Exchange rate uncertainty and export performance: what meta-analysis reveals?

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Exchange rate uncertainty and export performance: what meta-analysis reveals?[1]

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Abstract: Are exchange rate uncertainty affect export performance? This paper assesses this question using meta-analysis on a sample of 56 studies from 1984 to 2013 for the purpose of cumulating the findings across studies in order to reconcile the conflicting results of prior researches. The total sample meta-analysis lends stronger support of the association of risk aversion and hedging instruments with the controversial relation between exchange volatility and exports widely expected either theoretically or empirically. Then, subgroup meta-analysis is used to provide further evidence on the results already obtained by decomposing our sample into four subgroups depending to the nature of countries and the models explored to determine volatility. The evidence from subgroups is not supportive of this association. Furthermore and contrary to expectations, neither differential price volatility, nor asymmetry, nor nonlinearities are significantly linked to conflicting results.

Keywords: Exchange rate uncertainty, exports, meta-analysis.

[1]This paper aims at reconciling the inconsistent results of prior studies on the relationship between exchange rate volatility and exports performance. The views expressed in this paper belong to the authors. Our warm thanks go to Hichem KHLIF for his helpful comments and suggestions.

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1. Introduction

Since the breakdown of the Bretton Woods system, the volatility of exchange rate has been one of the main subjects of intense empirical financial research. Although there is a death of studies on the relationship between exchange rate uncertainty and trade performance (for instance, Akhtar and Hilton (1984), Gotur (1985), Bailey et al. (1986), Koray and Lastrapes (1989), Arize (1995), McKenzie and Brooks (1997), McKenzie (1998), Bacchetta and van Wincoop (2000), Aristotelous (2001), Vergil (2001), Bahmani-Oskooee (2002), Nabli and Varoudakis (2002), Arize et al. (2004), among others), the empirical evidence is rather mixed.

Drawing on various studies, the substantial empirical literature examining the link between exchange-rate uncertainty and trade has not found a consistent relationship. In fact, the excessive volatile behavior of commodity prices increases the exchange volatility that can be transmitted to exports leading to a decrease of its level (e.g. Bailey et al. (1986), Bahmani-Oskooee and Ltaifa (1992), Chowdhury (1993) and Dell'Ariccia (1999)). However, there are other researches suggesting that exchange adjustment can enhance export performance (e.g. McKenzie (1998), Achy and Sekkat (2003), Rey (2006), Egert and Zumaquero (2007) and Bouoiyour and Selmi (2013a) etc…). Up to now, there are several studies investigating the linkage between exchange volatility and exports. Meanwhile, very few studies advance convincing arguments on the ambiguous link that can characterize the relationship between exchange volatility and exports.

Despite this large number of studies on the considered issue, the theory upon this relationship varies and there is no clear-cut linkage to be found. There are still analytical gaps especially methodological. Our paper attempts to reconcile these mixed results and this controversial linkage. The purpose of this study is to assess the interaction between exchange rate volatility and exports performance using meta-analysis framework developed by Hunter et al. (1982) for a sample of 56 articles between 1984 and 2013. Importantly, by carrying out meta-analysis technique, we try throughout the rest of this study to highlight the main factors behind the ambiguous relationship exchange uncertainty and trade performance.

The remainder of the paper is organized as follows: Section 2 presents the empirical aspects on the issue of exchange rate volatility's effects on exports performance. Section 3 describes our methodological framework. Section 4 discusses our main empirical results. Section 5 concludes our paper.

