terms (e.g., if a significant coefficient is equal to 0.3, then a 10% increase in the regressor induces a 3% increase in the dependent variable). Conversely, the effect of a dichotomous variable (X_h, Y_s and Z_{sh}) on a dependent variable expressed in logs is captured by the following transformation of its coefficients $\beta : e^\beta - 1$ (e.g., if a significant coefficient β is equal to 0.3, then the effect of a dummy equal to 1 on the dependent variable is $e^{0.3} - 1 = 0.35$, to be interpreted as the effect being 35% larger than the effect of a dummy equal to 0).⁴

Finally, D is a dummy capturing the time dimension, such as the pre-crisis, crisis, or post-crisis period, which enables us to detect any global shift in foreign investment due to macroeconomic shocks.

To investigate the evolution of the linkages between bilateral FPE and bilateral exchange rate volatility (sd_RE_{sh}), the econometric specification (1) is enriched to include interactions between sd_RE_{sh} and time factors (D). Using a Difference-in-Difference approach, we seek to grasp the eventual time-varying effect of exchange rate volatility on FPE, on top of the global effect exerted by D on FPE.

$$\log(FPE_{sh}) = \alpha + \beta(sd_ER_{sh}) + \gamma D + \delta(sd_ER_{sh} \cdot D) + controls + \varepsilon_{sh} \tag{2}$$

Our econometric strategy follows Santos Silva & Tenreyro (2006) who explicitly addressed, within the standard trade log gravity models, the problem of inflation of zero investment data, and the need to obtain estimates robust to different patterns of heteroskedasticity. Accordingly, we model the dependent variable FPE_{sh} as following a Poisson distribution. We apply the Poisson Pseudo-Maximum Likelihood estimator, with year dummy, individual fixed effect, which in our case corresponds

³ Our data are time-varying, but for the sake of simplicity in notation, we drop the time index in the equations.

⁴ Note that if the coefficient is null (or non-statistically significant) then $e^0 - 1 = 0$, i.e., the effect of a dummy equal to 1 is null, i.e., it is not different from the effect of a dummy equal to 0.

to country-pair fixed effects, and with standard errors adjusted for two-way clustering at the investing-destination country pair and year levels.

4 Data and descriptive statistics

4.1 Data

We examined the impact of exchange rate volatility on the bilateral equity portfolio investments using panel data on 68 countries in the 2001–2017 period.⁵

The data on the bilateral equity portfolio investments were drawn from the Coordinated Portfolio Investment Survey (CPIS), issued by the IMF, a dataset which has been used in many papers in recent decades (Fidora et al., 2007; Lane & Milesi-Ferretti, 2007), Sorensen et al., 2007; Giannetti & Koskinen, 2010; Giofré, 2014). This survey collects security-level data from the major custodians and large end-investors. Portfolio investment is broken down by instrument (equity or debt) and residence of issuer, the latter providing information on the destination of portfolio investment.⁶

However, the CPIS is unable to address the issue of third-country holdings and round-tripping, which is very frequent in the case of financial offshore centers. Following the more recent literature on offshore center classifications, we excluded from our sample "the eight major pass-through economies—the Netherlands, Luxembourg, Hong Kong SAR, the British Virgin Islands, Bermuda, the Cayman Islands, Ireland, and Singapore— [hosting] more than 85 percent of the world's investment in special purpose entities, which are often set up for tax reasons" (Damgaard et al., 2018).⁷

To construct the measure of exchange rate volatility, we relied on raw data drawn from the International Financial Statistics (IMF). The exchange rate volatility that we adopted is quite standard in the literature (see (Rose, 2000), among others): it is measured by the standard deviation of the first-difference of the monthly natural logarithm of the bilateral exchange rate in the five preceding years. Since the literature has relied on both the nominal and the real exchange rate, we considered both measures in our analysis. The real exchange rate volatility was defined by relying on the consumer price index (CPI) or on the producer price index (PPI).

Details on the definition of the dependent variable and the regressors, and information on their respective sources are reported in "Appendix 1".

⁵ See "Appendix 1" for the full list of investing and destination countries.

⁶ While the CPIS provides the most comprehensive survey of international portfolio investment holdings, it is still subject to a number of important caveats. See data.imf.org/cpis, for more details on the survey.

⁷ In Table 8, in "Appendix 2", we consider alternative classifications of offshore centers.

Table 1 Descriptive statistics

	Descriptive statistics						
	Mean	SD	1st Qu	Median	3rd Qu	Min	Max
<i>I. Dependent variable</i>							
Equities _{s,h} (US \$)	4.18E+09	2.901E+10	0	8.10E+06	3.04E+08	0	1.29E+12
<i>II. Main regressor</i>							
<i>Bilateral Exchange Rate volatility_{s,h}</i>							
sd Nominal ER (5y)	0.012	0.007	0.008	0.012	0.015	0.000	0.062
H NER (5y)	0.513	0.500	0	1	1	0	1
sd Nominal ER (1y)	0.012	0.009	0.007	0.010	0.015	0	0.098
H NER (1y)	0.442	0.497	0	0	1	0	1
sd Real ER_CPI (5y)	0.012	0.006	0.009	0.012	0.016	0.001	0.057
H RER_CPI (5y)	0.501	0.500	0	1	1	0	1
sd Real ER_CPI (1y)	0.012	0.008	0.007	0.011	0.015	0.001	0.095
H RER_CPI (1y)	0.428	0.495	0	0	1	0	1
sd Real ER_PPI (5y)	0.013	0.007	0.009	0.012	0.017	0	0.070
H RER_PPI (5y)	0.474	0.499	0	1	0	0	1
sd Real ER_PPI (1y)	0.012	0.008	0.007	0.011	0.016	0	0.070
H RER_PPI (1y)	0.443	0.497	0	0	1	0	1
<i>III. Other controls</i>							
<i>Equity return correlations_{s,h}</i>							
Equity return correlation _{s,h}	0.338	0.357	0.097	0.373	0.619	-1	1
H correl _{s,h}	0.54	0.50	0	1	1	0	1
<i>Gravity variables</i>							
Distance _{s,h} (miles)	7207.36	4735.46	2781.71	7364.45	10159.53	59.62	19772.34
Border dummy _{s,h}	0.03	0.17	0	0	0	0	1
Colonial dummy _{s,h}	0.05	0.22	0	0	0	0	1
Language dummy _{s,h}	0.11	0.31	0	0	0	0	1
Legal origins dummy _{s,h}	0.25	0.43	0	0	0	0	1
<i>Capital mobility</i>							
Capital mobility*	4.48	2.82	1.54	4.62	6.92	0.00	10.00
<i>Size variables</i>							
Market cap* (US \$)	4.30E+11	1.80E+12	3.70E+09	3.55E+10	1.75E+11	3.80E+07	1.47E+13
GDP per cap* (US \$)	24327.00	21976.61	7262.00	16681.00	38166.00	447.00	1.19E+05
GDP* (US \$)	8.02E+11	2.07E+12	4.80E+10	2.14E+11	5.54E+11	1.27E+09	1.94E+13

This table reports the descriptive statistics of the dependent variable and the regressors used in the analysis. The subscript *sh* refers to the country-pair *sh*, * indicates that the corresponding variable is included in the analysis for both the destination and the investing country

4.2 Descriptive statistics

Table 1 reports the main descriptive statistics of the variables included in our analysis.

