Exports and Imports, is there simultaneity? A structural model for supertrading economies.

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Abstract

The determining of exports and imports independently, which is a common assumption in literature, may be over restrictive for extremely open economies. As an alternative, this study proposes and estimates structural models for the simultaneous determination of trade flows in three extremely open economies (Ireland, Belgium and Singapore). It confirms the existence of an interrelation between exports and imports and, as a result, the existence of a bias in the estimates of trade elasticities when the interrelation is not taken into account.

Keywords: Trade elasticities; imports; exports; simultaneous equation models

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1. INTRODUCTION

Since the seminal works of Brown (1942), Robinson (1947), Liu (1949), Orcutt (1950) and Houthaker and Magee (1969), many studies have quantified elasticities between international trade flows and their determining factors (real exchange rates, income, etc.). Trade elasticities are essential for evaluating and designing exchange and tariff policies, analysing the sustainability of trade imbalances, or studying the transfer of technology between economies. Bahmani-Oskooee and Niroomand (1998), Caporale and Chui (1999), Bahmani, Harvey and Hegerty (2013), Buzaushina (2015) and Bayar (2017) are examples of recent works that prove the interest that still exists in suitably estimating trade elasticities.

Applied studies at macro level have traditionally considered that, in a given country, exports (X) and imports (M) are determined independently (Bahmani-Oskooee and Niroomand, 1998). However, the extension of the phenomenon of international geographical fragmentation of the production process stages (*slicing up*) may mean that an economy's X and M are so inter-related that they are determined simultaneously (Krugman, 1995). An economy could be a link in an internationally fragmented production process, due to comparative advantage. In this case, imports would constitute an essential input for the production of exportable goods (supply flavour) and, symmetrically, exports would generate needs for the importation of inputs or capital goods from another economy in which a different stage of the production process is carried out (demand flavour). In fact, recent microeconometric studies conducted with firm data, show the existence of interrelation and simultaneity in input importation and output exportation decisions at firm level (see for example, Abreha, 2019; Lapham and Kasahara, 2013; Aristei et al. 2013). This result suggests the possible existence of simultaneous import and export decisions also at the aggregate level.

In this context, this work analyses the empirical relevance of eliminating the assumption that, at macro level, X and M are determined independently. For this purpose, the cases of Ireland, Belgium and Singapore have been studied. Those countries were selected for two reasons. First, because we think that the biases that may be caused by the non-consideration of the interrelation between X and M could be greater for extremely open economies, as is the case of the three analysed, in which the volume of X and M exceeds 50% of their GDP[1]. Besides, this characteristic is not a new one for any of these three economies (Krugman, 1995). For decades they have been among the three most open economies in the world, always forming part of what Krugman (1995) calls "*supertrading economies*"[2]. That permanence over time of the supertrading economies condition gives stability to the model considered and to the analysis performed. The second reason for the selection of these three economies is that their reduced size in relation to the world GPD implies their status of "small country", an assumption that is implicit in traditional models for X and M. Additionally, having selected countries from two different geographical areas, Europe and Asia, with the structural differences that this signifies (in terms of foreign trade patterns, labour market, economic integration, etc.), permits us to study to what extent that factor could determine the results obtained.

From an econometric perspective, not to consider the X-M inter-relationship in trade flow models triggers an endogeneity problem in the applied models usually considered for X and M, which causes Least Squares (LS) to be an inconsistent estimator of trade elasticities. To avoid bias, it is necessary to formulate a structural

[1] According to the World Bank, in 2015, the X-PIB ratio was 124% in Ireland, 82.9% in Belgium and 176.5% in Singapore, as opposed to 28.5% in OECD countries and 43.5% in the EU. The M-PIB ratio was 92.2% in Ireland, 81.3% in Belgium and 146.6% in Singapore, as opposed to 28.2% in OECD countries and 40% in the EU.