2. Literature survey

2.1. Brief overview

Given the attention to the relationship between exchange rate uncertainty and exports performance, a considerable literature has been devoted to study it (e.g. Bélanger and Gutiérrez (1990), Dell'Ariccia (1999), and Ozturk (2006), etc…). Appendix A provides a chronological list of the literature on this field. From the review of these empirical studies, we notice that:

(i) the assumption whereby the exchange volatility either in nominal or real terms has an ambiguous effect on trade either total, sectoral or bilateral exports (e.g. McKenzie (1999), Achy and Sekkat (2003) and Rey (2006), etc…); (ii) The nature of countries either developed, in transition or developing economies can be attributable to conflicting results in terms of the link in question; (ii) Different works use several measures of volatility without explaining in the majority of them the main causes behind the choice of each model. Several studies on this topic such as McKenzie and Brooks (1997), Nabli and Varoudakis (2002) and Rey (2006) have shown that standard deviation, moving average deviation and absolute deviation can be called "naïve models" considered as a good measures of exchange volatility. Nonetheless, other empirical studies have demonstrated that GARCH extensions are better (e.g. Clarck and Wei (2004) and Bouoiyour and Selmi (2012)) and have found that the results in terms of the effects of exchange volatility on exports are more robust using GARCH extensions than with naïve models. In addition, many works consider linear models to determine exchange rate volatility, in particular standard GARCH (e.g. Achy and Sekkat (2003), Rey (2006), Bouoiyour and Selmi (2012)); others used nonlinear GARCH models[3] (e.g. Egert and Zumaquero (2007) and Bouoiyour and Selmi (2013b)).

Indeed, subgroup meta-analysis is explored in this study to provide further evidence on the results that will be obtained using total sample meta-analysis by decomposing our sample into four subgroups: studies focused on the case of developed countries using naïve models (*DN*), on developed countries using GARCH extensions (*DG*), on developing countries using naïve specifications (*SN*), on developing countries carrying out GARCH models (*SG*).

[3] The conditional variance here follows two different processes depending on the sign of the error terms or according to the dynamics of the conditional deviation of returns.

2.2. Previous arguments of conflicting results

2.2.1. Differential price volatility

The relationship between exchange rate volatility and exports performance has been investigated in several researches but no consistent results have been up to now found. The subject on how the exchange rate uncertainty impacts trade has been investigated and the results have varied widely. Some studies have found a negative interaction between currency risk and exports (e.g. Baum et al (2001), Vergil (2001) and Rey (2006), etc…). Others have found positive effects (e.g. De Grauwe (1992) and Achy and Sekkat (2003), among others). More recently, Egert and Zumaquero (2007), Bouoiyour and Selmi (2012) and Bouoiyour and Selmi (2013a) argue that there is an ambiguous effect closely dependent to assumptions used in relation to the exchange rate volatility including whether to carry out the nominal or the real exchange rate. Alternatively, for floating regime, the nominal exchange floats excessively, this means that it should play a main role of changes in real effective exchange rate affecting considerably trade performance (e.g. Brooks and McKenzie, 1997). However, for fixed exchange rate regime where each currency maintains a stable value against an anchor currency or composite of currencies or a crawling peg regime where the nominal exchange rate moves into a target, the inclusion of the differential price uncertainty seems quite legitimate.

2.2.2. Risk aversion

Various researches advance the risk averse as a key reason behind the controversial link between exchange rate uncertainty and exports performance (e.g. Achy and Sekkat (2003), Rey (2006) and Hosseini and Moghadassi (2010)). A high degree of competitiveness in one sector leads it less vulnerable to exchange rate volatility. This implies, therefore, that exporters will be more averse to the risk. Several works reveal that an excessive exchange rate volatility generates uncertainty which increases the level of riskiness of trading activities and this will eventually depress trade. This negative effect can be intensely attributable to imperfect exchange and trade markets particularly in developing countries and to very cost hedging. Accordingly, Krugman (1989) and Daroodian (1999) argue that risk-aversion hypothesis exports may be negatively correlated with exchange rate volatility. However, Bouoiyour and Selmi (2012) show that if exporters are sufficiently risk-averse, an increase in exchange rate variability acts as an incentive to exporters to strength trade performance. Briefly, they provide evidence that higher risk associated with ups and downs exchange rate' movements can lead to great opportunity increasing exports performance.