The first panel reports the dependent variable, i.e., the bilateral portfolio equities holdings expressed in US\$. The second panel refers to the main regressor, i.e., the exchange rate volatility. We first report the descriptive statistics of the nominal exchange rate (NER) volatility, defined as the standard deviation of the first-difference of the monthly natural logarithm of the bilateral nominal exchange rate in the 5 preceding years: its mean is equal to 1.2%, with a standard deviation equal to 0.7% and a maximum equal to 6.2%. We then report its dichotomic counterpart (H NER (5y)), which is equal to 1 if the nominal exchange rate volatility is high, i.e., if it is above the mean, and 0 otherwise. We also report the corresponding 1-year NER volatility measure, in its continuous and dichotomic version. Finally, we report the statistics for two measures of volatility of the real exchange rate (CPI-based and PPI-based), with their dichotomic counterparts, in both their 5-year and 1-year specifications. Their mean, standard deviation, and range are close to the corresponding nominal exchange rate's statistics.

The third panel comprises all other regressors, and is further split into subgroups. We first report the bilateral stock returns' correlation variable, with a mean equal to 0.34, a median of 0.37, and a standard deviation equal to 0.62. Its dichotomic counterpart (H correl_{sh}) is equal to 1 if the bilateral returns correlation between source country and destination country is high, i.e., if it is above the mean, and 0 otherwise.

With the sole exception of the distance variable, the bilateral gravity variables are binary, expressing whether country-pairs share a border, a common language, colonial linkages, or legal origins.

The capital mobility variable ranges from 0 to 10, to indicate increasing levels of capital mobility. Finally, the size variables are stock market capitalization, GDP per capita and GDP, all defined in US\$ and all displaying a notable cross-country dispersion.

5 Empirical analysis

5.1 The role of exchange rate volatility

Recently, Ilzetzi et al. (2019) have shown that, even if some emerging markets have become more volatile with the global financial crisis, major currency exchange volatility has substantially decreased. In Fig. 1, we report Ilzetzi et al. (2019)'s Figure I, which shows the absolute value of the monthly change in the dollar-Deutschmark cross-rate from the end of the Bretton Woods system to 2018 (the German DM is replaced by the euro after 1999): despite its counter-cyclical nature, a visible secular decline in exchange rate volatility clearly emerges.⁸

⁸ Ilzetzi et al. (2019) confirm that the dollar-yen cross-rate shows a similar trend.



Declining Volatility in Dollar-Deutschmark (Euro) Exchange Rate

The figure shows the four-year moving average of the absolute value of the change in the dollar-Deutschmark bilateral exchange rate from 1973 to May 2018. The euro replaces the Deutschmark from January 1999. The straight line represents the trend.

Fig. 1 Declining volatility in Dollar-Deutschmark (Euro) Exchange Rate. This figure is drawn from Ilzetzi et al. (2019). The original caption is reported at the bottom of the figure. *Source:* Ilzetzi et al. (2019) (figure 1, p. 604)

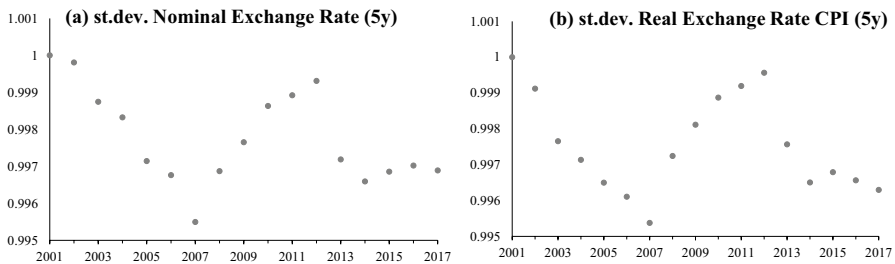


Fig. 2 Volatility in bilateral exchange rate. This figure reports the volatility of the real exchange rate, defined as the standard deviation of the first-difference of the monthly natural logarithm of the bilateral exchange rate in the 5 preceding years. Panel **a** refers to the bilateral nominal exchange rate, while panel **b** refers to CPI-based real exchange rate

In this paper, we explore the conjecture that the generalized decline in exchange rate volatility, probably correlated with a lower perceived currency risk, is paired with a decrease in the need for risk exchange hedging among foreign portfolio equity investors.

Figure 2 reports the dynamics of the bilateral exchange rate volatility from 2001 to 2017 for the country pairs considered in the analysis. Panel (a) refers to the bilateral nominal exchange rate, while panel (b) refers to the CPI-based real exchange rate, where the consumer price index (CPI) is used to convert the nominal into the real exchange rate.

Our graphs are based on the worldwide bilateral exchange rate volatility, but they quite faithfully replicate the dynamics observed by Ilzetzi et al. (2019) in the corresponding period: a rise during the crisis, within a general declining trend. A similar