[2] In 2015 the number of countries fulfilling the condition that the sum of X and M exceeded 50% of the GDP was around 50 according to the World Bank. However, when Krugman (1995) referred for the first time to supertrading economies, there were only six, Ireland, Belgium and Singapore among them.

model for the simultaneous determination of X and M and to use alternative estimators like Three-Stage Least Squares (3SLS) or Generalized Method of Moments (GMM) in order to obtain consistent estimates of trade elasticities. This is what has been done in this paper for Ireland, Belgium and Singapore. The model considered also has two special features that are not common: a) it considers that the aggregate investment effect in M is different to the effect of the rest of the aggregate demand[3] components, and b) it uses a weighted average (according to export quotas) of the production of each country's main trading partners as the measure of foreign income[4].

2. MODEL

Equations (1) and (2) show the model used to explain the simultaneous determination of *X* and *M*, both in constant domestic currency terms[5]:

$$\begin{aligned}\log X_t &= \alpha_1 + \alpha_2 \log p_t + \alpha_3 \log y_t^W + \alpha_4 \log M_t + \\ &+ \alpha_5 \log X_{t-1} + \alpha_6 \log p_{t-1} + \alpha_7 \log y_{t-1}^W + \alpha_8 \log M_{t-1} + \varepsilon_{Xt}\end{aligned} \tag{1}$$

$$\begin{aligned}\log M_t &= \beta_1 + \beta_2 \log p_t + \beta_3 \log I_t^D + \beta_4 \log y_t^D + \beta_5 \log X_t + \\ &+ \beta_6 \log M_{t-1} + \beta_7 \log p_{t-1} + \beta_8 \log I_{t-1}^D + \beta_9 \log y_{t-1}^D + \beta_{10} \log X_{t-1} + \varepsilon_{Mt}\end{aligned} \tag{2}$$

where p is the real effective exchange rate, y^W is world demand, defined as a weighted average of trading partners' GDP, I^D the real domestic investment and y^D the real domestic consumption. ε_{Xt} and ε_{Mt} are white noise processes with $E[\varepsilon_{Xt}] = E[\varepsilon_{Mt}] = 0$ $V[\varepsilon_{Xt}] = \sigma_X^2$ $V[\varepsilon_{Mt}] = \sigma_M^2$ and $C[\varepsilon_{Xt}, \varepsilon_{Mt}] = \sigma_{XM}$

[3] Thus it is aiming to take into account the effect that technological transfer may have on trade flows and productivity in countries oriented towards international trade.
[4] Buzaushina (2015) and Thomas (2016) also use this measure.
[5] Similar models have been used in the literature, although in considering that simultaneity does not exist, such as Langwasser (2009) and Buzaushina (2015).

If, as previously established in the literature (Bahmani-Oskooee and Niroomand, 1998), X, M and their determinants are I(1), but co-integration exists, (1) and (2) can be expressed as a structural VECM:

$$\begin{aligned}\Delta \log X_t &= \alpha_2 \Delta \log p_t + \alpha_3 \Delta \log y_t^W + \alpha_4 \Delta \log M_t - \\ &- \theta^X \left[\log X_{t-1} - \theta_1^X - \theta_2^X \log p_{t-1} - \theta_3^X \log y_{t-1}^W - \theta_4^X \log M_{t-1}\right] + \xi_{Xt}\end{aligned} \tag{3}$$

$$\begin{aligned}\Delta \log M_t &= \beta_2 \Delta \log p_t + \beta_3 \Delta \log I_t^D + \beta_4 \Delta \log y_t^D + \beta_5 \Delta \log X_t - \\ &- \theta^M \left[\log M_{t-1} - \theta_1^M - \theta_2^M \log p_{t-1} - \theta_3^M \log I_{t-1}^D - \theta_4^M \log y_{t-1}^D - \theta_5^M \log X_{t-1}\right] + \xi_{Mt}\end{aligned} \tag{4}$$

where α_k and β_k are short-term elasticities, θ_k^X y θ_k^M long-term elasticities and θ^X and θ^M the speed of adjustment parameters in the co-integration relationship.