2.2.3. Hedges

Several studies have assessed the association between hedges and the impact of exchange rate uncertainty on exports performance (for instance, Clarck (1973), Chen and Rogoff (2003) and Cashin et al. (2004), among others). One of the main motivation behind the literature was the insight that, in absence of access to hedging instruments, risk averse exporters would be intensely affected by exchange volatility or currency risk. Then, exports would be, of course, influenced negatively. Exchange rate volatility can be hedged through financial instruments including exchange rate derivatives or foreign currency debt or through the operational setup of the exporting firm. These instruments can be considered as standard tools for hedging risks related to exchange rates or commodities prices. Furthermore, it has been widely shown that the presence of hedge instruments or the lack of hedging might be determinant of controversial relationship between exchange rate uncertainty and exports performance either theoretically or empirically (e.g. Bélanger and Gutiérrez (1990), Vergil (2001), Achy and Sekkat (2003), Clarck and Wei (2004), etc…).

2.2.4. Asymmetry

While a variety of empirical studies on the issue of the possible interaction between exchange rate uncertainty and exports performance, the majority of them proceed under the assumption of symmetry, meaning that no difference exists between the risk effects of exchange rate appreciation and depreciation. Some works emerge from the evidence of possible asymmetrical effects on export price adjustments to exchange rate changes (e.g. Kanas (1997) and Mahdavi (2000), among others). Very few researches try to assess whether exchange rate volatility acts symmetrically or asymmetrically (e.g. Bouoiyour and Selmi, 2012). This study shows that changes in the exports performance differ between real depreciations and real appreciations and then provide evidence that the risk of economic exposure exhibits asymmetry. Monetary policy is a possible explanation of the asymmetric response of real exchange rate to oil shocks. Accordingly, Tatom (1993) argue that "monetary policy is contributing factor in asymmetry". Nonetheless, in such economies, the monetary policy has proved very good at keeping price stability to absorb several external shocks including those of oil and then to remedy an overvaluation of real exchange rate transmitted then to exports (e.g. Bouoiyour and Selmi, 2013b). Indeed, the asymmetric exchange rate uncertainty effect can reinforce the positive or negative effect of depreciation or appreciation leading to controversial relationship between currency risk and trade.

2.2.5. Nonlinearities

As mentioned above, a large literature survey on the relationship between exchange rate volatility and trade performance has shown that an increase in exchange rate volatility will have adverse effects on the volume of international trade (e.g. Akhtar and Hilton (1984), Gotur (1985), Bailey et al. (1986), McKenzie (1998), Bahmani-Oskooee (2002), among others). However, other strand of literature has shown that exchange rate volatility may have a positive effect on exports performance (e.g. Franke (1991)), negative effect (e.g. Koray and Latspears (1989) and Klein (1990)) or insignificant (e.g. Pick (1990) and Arize (1995)) depending on various features. Nonlinearities can be attributable to these conflicting results (e.g. Egert and Zumaquero (2007) and Bouoiyour and Selmi (2013 a)). Accordingly, Baum et al. (2004) argue that "research making use of aggregate measures, which assume that a single, linear relation exists at the aggregate level, is not likely to be successful. The effect of exchange rate uncertainty on trade flows appears complex…" This phenomenon (i.e. nonlinearity) is applicable to economies sensitive to sudden unexpected income flows from resource discoveries that are temporary (e.g. Mohadess and Pesaran, 2013).

3. Meta-analysis methodology

Since the majority of researches on the link between exchange rate uncertainty and exports performance where always contradictory and inconclusive, meta-analysis could be a useful and valuable tool in clarifying the inconsistent results. The present study follows the same procedure carried out by Hunter et al. (1982). Firstly, we start by determining the mean correlation $(\bar{r})$ expressed as follows:

$$\bar{r} = \frac{\sum (N_i r_i)}{\sum N_i} \tag{1}$$

Where N_i : the sample size for study i and r_i the Pearson correlation coefficient for study i

At that step and following Khlif and Souissi (2010), it is crucial to determine the unbiased of the population variance S_p^2 represented by:

$$S_p^2 = S_r^2 - S_e^2 \tag{2}$$

Where S_r^2 : The observed variance equal to $\sum\left[N_i(r_i-\bar{r})^2\right]/\sum N_i$