Table 2 FPE and exchange rate volatility

	Exchange rate volatility					
	NER		RER_CPI		RER_PPI	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
log(Distance _{s,h})	-0.079*** (0.020)	-0.079*** (0.018)	-0.056*** (0.021)	-0.061*** (0.020)	-0.012 (0.025)	-0.021 (0.022)
Border dummy _{s,h}	0.455*** (0.066)	0.451*** (0.066)	0.502*** (0.068)	0.500*** (0.068)	0.436*** (0.064)	0.432*** (0.064)
Language dummy _{s,h}	0.506*** (0.060)	0.508*** (0.060)	0.479*** (0.061)	0.483*** (0.061)	0.319*** (0.055)	0.323*** (0.056)
Colonial dummy _{s,h}	1.522*** (0.203)	1.521*** (0.203)	1.497*** (0.205)	1.492*** (0.206)	0.866*** (0.251)	0.857*** (0.251)
Legal origins dummy _{s,h}	-0.007 (0.058)	-0.004 (0.058)	-0.019 (0.059)	-0.015 (0.058)	0.194 (0.048)	0.198*** (0.048)
log(Market cap _s)	0.560*** (0.013)	0.560*** (0.013)	0.555*** (0.014)	0.555*** (0.014)	0.574*** (0.014)	0.574*** (0.014)
log(Market cap _h)	0.772*** (0.010)	0.772*** (0.010)	0.763*** (0.011)	0.763*** (0.011)	0.744*** (0.012)	0.744*** (0.012)
log(GDP per cap _s)	1.484*** (0.071)	1.484*** (0.071)	1.506*** (0.076)	1.504*** (0.076)	1.724*** (0.076)	1.717*** (0.075)
log(GDP per cap _h)	0.040 (0.033)	0.040 (0.033)	0.034 (0.036)	0.035 (0.035)	0.102** (0.045)	0.102** (0.044)
log(Capital mobility _s)	0.135*** (0.045)	0.131*** (0.045)	0.171*** (0.053)	0.167*** (0.053)	0.220*** (0.062)	0.216*** (0.062)
log(Capital mobility _h)	-0.050*** (0.014)	-0.051*** (0.014)	-0.048*** (0.015)	-0.050*** (0.015)	0.043 (0.031)	0.039 (0.031)
St.dev. NER (5-year)	-15.138*** (3.742)					
St.dev. NER (1-year)	-17.075*** (3.012)					
St.dev. RER_CPI (5-year)			-19.508*** (4.063)			
St.dev. RER_CPI (1-year)			-19.619*** (3.362)			
St.dev. RER_PPI (5-year)					-18.914*** (4.608)	
St.dev. RER_PPI (1-year)					-16.939*** (3.773)	
Observations	45,216	45,216	39,221	38,965	28,177	28,177
Adjusted R ²	0.709	0.710	0.707	0.708	0.736	0.736

This table reports the results of a Poisson Pseudo Maximum Likelihood regression (Santos Silva & Tenreyro, 2006), with year dummy, individual country pair fixed-effects and standard errors adjusted for two-way clustering at the investing-destination country pair and year levels. The dependent variable is $\log(FPE_{sh})$, where the subscript sh represents the source-host country-pair. Columns (1a) and (1b) consider the nominal exchange rate, columns (2a) and (2b) consider the CPI-based real exchange rate, columns (3a) and (3b) consider the PPI-based real exchange rate. The columns (#a) and (#b) consider a

Table 2 (continued)

 definition of exchange rate volatility relative to the five or one preceding years, respectively

***, **, *: significance at the 1, 5, and 10% levels, respectively

pattern is observed when considering a different definition of the real exchange rate, PPI-based, where the producer price index (PPI) is used to convert the nominal into the real exchange rate (Fig. 3 in “Appendix 2”).

In Table 2, we consider an econometric specification that follows Eq. (1), in which the dependent variable is the logarithm of bilateral foreign equity investment (*FPE*) and the regressors are reported at the head of the rows. The specification includes standard gravity variables used in literature to define the cultural and geographic proximity between two countries, the size variables, which express the economic weight of the investing and host countries, such as market capitalization and GDP per capita, and the control for capital mobility. As specified above, the coefficients of all regressors expressed in logs can be interpreted in elasticity terms, while the effect of dummy variables on the dependent variable is captured by the coefficient β as follows: $e^\beta - 1$.

Our main regressor is the exchange rate volatility.⁹ Columns (#a) consider the bilateral exchange rate volatility in the 5 preceding years, columns (#b) instead consider the volatility in the previous year. Since the literature has studied how foreign investments have been affected by the volatility of both nominal (Biger, 1979; Doidge et al., 2001; Gorg & Wakelin, 2002; Brzozowski, 2006) and real exchange rates (Cushman, 1985; Mishra, 2011), columns (1a) and (1b) consider the nominal exchange rate volatility, columns (2a) and (2b) consider the CPI-based real exchange rate, and columns (3a) and (3b) consider the PPI-based real exchange rate. In all specifications, the coefficient of the exchange rate volatility is negative and strongly significant, thus suggesting that a higher bilateral exchange rate volatility deters cross-border investments.

To underline the economic significance of this effect, we point out that a 1% increase of the exchange rate volatility of the nominal exchange rate induces a change in bilateral FPE ranging from -15 to -20% , which is a quite sizable effect. The effect of real exchange rate volatility appears to be stronger than the effect of nominal exchange rate volatility, while the comparison between the 5-year and the 1-year indicators does not yield any clear-cut pattern.

In Table 3, we replicate the same analysis as in Table 2, but we replace the exchange rate volatility with its binary counterpart. We define with *HNER*, *H RER_CPIH RER_PPI* a dummy variable equal to 1 if the bilateral (nominal, real CPI-based or real PPI-based) exchange rate volatility is above the mean, and 0 otherwise. This binary redefinition is intended to make the interpretation of the coefficients more immediate when dealing with the interaction terms of the exchange volatility indexes with time dummies, following the specification in Eq. (2). We report in columns (#a) the 5-year indicator and in columns (#b) the 1-year indicator. The interpretation of the high exchange rate volatility coefficient confirms the results of

⁹ To address the legitimate concerns about reverse causality on the exchange rate volatility (Devereux & Lane, 2003; Sercu & Uppal, 2003), we always consider lagged standard deviation measures.

Table 3 FPE and High exchange rate volatility (binary)