The existence of simultaneity implies that, to obtain consistent estimates of the parameters of equations (3) and (4), Instrumental Variable (IV) estimators are required. From among the IV estimators available for estimating (3) and (4), those used in this paper were 3SLS and GMM, because, asymptotically, they are more efficient than single equation estimators. Only in the case of the relation between X and M occurring exclusively through disturbances in equations (3) and (4)[6], would LS be a consistent, though inefficient, estimator. In that case we would have seemingly unrelated regression equations (SURE), and to obtain efficient estimates the equations would have to be estimated jointly by Generalized Least Squares (GLS).

3. RESULTS

The data used are from World Bank World Development Indicators (WDI). Data are annual. Appendix I presents the definition of the variables. The maximum sample

[6] $\alpha_4 = \theta_4^X = 0$, $\beta_5 = \theta_5^M = 0$ and $\sigma_{XM} \neq 0$

length available for each country is used: 1980-2013 for Ireland, 1970-2013 for Belgium and 1979-2013 for Singapore. Unit root tests were carried out, which showed that all variables are I(1) (see Appendix II). Similarly, the graphs presented in Appendix I, provide evidence of the non-stationarity of the variables considered in the study. Co-integration tests were also carried out, showing the existence of co-integration relationships such as those represented by (3)-(4) (see Appendix II). These results are in line with those of other studies (Bahmani-Oskooee and Niroomand, 1998).

Three models were estimated for each country: a) equations (3)-(4); b) assuming that (3) and (4) constitute a SURE and c) ignoring X-M simultaneity, as is traditionally done in the literature[7]. (3)-(4) was estimated by 3SLS and GMM; the SURE by GLS and the traditional model by Least Squares (LS). The results are shown in Table 1.

[Table 1]

The results confirm the existence of X-M simultaneity, both in the short and long term. For the three countries, M is statistically significant at the 5% level, in both the short and long-term in the X equation (see 3SLS and GMM columns). This also occurs in the M equation with X (see 3SLS and GMM columns). In addition, the size of the elasticities is substantial. Both the M-X and X-M short and long run elasticities exceed 0.45 in the case of Ireland and are greater than 0.8 in Belgium and Singapore. The positive signs of those elasticities show that X and M are complementary. This result has consequences for economic policy design since those that attempt to reduce imports can have adverse outcomes on exports, or, similarly, policies that stimulate exports also positively affect the importation of goods. There is a certain degree of neutralization of these types of policies in terms of the trading balance.

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[7] Assuming that $\alpha_4 = \theta_4^X = 0$, $\beta_5 = \theta_5^M = 0$ and $\sigma_{XM} = 0$. Note that, if these restrictions, assumed by the traditional model, are false, the parameters of that model are devoid of any economic interpretation.

From an econometric perspective, the existence of X-M simultaneity implies a bias in the estimates obtained by LS imposing X-M independence or in a SURE model, which justifies the substantial differences observed in Table 1 between trade elasticities estimates when simultaneity is considered, when it is not, or when a SURE model is considered. The short-term price elasticities estimated for M with simultaneity are, for Ireland and, depending on the estimator employed, up to 55% lower than those estimated without simultaneity or in a SURE model. For Singapore, the figure is 96% and for Belgium the sign estimated for that elasticity changes when considering simultaneity. For long-term price elasticity, the figures are also very different when the simultaneity is considered or not. A comparison of the estimates of income elasticities of M also shows, except in the case of Ireland in the short term, a substantial over-estimation when simultaneity is not considered or in the SURE model. Differences are also observed between estimates for X, depending on whether simultaneity is considered or not or if the SURE model is employed.

Table 2 presents a summary of estimates of long-run trade elasticities obtained in other recent empirical works for the three countries considered in this paper. In none of these works is the existence of simultaneity between X and M taken into account. As can be seen, there is an enormous variability in the results obtained for each country and trade elasticity. This makes it difficult to compare our results with those obtained in previous studies. However, it can indeed be noted that the non-consideration of X-M simultaneity notably affects the estimates. Thus, it is observed that the estimated income elasticities are considerably greater when simultaneity is ignored than when it is not. For imports, for example, Bahmani, Harvey and Hegerty (2013) estimate elasticities of 1.10 for Ireland and 1.16 for Belgium, that are much higher than those obtained in this work when estimating by 3SLS (0.467 and 0.314, respectively) or by GMM (0.562 and

0.297, respectively). For the case of Singapore, too, this phenomenon occurs when the results obtained by 3SLS (0.10) and GMM (0.15) are compared to those reported in Marquez (2002) and Bahmani-Oskooee and Kara (2005), 1.47 and 0.84, respectively. Analogously, for exports, higher income elasticities are observed when X-M simultaneity is not considered than when it is. For the price elasticities, differences are also seen according to whether or not simultaneity is contemplated, but they are not so systematic[8].