S_e^2 : The estimate of sampling error variance equal to $\left[(1-\bar{r}^2)^2 k\right]/\sum N_i$

Secondly, we determine the 95 percent confidence interval. As our sample size is larger than 30, the z-statistic can be written as follows:

$$\left[\bar{r}-0.975S_P, \bar{r}+0.975S_p\right]=\left[\bar{r}-1.96S_p, \bar{r}+1.96.S_p\right] \quad (3)$$

Thirdly, while trying to test the statistical validity of the considered model, Hunter et al. (1982) proposed the statistic mentioned below:

$$\chi^2_{k-1}=\frac{NS_r^2}{(1-\bar{r}^2)^2}=k\frac{S_r^2}{S_e^2} \quad (4)$$

4. EMPIRICAL RESULTS

4.1. Publication bias

Before starting the meta-procedure mentioned above, we should first take attention to the publication bias or "the file drawer problem" which is essentially the consequence of research papers' selection. There are meta-studies taking into account published works, both published and unpublished studies and there is also a sample of studies which look more favorably on the works with significant results. This leads us to use Egger's test to capture publication bias for our sample (i.e. 56 studies[4]). From Table 1, we notice that the intercept associated to all studies which have a direct influence on t-statistics is positive and statistically significant. Similarly, the coefficient of bias is positive and significant that leads to accept the existence of publication bias[5].

[4] The sample studies and their characteristics are described in Appendices A and B.

[5] For more details about publication bias, see Doucouliagos and Stanley (2008).

Table 1. Egger's test

Intercept	0.18181
Standard error	0.04331
95% Lower limit (2-tailed)	0.07048
95% Upper limit (2-tailed)	0.29314
t-value	4.1980
P-value (1-tailed)	0.00425
P-value (2-tailed)	0.00851

4.2. Meta-analysis estimates

4.2.1. Differential price volatility

The evidence from the total sample meta-analysis suggests that there is no significant association between hedging and the relationship between exchange rate volatility and exports performance (see Table 2). These results do not change substantively depending to subgroup-to-subgroup variation (i.e. developed countries using naïve models, developed countries using GARCH specifications, developing countries using naïve models, developing countries using GARCH extensions). Given these results, the evidence from both the global meta-analysis and different subgroups meta-analysis does not provide support to an intense association between differential price volatility (by supposing that there is no correlation between nominal effective exchange rate and real effective exchange rate) and the ambiguous interaction between exchange rate uncertainty and trade performance.

Table 2. Differential price volatility

	N	k	$\bar{r}$	S_r^2	S_e^2	S_p^2	*Lower of CI*	*Upper of CI*	χ^2_{k-1}
General	1,658	8	0,063	0,00091245	0,09898185	-0,0980694	-0,03261766	0,158617662	0,073747
DN	1,721	2	0,059	0,0006754	0,09982875	-0,09915335	-0,03767451	0,155674515	0,01353118
DG	1,911	3	0,044	0,0004171	0,10303675	-0,10261965	-0,05605416	0,14405416	0,01214427
SN	1,916	1	0,051	0,00056184	0,10153337	-0,10097153	-0,04744724	0,149447243	0,00553354
SG	1,664	2	0,046	0,00039696	0,10260609	-0,10220913	-0,0536539	0,145653901	0,00773753

Notes: *CI:* confidence interval.

4.2.2. Risk aversion

From the total sample meta-analysis, we show that the risk aversion is associated with a mean correlation $\bar{r} = 0.137$ and a confidence interval of [-0.064 ; 0.138] (see Table 3). The evidence suggests that risk aversion is significantly associated but not mainly conductive to the controversial interaction between exchange rate uncertainty and trade performance. However, when the same analysis is performed to the different subgroups (*DN ; DG, SN* and *SG*), the significant association is not found with $\bar{r} = 0.059$, $\bar{r} = 0.028$, $\bar{r} = 0.064$ and $\bar{r} = 0.079$, respectively. Furthermore, the computed chi-square statistic χ^2_{k-1} confirms the strong empirical validity of this finding in general meta-analysis. These results are in favour of the hypothesis that risk aversion may be the main source behind the conflicting results on the issue in question. However, The inconsistency observable when moving to subgroup meta-analysis is perhaps owing to the nature of countries (i.e. developed or developing economies) and the model used to determine volatility (i.e. naïve or GARCH models)[6].