	High Exchange rate volatility					
	H NER		H RER_CPI		H RER_PPI	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
log(Distance _{s,h})	- 0.081*** (0.019)	- 0.094*** (0.018)	- 0.060*** (0.021)	- 0.075*** (0.020)	- 0.037 (0.023)	- 0.038* (0.022)
Border dummy _{s,h}	0.493*** (0.068)	0.468*** (0.067)	0.537*** (0.070)	0.514*** (0.069)	0.447*** (0.067)	0.440*** (0.066)
Language dummy _{s,h}	0.486*** (0.060)	0.504*** (0.061)	0.458*** (0.062)	0.473*** (0.062)	0.304*** (0.057)	0.314*** (0.057)
Colonial dummy _{s,h}	1.502*** (0.205)	1.506*** (0.205)	1.485*** (0.205)	1.490*** (0.206)	0.810*** (0.250)	0.827*** (0.250)
Legal origins dummy _{s,h}	0.005 (0.058)	0.005 (0.058)	- 0.008 (0.059)	- 0.007 (0.059)	0.202 (0.049)	0.204*** (0.049)
log(Market cap _s)	0.556*** (0.013)	0.557*** (0.013)	0.550*** (0.014)	0.552*** (0.014)	0.572*** (0.014)	0.574*** (0.014)
log(Market cap _h)	0.768*** (0.010)	0.770*** (0.010)	0.759*** (0.011)	0.761*** (0.011)	0.741*** (0.012)	0.743*** (0.012)
log(GDP per cap _s)	1.490*** (0.071)	1.478*** (0.070)	1.509*** (0.075)	1.497*** (0.075)	1.705*** (0.074)	1.704*** (0.074)
log(GDP per cap _h)	0.048 (0.033)	0.045 (0.033)	0.045 (0.035)	0.041 (0.035)	0.108** (0.044)	0.107** (0.044)
log(Capital mobility _s)	0.135*** (0.045)	0.139*** (0.046)	0.169*** (0.052)	0.178*** (0.053)	0.220*** (0.062)	0.220*** (0.062)
log(Capital mobility _h)	- 0.055*** (0.014)	- 0.054*** (0.014)	- 0.054*** (0.015)	- 0.053*** (0.015)	0.037 (0.031)	0.040 (0.031)
H NER (5-year)	- 0.125*** (0.042)					
H NER (1-year)	- 0.104*** (0.039)					
H RER_CPI (5-year)			- 0.144*** (0.046)			
H RER_CPI (1-year)					- 0.106** (0.043)	
H RER_PPI (5-year)					- 0.083 (0.055)	
H RER_PPI (1-year)						
Observations	45,216	45,216	39,221	38,965	28,177	28,177
Adjusted R ²	0.712	0.707	0.710	0.704	0.735	0.732

This table is the same as Table 2, but the exchange rate volatility is defined in binary terms, i.e., it is equal to 1 if the bilateral exchange volatility is high (above the mean), and 0 otherwise

***, **, *: significance at the 1, 5, and 10% levels, respectively

Table 2: country pairs with a high bilateral volatility of the nominal exchange rate (5-year), for instance, feature 12% lower bilateral FPE ($e^{-0.125} - 1 = -0.12$).

5.2 Heterogeneity over time and country-size

The trade literature has highlighted a significant heterogeneity in the impact of exchange rate volatility along several dimensions, such as size (Micco et al., 2003; Baldwin, 2006; Santos Silva & Tenreyro, 2010) and time period (De Sousa, 2012).

To check for the presence of heterogeneity in the role of exchange rate volatility also in financial markets, we start from considering the time dimension.

In columns (1a) of Table 4, we include a Period 2 dummy covering the 2008–2017 period, and its interaction with the binary exchange rate volatility, as in equation (2). Since the exchange rate volatility displays a countercyclical dynamic, as shown in Figs. 1 and 2, with a marked rise associated with the crisis period, in columns (1b), we further split the Period 2 into a crisis (2008–2012) and a post-crisis period (2013–2017).

Columns (#a) show that the negative effect of exchange rate volatility on bilateral cross-border investments has dramatically decreased: column (1a), for instance, shows that the average -12% of Table 2 is the aggregated result of a larger negative impact in the first period ($e^{-0.235} - 1 = -0.21$) and an almost null effect in the second period ($e^{-0.235+0.210} - 1 = -0.02$). When splitting the second period into crisis and post-crisis, in columns (#b), we observe more specifically that the reduction of the exchange rate volatility effect over time is confined to the post-crisis period. Indeed, the negative impact of stock exchange volatility has almost vanished in the post-crisis period, while in the crisis period, when the exchange volatility experienced a peak, only a marginally significant and non-systematic decrease (only for the nominal exchange rate measure) is detected.

These results are consistent with the idea that the deterring role of exchange rate volatility may depend upon the importance of the associated risk for foreign investors: in periods with lower exchange rate volatility, the risk appears to be less significant, and cross-border investments are less affected by its presence.¹⁰

As far as the cross-country heterogeneity dimension is concerned, Saiki (2005) emphasized that the negative effect of exchange rate uncertainty on trade of goods and services is less of a concern for large developed countries for several reasons, including the availability of risk hedging in the financial markets.

In order to understand the heterogeneous impact of exchange rate volatility across financial markets, we compare its effect on the sample of large and small countries.

In Table 5, we split the sample into country-pairs with a large destination economy (GDP above the median, columns (1a) to (2b)), and country pairs with a small destination economy (GDP below the median, columns (3a) to (4b)).

¹⁰ In Table 8 in “Appendix 2”, we test the sensitivity of the results reported in Table 4 to alternative definitions of the offshore centers. We confirm the declining impact of exchange rate volatility on bilateral foreign investment. The decrease is present also in the crisis period; however, consistently with our conjecture, it is larger (in absolute value) and more statistically significant in the post-crisis period. For a detailed list of offshore centers in the different specifications, see “Appendix 1”.

Table 4 Heterogeneity over time

	High exchange rate volatility and the role of crises					
	H NER		H RER_CPI		H RER_PPI	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
H NER (5-year)	- 0.235*** (0.072)	- 0.235*** (0.071)				
H NER (5-year)_P2	0.210** (0.081)					
H NER (5-year)_Crises		0.156* (0.094)				
H NER (5-year)_Post Crises		0.252*** (0.090)				
H RER_CPI (5-year)			- 0.240*** (0.071)	- 0.239*** (0.071)		
H RER_CPI (5-year)_P2			0.191** (0.0836)			
H RER_CPI (5-year)_Crises				0.146 (0.098)		
H RER_CPI (5-year)_Post Crises				0.226** (0.096)		
H RER_PPI (5-year)					- 0.192** (0.079)	- 0.193** (0.079)
H RER_PPI (5-year)_P2					0.181* (0.093)	
H RER_PPI (5-year)_Crises						0.156 (0.109)
H RER_PPI (5-year)_Post crises						0.197* (0.104)
Period 2	- 0.599*** (0.074)		- 0.584*** (0.077)		- 0.628*** (0.077)	
Crises period		- 0.589*** (0.080)		- 0.565*** (0.084)		- 0.596*** (0.084)
Post crises		- 0.648*** (0.129)		- 0.583*** (0.133)		- 0.545*** (0.134)
Controls: size, gravity and capital mobility variables						
Observations	45,216	45,216	39,221	39,221	28,177	28,177
Adjusted R ²	0.722	0.722	0.718	0.718	0.745	0.745

This table reports the results of a Poisson Pseudo Maximum Likelihood regression (Santos Silva & Teneyro, 2006), as in Table 3. The columns (#a) consider the interaction of the exchange rate volatility measure with the Period 2 dummy (2008–2017), while columns (#b) consider the interaction of the exchange rate volatility measure with the crises dummy (2008–2012) and the post-crises dummy (2013–2017). All controls of Table 3 are included, but not reported