[Table 2]

One focal element of the “commercial policy” analysis is to find out how the trade balance responds to changes in X-M relative prices (Bahmani-Oskooee and Niroomand, 1998; Bahmani, Harvey and Hegerty, 2013). In this context, complying with the Marshall-Lerner (M-L) condition determines that the modifications in those relative prices (for instance, through a devaluation or a depreciation) will or will not have a favourable effect on the trade balance. In the empirical literature, some very different results with respect to meeting or not that condition are found, both generally and for the countries considered in this work (Bahmani, Harvey and Hegerty, 2013). In this regard, in the above-mentioned Table 2, for the three countries studied, the results obtained in the literature in testing the M-L[9] condition are summarized. As can be seen, only for the case of Singapore do Bahmani-Oskooee and Kara (2005), reject the non fulfilment of the M-L condition at the 5% level of significance. In this paper we have carried out an empirical verification of the Marshall-Lerner condition, using simultaneous estimates. Specifically, we have used the test of this condition proposed

[8] Also, taking into account that in this work the imports are expressed in real terms of national currency and that the variable Real exchange rate considered expresses the competitiveness inversely, the price elasticity of the imports cannot be compared automatically (see Sánchez-Larrión, 2004).

[9] In all of them, the null hypothesis is the non-compliance of the M-L condition (The sum of the absolute values of a country´s import and export price elasticities are less than one).

by Sánchez-Larrión (2004)[10]. The results are conclusive (see Table 3), all cases showing that the condition holds with a 5% significance for both 3SLS and GMM estimates, except in the 3SLS estimates for the case of Belgium, in which the condition holds at a 12% significance. In contrast, when the estimates by LS and GLS (SURE) are considered, the results obtained show evidence of a possible non fulfilment of the M-L condition. This result can be regarded as being a sample of the relevance of the consideration of simultaneity between X-M for a study of the M-L condition, and, therefore, for the design of economic policies.

[Table 3]

4. CONCLUSIONS

The results obtained enable two conclusions. The first is that X and M in Ireland, Belgium and Singapore are determined simultaneously. This is possibly due to the extremely open nature of the three economies and the role played by geographical fragmentation of the different stages of production processes. The simultaneous determination of X and M and the complementarity existing between them, has implications for economic policy in the sense that X cannot be stimulated without expecting increases in M, and M cannot be reduced without generating reductions in X.

The second conclusion is that when X and M are not considered simultaneously, a bias exists in the estimated trade elasticities, with relevant consequences on the evaluation and design of economic policy. One example would be the verification of the M-L condition. Fulfilling this condition is indispensable for enabling external imbalances to be adjusted via prices. The results obtained show, for the three countries

[10] The null hypothesis is non-compliance of the Marshall-Lerner condition and it is expressed as: $\gamma > \delta$, where γ and δ are long-term price elasticities of X and M in the reduced form of (3)-(4).

considered, that only when assuming X and M simultaneity is empirical evidence found in favour of the fulfilment of that condition. This requirement of the effectiveness of the adjustment channels via price of external imbalances is considered to be of obligatory compliance due to their implications on the exchange stability and intertemporal sustainability of those imbalances.