Table 3. Risk aversion

	N	k	$\bar{r}$	S_r^2	S_e^2	S_p^2	*Lower of CI*	*Upper of CI*	χ^2_{k-1}
General	3,147	48	0,137	0,00075279	0,10455118	-0,10379839	-0,06420343	0,13820343	0,34561193*
DN	1,864	19	0,059	0,00073152	0,09982875	-0,09909723	-0,0376198	0,155619798	0,13922726
DG	1,379	13	0,028	0,00012189	0,10651454	-0,10639266	-0,07573284	0,13173284	0,01487617
SN	1,266	9	0,064	0,00058462	0,09877069	-0,09818607	-0,03173142	0,159731421	0,05327022
SG	1,214	7	0,079	0,00085418	0,09563033	-0,09477615	-0,01340674	0,171406744	0,0625247

Notes: * significant at 5%; *CI:* confidence interval.

4.2.3. Hedges

Using naïve models, the evidence of significant and stronger correlation between hedges and the relation between exchange rate volatility and exports is supported for both developed and developing countries with mean correlation equal successively to $\bar{r} = 0.333$ and $\bar{r} = 0.452$ (See Table 4). However, there is not significant association when carrying out more sophisticated models including GARCH extensions for the case of developed economies

[6] For more details, see Appendix A.

with $\bar{r} = 0.039$. Additionally, the computed chi-square statistic χ^2_{k-1} confirms the strong empirical validity of this finding. Similar results are obtained from the subgroup meta-analysis, except for *SG* and *DG* where the association seems to be insignificant. These results are in favour of the hypothesis that hedging may be a potential source of the ambiguous sign that characterize the link between exchange rate uncertainty and exports performance. However, these observation outcomes depend intensely to subgroup-to-subgroup variation.

Table 4. Hedges

	N	k	$\bar{r}$	S_r^2	S_e^2	S_p^2	*Lower of CI*	*Upper of CI*	χ^2_{k-1}
General	2,337	21	0,359	0,04351899	0,04438118	-0,0008622	0,35815936	0,359840644	20,5920305*
DN	1,864	8	0,333	0,02232632	0,04805455	-0,02572822	0,30791498	0,358085019	3,71682997*
DG	1,578	5	0,039	0,00025925	0,09975383	-0,09949458	-0,05800722	0,13600722	0,0129945
SN	1,866	7	0,452	0,04117858	0,03243724	0,00874133	0,4405228	0,4434772	8,88639128*
SG	1,613	1	0,45	0,03528111	0,03267444	0,00260666	0,4425415	0,447458502	1,07977686

Notes: * significant at 5%; *CI:* confidence interval.

4.2.4. Asymmetry

From Table 5, the results of both total sample and subgroups meta-analyses provide evidence that there is no significant interaction between the occurrence of asymmetry and the controversial relationship between exchange volatility and exports performance with mean correlation for general meta-analysis $\bar{r} = 0.049$ and confidence interval [-0.045 ;0.143]. Importantly, the computed chi-square statistic χ^2_{k-1} confirms the strong empirical invalidity of this finding in all considered cases (i.e. in both general meta-analysis and the various subgroups studied, the association between asymmetry and the conflicting results in terms of the linkage between exchange rate uncertainty and exports performance appears insignificant). These inconsistent results may be due to the nature of considered countries (see Appendix A) or the model explored to determine volatility including GARCH extensions.