***, **, *: significance at the 1, 5, and 10% levels, respectively

Table 5 Heterogeneity over country-size

	High Exchange Rate volatility and size							
	High GDP USD _h		Low GDP USD _h					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
H NER (5-year)	-0.233*** (0.071)	-0.233*** (0.071)			-0.705*** (0.137)	-0.705*** (0.136)		
H NER (5-year)_P2	0.208** (0.080)				0.380** (0.168)			
H NER (5-year)_Crises		0.160* (0.094)				0.082 (0.188)		
H NER (5-year)_Post Crises		0.245*** (0.090)				0.594*** (0.187)		
H RER_CPI (5-year)			-0.245*** (0.070)	-0.244*** (0.070)			-0.719*** (0.161)	-0.731*** (0.161)
H RER_CPI (5-year)_P2			0.1921** (0.0831)				0.4711** (0.1841)	
H RER_CPI (5-year)_Crises				0.152 (0.097)				0.271 0.203
H RER_CPI (5-year)_Post Crises				0.224** (0.096)				0.627*** (0.205)
Period 2	-0.606*** (0.075)		-0.592*** (0.077)		-0.346* (0.191)		-0.375* (0.193)	
Crises period		-0.593*** (0.081)		-0.569*** (0.084)		-0.320 (0.196)		-0.393* (0.202)
Post crises		-0.636*** (0.130)		-0.572*** (0.133)		-0.634*** (0.280)		-0.645*** (0.298)

Table 5 (continued)

	High Exchange Rate volatility and size							
	High GDP USD _h		Low GDP USD _h					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Controls: size, gravity and capital mobility variables								
Observations	26913	26913	23571	23571	18303	18303	15650	15650
Adjusted R ²	0.728	0.728	0.724	0.724	0.552	0.563	0.578	0.582

This table is the same as Table 4, but the sample of countries is split by size into large (GDP above the median, columns (1a) to (2b)) and low (GDP below the median, columns (3a) to (4b)) destination economies

We observe, first, that the effect of exchange rate volatility in the pre-crisis period is always significantly larger for countries investing in small countries: a high nominal exchange rate volatility induces a 51% lower investment in small economies, versus a 21% lower investment in large economies (similar percentages for the real exchange rate volatility). Secondly, for both groups of countries, the decrease of investment in the crisis period, when the exchange rate volatility notably surge, is not statistically different from zero. Finally, after the crises, the role of exchange rate volatility vanishes for investment in larger destination countries, while it decreases, but is still present, for investment in smaller destination economies.

These findings seem to suggest that exchange rate volatility has a more significant impact in crisis periods rather than in stable ones, and on small destination economies than on large ones.

5.3 Implications for EMU countries

The occurrence of the global financial crisis and of the immediately subsequent European sovereign debt crisis has drastically weakened reciprocal portfolio investment among EMU member countries (Giofré & Sokolenko, 2022).

The findings reported so far suggest that the global trend of the exchange rate volatility may have played a role. Indeed, on the one hand, its secular decline may have induced investors to disregard the exchange rate risk shielded in a common currency. On the other hand, Euro-area members' economies are, on average, larger than the median country and then, accordingly to the findings above, relatively less sensitive to the exchange rate volatility issue. As a consequence, after the crisis, when the impact of exchange rate volatility on portfolio investments has globally decreased, the presence of a common currency area that eliminates this source of risk may have become less important, thus making the reciprocal investments among Euro-area members relatively less attractive.

However, we are unable to directly test the change in the impact of exchange rate volatility on FPE within the Euro area because the common currency entirely removes the exchange rate volatility. To deal with this issue, we can check if the decline in the common currency effect on cross-border investments persists, even after partialling out the dynamics of the exchange rate volatility.

Since the inception of the European Economic and Monetary Union, more than two decades ago, the effect of the common currency on cross-border investments has been very strong, with Eurozone countries disproportionately investing in their partners' assets, both in bonds (Lane, 2006; Giofré, 2013) and in equities (Lane & Milesi-Ferretti, 2007; Balta & Delgado, 2009; Berkel, 2004; Slavov, 2009). Since 2007, however, this tendency has greatly diminished.

Amid the general downturn of international financial flows after the financial crisis (Lane, 2013; Milesi-Ferretti & Tille, 2011), bilateral cross-border portfolio equity holdings within the EMU area experienced a more abrupt and persistent fall. The recent literature has highlighted that this markedly weaker effect of the common currency on cross-border investments was mainly due to the financial crisis and

Table 6 Exchange rate volatility and EMU

	EMU and high exchange rate volatility							
	EMU _s EMU _h				OLD _s OLD _h			
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
EMU	0.660*** (0.062)	0.664*** (0.063)	0.661*** (0.062)	0.661*** (0.062)	0.660*** (0.062)	0.660*** (0.062)	0.660*** (0.062)	0.660*** (0.062)
EMU_Crises Period	-0.184* (0.096)	-0.199** (0.096)	-0.175* (0.097)	-0.175* (0.097)	-0.177* (0.096)	-0.177* (0.096)	-0.182* (0.096)	-0.182* (0.096)
EMU_Post Crises	-0.133 (0.089)	-0.160* (0.090)	-0.123 (0.090)	-0.123 (0.090)	-0.128 (0.090)	-0.128 (0.090)	-0.129 (0.090)	-0.129 (0.090)
HNER (5-year)	-0.182** (0.075)		-0.183** (0.075)		-0.182** (0.075)		-0.183** (0.074)	
HNER (5-year)_Crises	0.164 (0.100)		0.165* (0.100)		0.165* (0.100)		0.164 (0.100)	
HNER (5-year)_Post Crises	0.233** (0.095)		0.234** (0.095)		0.234** (0.095)		0.234** (0.095)	
HRER_CPI (5-year)		-0.178** (0.073)		-0.183** (0.075)		-0.182** (0.075)		-0.183** (0.074)
HRER_CPI (5-year)_Crises		0.136 (0.103)		0.165* (0.100)		0.165* (0.100)		0.164 (0.100)
HRER_CPI (5-year)_Post Crises		0.202** (0.100)		0.234** (0.095)		0.234** (0.095)		0.234** (0.095)
Crises Period	-0.581*** (0.085)	-0.549*** (0.089)	-0.582*** (0.085)	-0.582*** (0.085)	-0.582*** (0.085)	-0.582*** (0.085)	-0.581*** (0.085)	-0.581*** (0.085)
Post crises	-0.627*** (0.131)	-0.562*** (0.136)	-0.627*** (0.131)	-0.627*** (0.131)	-0.627*** (0.131)	-0.627*** (0.131)	-0.627*** (0.131)	-0.627*** (0.131)

the ensuing sovereign debt crisis, rather than to the enlargement of the EMU itself, although these events occurred jointly after 2007 (Giofré & Sokolenko, 2022; Giofré, 2022).