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APPENDIX I: SUMMARY AND GRAPHS OF VARIABLES

[Table A.I.1]

[Figure A.I.1]

[Figure A.I.2]

[Figure A.I.3]

APPENDIX II: UNIT ROOT AND COINTEGRATION TESTS

[Table A.II.1]

Table 1: Estimates of X-M models

	IRELAND[(a)]				*BELGIUM*[(b)]				*SINGAPORE*[(c)]			
	Simultaneous-equations			Unrelated-equations	Simultaneous-equations			Unrelated-equations	Simultaneous-equations			Unrelated-equations
	3SLS	GMM	GLS (SURE)	LS	3SLS	GMM	GLS (SURE)	LS	3SLS	GMM	GLS (SURE)	LS
Exports $\Delta \log X_t$												
$\Delta \log p_t$	-0.2415* (0.1062)	-0.2453* (0.0340)	-0.4621* (0.0914)	-0.5463* (0.0994)	-0.2508* (0.0585)	-0.1929* (0.0432)	-0.2116* (0.1074)	-0.2858* (0.1260)	-0.1052* (0.0367)	-0.1070* (0.0170)	-0.4082* (0.1444)	-0.3786* (0.1549)
$\Delta \log y_t^W$	0.4129* (0.2733)	0.4102* (0.0881)	0.7645* (0.2077)	1.1369* (0.2460)	0.8974* (0.3107)	0.8473* (0.2831)	2.0270* (0.2154)	2.4636* (0.2495)	0.0438 (0.0416)	0.0310 (0.0334)	-0.0294 (0.1745)	0.1389 (0.2236)
$\Delta \log M_t$	0.5447* (0.1192)	0.5101* (0.0331)			0.5927* (0.1099)	0.6406* (0.1205)			0.9141* (0.0554)	0.9301* (0.0305)		
Error-Correction-Term	0.2386** (0.1407)	0.2170* (0.0463)	0.2266* (0.0576)	0.3310* (0.0682)	0.2069** (0.1195)	0.2312** (0.1202)	0.0805 (0.0702)	0.0215 (0.0796)	0.6576* (0.2053)	0.6904* (0.08553)	0.0052 (0.0756)	0.0770 (0.0965)
Intercept-ECM	-33.5808* (10.7455)	-36.0821* (3.1210)	-63.7267* (4.8376)	-67.3935* (3.2919)	2.9651 (6.7816)	2.2571 (4.5971)	-43.4325* (11.5285)	-91.5080 (215.9547)	-1.0314 (1.2340)	-0.7479 (0.8365)	558.3094 (8638.9910)	-0.9664 (51.2713)
$\log p_{t-1}$	-1.0120* (0.4784)	-1.1304* (0.1661)	-2.0394* (0.5412)	-1.6506* (0.3622)	-0.4817* (0.2068)	-0.4352* (0.1831)	0.1514 (0.7552)	1.2579 (4.9858)	-0.1600* (0.0702)	-0.1549* (0.0191)	-77.9685 (1131.8880)	-4.9167 (6.9749)
$\log y_{t-1}^W$	1.7307* (0.5350)	1.8900* (0.1647)	3.3738* (0.1176)	3.4350* (0.0843)	-0.0849 (0.3304)	-0.0675 (0.2086)	2.0655* (0.3076)	3.3480 (5.8775)	0.0666 (0.0659)	0.0449 (0.0488)	-5.6167 (114.1318)	1.8042* (0.7172)
$\log M_{t-1}$	0.5195* (0.1810)	0.4561* (0.0631)			1.0813* (0.1911)	1.0779* (0.1165)			1.0005* (0.0304)	1.0121* (0.0217)		
SE (σ_X)	0.0237	0.0240	0.0379	0.0388	0.0122	0.0119	0.0248	0.0237	0.0159	0.0159	0.0671	0.0665
DW	1.8927	1.8936	1.3495	1.3499	2.2073	2.0106	2.2269	2.0425	1.7854	1.8099	1.9279	1.8048
Imports $\Delta \log M_t$												