Table 5. Asymmetry

	N	k	$\bar{r}$	S_r^2	S_e^2	S_p^2	*Lower of CI*	*Upper of CI*	χ^2_{k-1}
General	2,469	5	0,049	0,00086909	0,0973521	-0,09648301	-0,04507093	0,143070933	0,04463647
DN	1,7	1	0,041	0,00030761	0,09899688	-0,09868927	-0,05522204	0,137222036	0,00310727
DG	1,711	2	0,063	0,000731	0,09450689	-0,09377589	-0,0284315	0,154431495	0,0154697
SN	1,693	1	0,047	0,00040257	0,097762	-0,09735944	-0,04792545	0,14192545	0,00411782
SG	1,717	1	0,05	0,00046206	0,09714747	-0,09668541	-0,04426828	0,144268279	0,00475623

Notes: *CI:* confidence interval.

4.2.5. Nonlinearities

The total sample meta-analysis based on 7 articles indicates the occurrence of significant association between nonlinearities and the considered linkage between exchange uncertainty and exports performance with $\bar{r} = 0.111$ and with the respective confidence interval [0.042; 0.179] (see Table 6). Nonetheless, the computed chi-square statistic χ^2_{k-1} shows that this finding is insignificant. According to these results, the evidence from either global or subgroup meta-analysis does not provide strong support to the hypothesis whereby nonlinearities may be attributable to the conflicting outcomes on the relationship between exchange rate volatility and exports performance. This insignificant association might be attributable to the economic structure and regulatory environment of studied countries.

Table 6. Nonlinearities

	N	k	$\bar{r}$	S_r^2	S_e^2	S_p^2	*Lower of CI*	*Upper of CI*	χ^2_{k-1}
General	3,054	7	0,111	0,00503659	0,07508988	-0,0700533	0,04269804	0,179301963	0,46951868
DN	2,11	3	0,082	0,00134799	0,08006879	-0,07872079	0,00524723	0,158752774	0,05050636
DG	2,1	2	0,047	0,00044075	0,08629064	-0,08584989	-0,03670364	0,130703643	0,01021549
SN	1,612	1	0,05	0,0003829	0,08574822	-0,08536532	-0,03323119	0,133231188	0,00446537
SG	1,649	1	0,033	0,00017062	0,08884456	-0,08867394	-0,05345709	0,119457093	0,00192042

Notes: *CI:* confidence interval.

5. Conclusion

This study is conducted in order to develop the existing literature on the controversial relationship between exchange rate uncertainty and exports performance and find better ways and additional explanations of the conflicting results widely expected either theoretically or empirically.

This meta-analysis has improved our understanding by integrating various outcomes of several studies on this issue. More precisely, the present research incorporates different explanatory variables (differential price volatility, risk aversion, hedges, asymmetry and nonlinearities) to assess if there are the main sources attributable to the study-to-study variation or the mixed results in terms of the link in question.

Interestingly, our total sample meta-analysis provides a support for the significant association of risk aversion and hedging instruments with the ambiguous relation between exchange volatility and trade performance. These results change substantively if we perform the same analysis to subgroups or more precisely depending to the nature of countries (i.e. developed or developing countries) and to the models carried out to determine volatility (i.e. naïve or GARCH models). However, contrary to expectations, neither differential price volatility, nor asymmetry, nor nonlinearities are significantly linked to the conflicting results.

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Appendices

Appendix A. Literature survey on the relationship between exchange volatility and exports performance