In Table 6, we add the exchange rate volatility indicator to the estimation specification adopted by Giofré & Sokolenko (2022) in order to test if and how the inclusion of this new covariate and its dynamics over time helps explain the fall in bilateral investments among Euro area countries. Columns (#a) consider the volatility indicator based on the nominal exchange rate, while columns (#b) consider the indicator based on the CPI-based real exchange rate. Columns (1a) and (1b) consider the EMU countries' dummy, columns (2a) and (2b) consider the OLD EMU members' dummy, columns (3a) and (3b) consider OLD EMU countries investing in EMU countries, and columns (4a) and (4b) consider EMU countries investing in OLD EMU economies.¹¹

The first thing to be noted is that the results are very similar when considering the whole EMU area (columns (1a) and (1b)) or its sub-samples (columns (2a) to (4b)), which confirms the marginal role played in the area by the new members (Giofré & Sokolenko, 2022). After partialling out the exchange rate volatility indicator, we observe that the coefficient of the EMU dummy in the excluded period (pre-crisis) accounts for 93% higher bilateral investments; this effect drops to 61% in the crisis period and, interestingly, the drop becomes non-significant in the post-crisis period (except in column (1b), where the coefficient is however only marginally significant). The novel finding is therefore that, after accounting for the declining role of exchange rate risk hedging documented in the data, we do not observe any 'unexplained' significant fall in the EMU linkages after the crisis period. The global declining role of exchange rate risk hedging helps explain the persistent decline in bilateral equity investments within the Euro area after the financial crisis: the lower responsiveness of international investment to exchange rate volatility caused a decrease in significance of the full exchange risk hedging system represented by the common currency area.

Vermeulen (2013) showed a significant negative relationship between foreign equity holdings and stock market correlations during the financial crisis, while no such a relationship was detected before the crisis. Giofré (2022) focused specifically on the contraction of 'core' EMU countries' investments in the Euro area, and found that lower diversification opportunities, due to the increase in stock return correlation induced by the global crisis, played a significant role in explaining the change in the investment pattern of core countries in the Euro-area since 2007.¹²

Table 7 sets out the dynamics of the EMU linkages when accounting also for the bilateral stock return correlation.

As a measure of return correlation, we consider, consistently with Giofré (2022), a dichotomic index, $H\text{correl}_{s,h}$, equal to 1 if the correlation of the stock returns between country s and h is larger than the mean, and 0 otherwise. The stock return

¹¹ See "Appendix 1", for details on the definition of different EMU dummies.

¹² Following a consolidated classification, Giofré & Sokolenko (2022) consider Austria, Belgium, Finland, France, Germany, Luxembourg, and the Netherlands, as Euro 'core' countries, and Greece, Ireland, Italy, Portugal, and Spain, as Euro 'periphery' countries.

Table 7 EMU, exchange rate volatility and return correlation

	EMU, high exchange rate volatility and high return correlation							
	EMU _s EMU _h		OLD _s OLD _h		OLD _s EMU _h		EMU _s OLD _h	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
EMU	0.638*** (0.062)	0.643*** (0.063)	0.639*** (0.062)	0.644*** (0.063)	0.639*** (0.062)	0.643*** (0.063)	0.639*** (0.062)	0.643*** (0.063)
EMU_Crises Period	-0.167* (0.097)	-0.182* (0.097)	-0.158 (0.097)	-0.173* (0.097)	-0.160 (0.097)	-0.175* (0.097)	-0.165* (0.097)	-0.180* (0.097)
EMU_Post Crises	-0.117 (0.090)	-0.146 (0.091)	-0.108 (0.091)	-0.136 (0.091)	-0.112 (0.090)	-0.141 (0.091)	-0.113 (0.090)	-0.142 (0.091)
HNER (5-year)	-0.186** (0.075)		-0.186** (0.075)		-0.186** (0.075)		-0.186** (0.075)	
HNER (5-year)_Crises	0.165* (0.100)		0.166* (0.100)		0.166* (0.100)		0.165* (0.100)	
HNER (5-year)_Post Crises	0.230** (0.095)		0.230** (0.095)		0.230** (0.095)		0.230** (0.095)	
HRER_CPI (5-year)		-0.184** (0.073)		-0.184** (0.073)		-0.184** (0.073)		-0.184** (0.073)
HRER_CPI (5-year)_Crises		0.137 (0.103)		0.138 (0.103)		0.138 (0.103)		0.137 (0.103)
HRER_CPI (5-year)_Post Crises		0.197* (0.100)		0.198** (0.100)		0.197* (0.100)		0.197** (0.100)
H corre _{s,h} (1-year)	0.290** (0.117)	0.287** (0.121)	0.290** (0.117)	0.287** (0.121)	0.290** (0.117)	0.287** (0.121)	0.289** (0.117)	0.287** (0.121)
H corre _{s,h} (1-year)_Crises	-0.257 (0.166)	-0.246 (0.171)	-0.262 (0.166)	-0.251 (0.171)	-0.260 (0.166)	-0.250 (0.171)	-0.259 (0.166)	-0.248 (0.171)

Table 7 (continued)

EMU, high exchange rate volatility and high return correlation								
	EMU _s EMU _h		OLD _s OLD _h		OLD _s EMU _h		EMU _s OLD _h	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
H correl _{s,h} (1-year)_Post Crises	-0.285** (0.139)	-0.263* (0.145)	-0.287** (0.139)	-0.265* (0.145)	-0.287** (0.139)	-0.264* (0.145)	-0.286** (0.139)	-0.263* (0.145)
Crises period	-0.341* (0.177)	-0.320* (0.183)	-0.337* (0.177)	-0.317* (0.183)	-0.339* (0.177)	-0.318* (0.183)	-0.340* (0.177)	-0.319* (0.183)
Post crises	-0.354* (0.186)	-0.312 (0.193)	-0.353* (0.186)	-0.311 (0.193)	-0.353* (0.186)	-0.311 (0.193)	-0.353* (0.186)	-0.311 (0.193)
Controls: size, gravity and capital mobility variables								
Observations	41513	35823	41513	35823	41513	35823	41513	35823
Adjusted R ²	0.728	0.724	0.728	0.723	0.727	0.723	0.728	0.724

This table is the same as Table 6, with the addition of a binary regressor indicating a (1-year lagged) High stock return correlation between source and host economy

correlation is computed as the bilateral correlation of monthly returns in the previous year.