$\Delta \log p_t$	-0.1629** (0.0990)	-0.2534* (0.0476)	-0.5109* (0.16449)	-0.4963* (0.1860)	0.1263* (0.0347)	0.1254* (0.0278)	-0.0502 (0.0851)	-0.0869 (0.0967)	-0.0325 (0.1000)	-0.1268* (0.0382)	-0.6444* (0.2225)	-0.7440* (0.3000)
$\Delta \log I_t^D$	0.1426* (0.0318)	0.1588* (0.0064)	-0.0612 (0.0621)	-0.0267 (0.0760)	0.1221* (0.0340)	0.1163* (0.0240)	0.3110* (0.0847)	0.3657* (0.1030)	0.1315* (0.0682)	0.1895* (0.0382)	0.4839* (0.1285)	0.6836* (0.1768)
$\Delta \log y_t^D$	0.3308* (0.1478)	0.4760* (0.0745)	0.5221 (0.3352)	0.4078 (0.4144)	0.6792* (0.2171)	0.5189* (0.2467)	2.5922* (0.4103)	2.9803* (0.4908)	0.0867 (0.0886)	0.1448* (0.0392)	0.4994* (0.1223)	0.8165* (0.1670)
$\Delta \log X_t$	0.7779* (0.1558)	0.6500* (0.0488)			0.8871* (0.0638)	0.8975* (0.0452)			0.9243* (0.1200)	0.8070* (0.0469)		
Error-Correction-Term	0.7083* (0.1453)	0.8466* (0.0409)	0.2227 (0.1584)	0.1891 (0.1980)	0.4197* (0.1042)	0.3842* (0.0728)	0.2243* (0.0972)	0.2661* (0.1134)	0.8518* (0.1982)	0.9914* (0.0874)	0.3434* (0.0881)	0.5105* (0.1237)
Intercept-ECM	-4.8120* (1.7037)	-5.5431* (0.6527)	-15.8093* (6.6765)	-12.8082 (12.1682)	-7.5482* (2.1496)	-7.3462* (1.4732)	-36.8972* (8.1048)	-34.9012* (7.4712)	-1.0024 (0.9116)	-1.3119* (0.4361)	-11.3750* (3.1084)	-14.9263* (2.9456)
$\log p_{t-1}$	-0.2300* (0.1118)	-0.2993* (0.0434)	-2.2945 (1.4614)	-2.6239 (2.4191)	0.3010* (0.0963)	0.3264* (0.0722)	-0.2238 (0.3550)	-0.3264 (0.3317)	0.0634 (0.0810)	0.0150 (0.0405)	-0.7209 (0.6026)	-0.1337 (0.5688)
$\log I_{t-1}^D$	0.2013* (0.0325)	0.1876* (0.0074)	-0.2749 (0.3303)	-0.1411 (0.4260)	0.1135 (0.0788)	0.1185** (0.0726)	0.1574 (0.3858)	0.3311 (0.3372)	0.0419 (0.0471)	0.0573 (0.0293)	0.1881 (0.3347)	0.0726 (0.3284)
$\log y_{t-1}^D$	0.4671* (0.1562)	0.5622* (0.0635)	2.3446* (0.4041)	2.1564* (0.5125)	0.3142* (0.1268)	0.2969* (0.1003)	2.2965* (0.6344)	2.0720* (0.5675)	0.1018 (0.0963)	0.1461* (0.0404)	1.4545* (0.3369)	1.5993* (0.3335)
$\log X_{t-1}$	0.5731* (0.0601)	0.5345* (0.0249)			0.8109* (0.0746)	0.8114* (0.0550)			0.8864* (0.0547)	0.8505* (0.0245)		
SE (σ_M)	0.0197	0.0119	0.0613	0.0661	0.0102	0.0103	0.0309	0.0301	0.0152	0.0160	0.05405	0.0493
DW	1.9030	1.6957	0.7238	0.7517	2.6191	2.5864	2.2042	2.1156	2.1157	2.2753	2.3615	2.2510
σ_{XM}	-0.000220	-0.000131	0.001591		-4.79×10^{-5}	-5.53×10^{-5}	0.000444		-0.000167	-0.000137	0.002655	
Sample size	33				43				34			