Authors	Data	Countries	Measures of risk	Analysis	Model	Results
Akhtar and Hilton (1984)	Quarterly	Developed	Naïve models	Nominal terms	OLS	Negative
Gotur (1985)	Quarterly	Developed	Naïve models	Nominal terms	OLS	Insignificant
Bailey et al. (1986)	Quarterly	Developed	Naïve models	Nominal/Real	OLS	Ambiguous
Bailey and Talvas (1987)	Quarterly	Developed	Naïve models	Nominal terms	OLS	Insignificant
Koray and Lastpears (1989)	Monthly	Developing	Naïve models	Real terms	VAR	Negative
Klein (1990)	Annual	Developed	Naïve models	Real terms	VECM	Negative
Pick (1990)	Quarterly	Developed	Naïve models	Nominal terms	VECM	Insignificant
Aktar and Hilton (1991)	Quarterly	Developed	Naïve models	Nominal terms	OLS	Insignificant
Kumar and Dhavan (1991)	Annual	Developing	Naïve models	Real terms	VECM	Negative
Franke (1991)	Quarterly	Developed	Naïve models	Real terms	MCO	Negative
Rose (1991)	Annual	Developed	Naïve models	Nominal terms	Gravity	Negative
Savvides (1992)	Annual	Developed	Naïve models	Real terms	Panel	Negative
Caporale (1994)	Annual	Developing	Naïve models	Nominal terms	Panel	Negative
Arize (1995)	Annual	Developed	Naïve /GARCH	Nominal terms	Panel	Insignificant
Reinhart (1995)	Annual	Developed	Naïve models	Nominal terms	Panel	Negative
Franses and Dijke (1996)	Quarterly	Developed	GARCH	Nominal terms	MCO	Insignificant
Arize (1997)	Quarterly	Developed	GARCH	Real terms	MCO	Negative
McKenzie and Brooks (1997)	Monthly	Developed	Naïve models	Nominal terms	MCO	Positive
McKenzie (1998)	Quarterly	Developed	GARCH	Real terms	MCO	Positive
Senhadji (1998)	Quarterly	Developing	Naïve models	Nominal terms	OLS	Insignificant
McKenzie (1999)	Monthly	Developed	Naïve model	Real terms	MCO	Ambiguous
Doroodian (1999)	Monthly	Developing	Naïve models	Nominal terms	Panel	Negative
Brell and Eckwert (1999)	Annual	Developed	Naïve models	Real terms	VECM	Negative
Dell'Ariccia (1999)	Annual	Developed	Naïve models	Real terms	Panel	Negative
Arize et al. (2000)	Quarterly	Developed	Naïve /GARCH	Real terms	MCO	Negative
Langley et al. (2000)	Annual	Developed	Naïve models	Nominal terms	Panel	Negative
Aristotelus (2001)	Annual	Developing	Naïve models	Real terms	Gravity	Insignificant
Peters (2001)	Quarterly	Developed	GARCH	Nominal terms	VECM	Negative
Vergil (2002)	Annual	Developing	Naïve models	Real terms	VECM	Negative
Nabli and Varoudakis (2002)	Quarterly	Developing	Naïve model	Real terms	Panel	Negative
Garces (2002)	Quarterly	Developing	Naïve model	Real terms	VECM	Negative
Cho et al. (2002)	Quarterly	Developing	Naïve model	Real terms	VECM	Insignificant
Achy and Sekkat (2003)	Annual	Developing	GARCH	Real terms	MCO	Ambiguous
Clarck and Wei (2004)	Quarterly	Developed	GARCH	Nominal terms	Panel	Negative
Arize et al. (2004)	Quarterly	Developed	Naïve /GARCH	Real terms	VECM	Negative
Grier and Hernandez (2004)	Quarterly	Developed	Naïve model	Nominal terms	VECM	Negative
Sadikov et al. (2004)	Quarterly	Developing	Naïve model	Real terms	OLS	Insignificant
Honroyiannis et al. (2005)	Quarterly	Developing	Naïve model	Real terms	MCO	Ambiguous