The results in regard to the declining role of exchange rate volatility after the crisis are confirmed, and so too are the results in regard to the stronger (negative) role of returns correlation found by Giofré (2022): the fall in the EMU linkages can be successfully explained by the forces driving these two factors.¹³

To sum up, the drop in bilateral EMU investment during the crisis period cannot be explained by exchange rate volatility because of its countercyclical nature; rather, it is explained by the decline in economic development and, more importantly, by deterioration of the control of corruption standards of Euro periphery countries (Giofré & Sokolenko, 2022). However, our findings suggest that, in the post-crisis period, when the countercyclical spikes of exchange rate volatility were absorbed, the persistent drop in bilateral portfolio investments in the Euro area has instead been driven by a weaker (negative) response to exchange rate volatility, besides a stronger (negative) response to diversification benefits (Giofré, 2022). In fact, after accounting for these dynamics, the evidence of a distinctive fall in bilateral foreign investments among Euro members in the post-crisis period disappears.

6 Conclusions

In this paper we have tested the conjecture that the generalized decline in exchange rate volatility, probably correlated with a lower perceived currency risk, is paired with a decreased need for risk exchange hedging among foreign portfolio equity investors. We have found that the significant negative association between bilateral foreign portfolio investments and the volatility of the exchange rate has significantly weakened worldwide since 2012, especially for large economies.

We have discussed the implications of these results for the reciprocal investments among Euro-area members. Giofré and Sokolenko (2022) highlighted that the crisis drastically weakened the financial linkages among original members after 2007. The decline in economic development and the deterioration of the control of corruption standards of Euro periphery countries were found to be the drivers of the fall in the crisis period. This paper helps explain the persistent reduction of reciprocal EMU investment even in the post-crisis period. The weaker response of portfolio investments to a declining exchange rate risk, combined with the diversification motive, can account for the lower bilateral investments after the crisis.

In particular, the generalized reduction in the perceived exchange rate risk, as a consequence of the global decline of exchange rate volatility, raises a fatal challenge to the relevance of the common currency area and hence to the attractiveness of reciprocal investments by member countries.

¹³ As a robustness check, Table 9 in “Appendix 2” reports the results of the same regression run in Table 7, but including the returns’ correlation at the same time lag (5 preceding years) used for the exchange rate volatility. Results are qualitatively similar.

Appendix 1: Data appendix

Dependent variable

Foreign Portfolio Equities: Cross-border holdings of equities issued by host country residents and held by the source country residents. Source: Coordinated Portfolio Investment Survey (IMF).

Investing and destination countries

Argentina, Australia, Austria, Bahrain, Barbados, Belgium, Brazil, Bulgaria, Canada, Chile, China Hong Kong, China, Colombia, Costa Rica, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Korea, Kuwait, Latvia, Lebanon, Lithuania, Luxembourg, Malaysia, Malta, Mauritius, Mexico, Mongolia, Netherlands, New Zealand, Norway, Pakistan, Panama, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, United States, Uruguay, Venezuela.

Offshore centres

Note that the below-mentioned offshore centres are considered as investing but not as destination economies.

Baseline specification: the Netherlands, Luxembourg, Hong Kong SAR, Ireland, and Singapore (Damgaard et al., 2018).

Robustness: Table 8, columns (#a): Bahrain, Hong Kong, Cyprus, Ireland, Luxembourg, Malta, Mauritius, the Netherlands, Panama, Singapore, Switzerland, Belgium, United Kingdom (Lane & Milesi-Ferretti, 2017); columns (#b): Bahrain, Barbados, Hong Kong, Cyprus, Ireland, Luxembourg, Malta, Mauritius, Panama, Singapore, Switzerland, United Kingdom, Latvia, Uruguay (Zoromé, 2007).

Exchange rate volatility

Nominal exchange rate

The volatility of the exchange rate is defined as the standard deviation of the first-difference of the monthly natural logarithm of the bilateral nominal exchange rate in the 5 preceding years (1 preceding year, in the alternative definition).

Source: International Financial Statistics (IMF).

Real exchange rate (CPI based)

The volatility of the CPI-based real exchange rate is defined as the nominal exchange rate, but the consumer price index (CPI) is used to convert the nominal into the real exchange rate.

Source: International Financial Statistics (IMF).

Real exchange rate (PPI based)

The volatility of the PPI-based real exchange rate is defined as the nominal exchange rate, but the producer price index (PPI) is used to convert the nominal into the real exchange rate.

Source: International Financial Statistics (IMF).

Stock returns' correlation

The correlation between the stock market returns of the host and source country, expressed in US dollars, is computed as the lagged correlation of monthly returns in the previous year.

Source: Monthly Monetary and Financial Statistics (MEI), OECD.

Size variables

GDP: Gross Domestic Product, Current U.S. Dollars, Annual, Not Seasonally Adjusted. Federal Reserve Economic Data (FRED).

Gravity variables

Distance: Measure of the distance between the capital of the source and the host country, estimated with the great circle distance in miles. Source: CEPII's distance measures, the GeoDist database.

Border dummy: Dummy variable that takes the value equal to 1 when a pair of countries have at least one border in common, and 0 otherwise. Source: CEPII's distance measures, the GeoDist database.

Colonial dummy: Dummy variable that takes the value equal to 1 for those pair of countries that share a common colonial past, and 0 otherwise. Source: CEPII's distance measures, the GeoDist database.

Language dummy: Dummy variable that takes the value equal to 1 when a pair of countries have an official language in common, and 0 otherwise. Source: CEPII's distance measures, the GeoDist database.

Legal origins dummy: Dummy variable that takes the value equal to 1 for those pair of countries that share a common origin (British, French, Socialist, German or Scandinavian).

Capital mobility

Capital mobility: Rank from 1 to 10, denoting increasing capital mobility, for both the source and the host country. Source: Economic Freedom of the World. (<https://www.transparency.org/en/cpi>).

EMU dummies

EMU_sEMU_h : Dummy variable that takes the value equal to 1 for a country-pair in which both the investing and the destination country are members of the EMU, and 0 otherwise.

OLD_sOLD_h : Dummy variable that takes the value equal to 1 for a country-pair in which both the investing and the destination country are original members of the EMU, and 0 otherwise.