Notes: Standard-Error in parentheses. (a) sample 1980-2013 (b) sample 1970-2013 (c) sample 1979-2013. (*) p-value<5%, (**) p-value<10%

Table 2: Estimates of Long-run Trade Elasticities

	IRELAND					*BELGIUM*					*SINGAPORE*				
Authors	**Exports**		**Imports**		**M-L[c]**	**Exports**		**Imports**		**M-L[c]**	**Exports**		**Imports**		**M-L[c]**
	Income	**Price**	**Income**	**Price**		**Income**	**Price**	**Income**	**Price**		**Income**	**Price**	**Income**	**Price**	
Bahmani-Oskooee & Niroomand (1998)	2.61	0.42	1.45	0.25	-	1.82 3.59	-0.10 2.04	1.82 2.36	-0.80 0.81	- -	-	-	-	-	-
Caporale & Chui (1999)	2.97	-0.34[a]	1.49	-0.39[a]	-0.33 (0.63)	2.18	-0.76	2.25	0.12[a]	-0.65 (0.74)	-	-	-	-	-
	3.59[a]	-6.12[a]	1.42	-0.45[a]	0.34 (0.37)	2.21	0.03[a]	2.10	-0.3[a]	-1.45 (0.93)	-	-	-	-	-
Marquez (2002)	-	-	-	-	-	-	-	-	-	-	2.33	-0.69[a]	1.47	−0.31	0.01 (0.49)
Bahmani-Oskooee & Kara (2005)	1.33[a]	−1.10[a]	0.66	−0.80[a]	0.82 (0.21)	3.07[a]	-1.50[a]	0.91[a]	−2.59	0,79 (0.21)	0.85	3.26	0.84	−0.61	4.39 (0.00)
Langwasser, K. (2009)[b]	-3.75	1.77	−1.00	0.41	-	−1.98	0.93	7.32	0.21[a]	-	-	-	-	-	-
Bahmani, Harvey & Hegerty (2013)	4.75	-0.34[a]	1.10	0.05[a]	-1.61 (0.95)	1.36	0.41[a]	1.16	-0.25[a]	-0.73 (0.77)	-	-	-	-	-

Notes: (a): non significant at 10%. (b): in this case Belgium also includes Luxemburg. (c) Test of The Marshall-Lerner condition H_0: The condition of M-L is not verified. p-value in parentheses.

Table 3: Test of The Marshall-Lerner condition

	IRELAND[(a)]	BELGIUM[(b)]	SINGAPUR[(c)]
3SLS	-1.7744 (0.0380)	-1.1675 (0.1215)	-2.4668 (0.0000)
GMM	-5.8892 (0.0000)	-1.6972 (0.0448)	-8.2961 (0.0000)
GLS (SURE)	0.0326 (0.5716)	-0.8316 (0.2028)	-0.0673 (0.4731)
LS	0.3979 (0.6546)	0.3171 (0.6244)	-0.6835 (0.2472)

Notes: H_0: The M-L condition is not verified. p-value in parentheses. (a) sample 1980-2013 (b) sample 1970-2013 (c) sample 1979-2013.