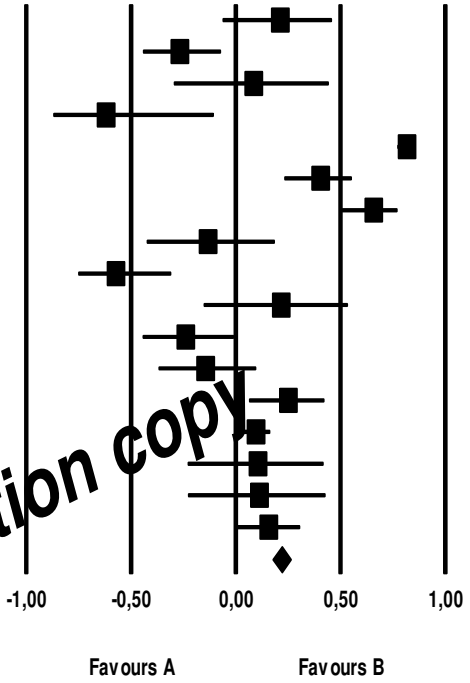
Saucier and Lee (2005)	Quarterly	Developed	GARCH	Nominal terms	MCO	Negative
Rey (2006)	Quarterly	Developing	Naïve models	Nominal /Real	MCO	Ambiguous
Egert and Zumaquero (2007)	Monthly	Developed	Naïve models	Nominal /Real	VECM	Ambiguous
Grier and Smalwood (2007)	Annual	Developed	Naïve models	Real terms	OLS	Insignificant
Tenreyro (2007)	Quarterly	Developed	Naïve models	Real terms	VECM	Negative
Narayan et al . (2008)	Quarterly	Developed	GARCH	Real terms	Bivariate	Negative
Chung et al. (2009)	Quarterly	Developing	GARCH	Nominal terms	VAR	Negative
Wang and Yung (2009)	Quarterly	Developing	GARCH	Real terms	MCO	Negative
Cermeno et al. (2009)	Monthly	Developing	Naïve models	Real terms	VECM	Insignificant
Chen et al. (2010)	Quarterly	Developed	Naïve models	Real terms	VAR	Negative
Hosseini and Moghadsi (2010)	Annual	Developing	Naïve models	Real terms	MCO	Ambiguous
Ayachi et al. (2010)	Annual	Developing	GARCH	Real terms	MCO	Ambiguous
Gosh (2011)	Quarterly	Developing	GARCH	Real terms	Bivariate	Negative
Cheong Vee et al. (2011)	Monthly	Developing	GARCH	Real terms	Panel	Negative
Arezki et al. (2012)	Quarterly	Developing	Naïve models	Real terms	OLS	Negative
Bouoiyour and Selmi (2012)	Annual	Developing	Naïve/GARCH	Real terms	Bivariate	Ambiguous
Bouoiyour and Selmi (2013 a)	Quarterly	Developing	GARCH	Nominal/ Real	MCO	Ambiguous
Bouoiyour and Selmi (2013 b)	Monthly	Developing	GARCH	Real terms	Wavelets	Ambiguous

Appendix B. Characteristics of some studies

Study name	Correlation	Lower limit	Upper limit	Z-Value	p-Value	Relative weight	Relative weight
Bailey et al,1986	0,213	-0,064	0,459	1,514	0,130	2,56	
Koray and Lastpears,1989	-0,267	-0,444	-0,070	-2,639	0,008	4,86	
Aktar and Hilton,1991	0,086	-0,297	0,445	0,431	0,666	1,31	
Savvides,1992	-0,619	-0,872	-0,103	-2,288	0,022	0,52	
McKenzie and Brooks,1997	0,818	0,770	0,857	17,261	0,000	11,76	
McKenzie,1998	0,405	0,230	0,554	4,318	0,000	5,28	
McKenzie,1999	0,659	0,504	0,773	6,571	0,000	3,61	
Vergil,2001	-0,132	-0,426	0,187	-0,808	0,419	1,93	
Nabli and Varoudakis,2002	-0,571	-0,753	-0,307	-3,840	0,000	1,83	
Achy and Sekkat,2003	0,218	-0,154	0,536	1,151	0,250	1,41	
Clarck and Wei,2004	-0,238	-0,445	-0,007	-2,016	0,044	3,61	
Saucier and Lee,2005	-0,144	-0,370	0,098	-1,169	0,242	3,40	
Rey,2006	0,252	0,062	0,424	2,588	0,010	5,28	
Egert and Zumaquero,2007	0,097	0,028	0,166	2,733	0,006	41,24	
Hosseini and Moghadassi,2010	0,106	-0,231	0,420	0,611	0,541	1,73	
Ayachi et al,2010	0,113	-0,229	0,430	0,642	0,521	1,67	
Boucioyour and Selmi,2012	0,158	0,001	0,308	1,971	0,049	8,00	
	0,218	0,175	0,260	9,682	0,000		

Statistics for each study

Correlation and 95% CI



Meta Analysis