OLD_sEMU_h : Dummy variable that takes the value equal to 1 for a country-pair in which the investing country is an original EMU member and the destination country is an EMU country, either original or new, i.e., entered in the EMU after the enlargement (0 otherwise)

EMU_sOLD_h : Dummy variable that takes the value equal to 1 for a country-pair in which the investing country is an EMU country, either original or new, i.e., entered in the EMU after the enlargement, and the destination country is an original EMU member country (0 otherwise).

Appendix 2: Additional tables and figures

See Fig. 3 and Tables 8 and 9.

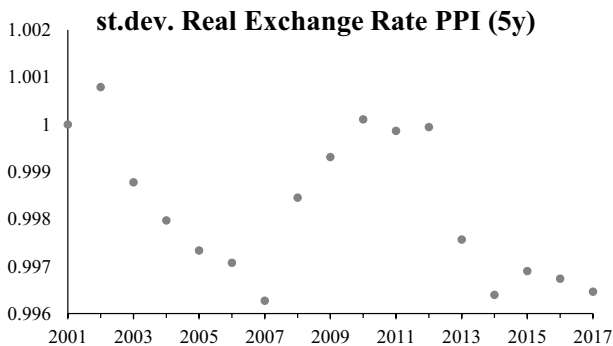


Fig. 3 Volatility of bilateral real exchange rate (PPI based). This figure is the same as panel (b) of Fig. 2, but the volatility of the real exchange rate is based on the Producer Price Index, rather than on the Consumer Price Index

Table 8 Alternative offshore classifications

High Exchange rate volatility: alternative offshore classifications								
IMF (2007)			L-MF (2017)					
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
H NER (5-year)	- 0.299*** (0.066)	- 0.300*** (0.067)			- 0.298*** (0.067)	- 0.298*** (0.067)		
H NER (5-year)_P2	0.267*** (0.079)				0.264*** (0.080)			
H NER (5-year)_Crises		0.215** (0.093)				0.210** (0.094)		
H NER (5-year)_Post Crises		0.307*** (0.090)				0.306*** (0.091)		
H RER_CPI (5-year)			- 0.303*** (0.072)	- 0.302*** (0.072)			- 0.301*** (0.072)	- 0.299*** (0.072)
H RER_CPI (5-year)_P2			0.204** (0.085)				0.201** (0.085)	
H RER_CPI (5-year)_Crises				0.171* (0.099)				0.165* (0.099)
H RER_CPI (5-year)_Post Crises				0.228** (0.099)				0.227** (0.099)
Period 2	- 0.645*** (0.080)		- 0.607*** (0.081)		- 0.640*** (0.081)		- 0.601*** (0.082)	
Crises period		- 0.641*** (0.086)		- 0.600*** (0.088)		- 0.636*** (0.088)		- 0.594*** (0.089)
Post crises		- 0.718*** (0.131)		- 0.630*** (0.134)		- 0.718*** (0.133)		- 0.630*** (0.136)

Table 8 (continued)

High Exchange rate volatility: alternative offshore classifications						
IMF (2007)			L-MF (2017)			
	(1a)	(1b)	(2a)	(2b)	(3a)	(4b)
Controls: size, gravity and capital mobility variables						
Observations	38,344	38,344	32,913	32,913	38,585	33,119
Adjusted R ²	0.703	0.703	0.699	0.699	0.705	0.702

This table is the same as Table 4, but the offshore countries are defined according to two alternative definitions: columns (1a) to (2b) follow the classification in Zoromé (2007), while columns (3a) to (4b) follow (Lane & Milesi-Ferretti, 2017) (see “Appendix 1” for details)

Table 9 EMU, exchange rate volatility and returns correlation (5 year lag)

	EMU, High exchange rate volatility and high return correlation (5y-lag)			
	EMU _s EMU _h		OLD _s OLD _h	
	(1a)	(1b)	(2a)	(2b)
	OLD _s EMU _h		EMU _s OLD _h	
	(3a)	(3b)	(4a)	(4b)
EMU	0.614*** (0.062)	0.616*** (0.063)	0.615*** (0.062)	0.617*** (0.063)
EMU_Crises_Period	-0.147 (0.097)	-0.161* (0.097)	-0.137 (0.098)	-0.154 (0.097)
EMU_Post_Crises	-0.105 (0.090)	-0.131 (0.090)	-0.096 (0.090)	-0.126 (0.090)
H NER (5-year)	-0.191** (0.075)	-0.191** (0.075)	-0.191** (0.075)	-0.191** (0.075)
H NER (5-year)_Crises	0.165* (0.100)	0.166* (0.100)	0.166* (0.100)	0.165* (0.100)
H NER (5-year)_Post Crises	0.224** (0.094)	0.224** (0.094)	0.224** (0.094)	0.224** (0.094)
H RER_CPI (5-year)	-0.193*** (0.073)	-0.193*** (0.073)	-0.193*** (0.073)	-0.193*** (0.073)
H RER_CPI (5-year)_Crises	0.139 (0.103)	0.139 (0.103)	0.140 (0.102)	0.139 (0.102)
H RER_CPI (5-year)_Post Crises	0.190* (0.100)	0.190* (0.100)	0.191* (0.100)	0.190* (0.100)
H corre _{s,h} (5-year)	0.641*** (0.110)	0.654*** (0.115)	0.640*** (0.110)	0.654*** (0.115)
H corre _{s,h} (5-year)_Crises	-0.568*** (0.161)	-0.559*** (0.167)	-0.573*** (0.162)	-0.563*** (0.167)
H corre _{s,h} (5-year)_Post Crises	-0.538*** (0.147)	-0.542*** (0.154)	-0.542*** (0.147)	-0.544*** (0.154)

Table 9 (continued)

EMU, High exchange rate volatility and high return correlation (5y-lag)		OLD _s OLD _h		OLD _s EMU _h		EMU _s OLD _h	
EMU _s EMU _h		OLD _s OLD _h		OLD _s EMU _h		EMU _s OLD _h	
(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
Crises Period	- 0.043 (0.172)	- 0.039 (0.171)	- 0.014 (0.179)	- 0.041 (0.171)	- 0.016 (0.179)	- 0.041 (0.171)	- 0.017 (0.179)
Post crises	- 0.103 (0.192)	- 0.100 (0.191)	- 0.030 (0.198)	- 0.102 (0.192)	- 0.032 (0.198)	- 0.101 (0.192)	- 0.032 (0.198)
Controls: size, gravity and capital mobility variables							
Observations	41563	41563	35871	41563	35871	41563	35871
Adjusted R ²	0.728	0.728	0.724	0.728	0.724	0.728	0.724

This table is the same as Table 7, but the binary regressor of High stock return correlations is constructed over the previous 5-year lagged monthly stock return correlation, rather than on the previous year

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