Table A.I.1: Summary of variables

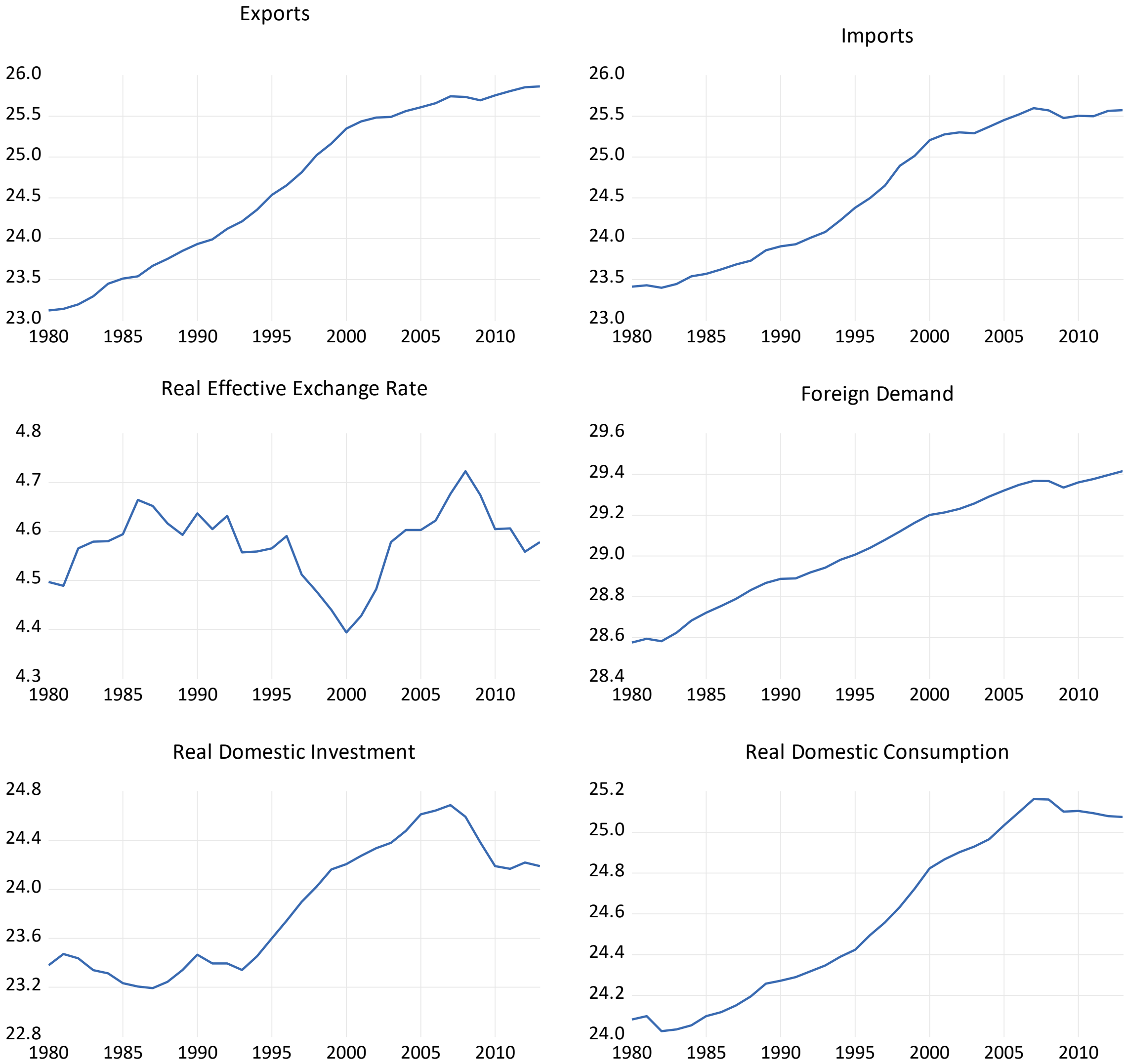
Denomination	Content	Observations	Sample available	Source
X	Real exports of goods and services	Constant local currency	Ireland: 1980:2013 Belgium: 1970-2013 Singapore: 1979-2013	World Bank World Development Indicators
M	Real imports of goods and services	Constant local currency	Ireland: 1980:2013 Belgium: 1970-2013 Singapore: 1979-2013	World Bank World Development Indicators
P	Real Effective Exchange Rate	An increase means a depreciation.	Ireland: 1980:2013 Belgium: 1970-2013 Singapore: 1979-2013	World Bank World Development Indicators
y^W	Foreign Demand	Defined as a weighted average of trading partners' GDPs	Ireland: 1980:2013 Belgium: 1970-2013 Singapore: 1979-2013	Authors' elaboration based on data from the World Bank World Development Indicators
I^D	Real Domestic Investment	Real Gross Fixed Capital Formation (constant local currency)	Ireland: 1980:2013 Belgium: 1970-2013 Singapore: 1979-2013	World Bank World Development Indicators
y^D	Real Domestic Consumption	Real Private & Public Consumption (constant local currency	Ireland: 1980:2013 Belgium: 1970-2013 Singapore: 1979-2013	World Bank World Development Indicators

Table A.II.1: Unit Root and Cointegration Tests

	IRELAND[(a)]			*BELGIUM*[(b)]			*SINGAPORE*[(c)]		
Unit Root Tests									
Variable	**ADF T&I**	**ADF I**	**ADF**	**ADF T&I**	**ADF I**	**ADF**	**ADF T&I**	**ADF I**	**ADF**
Exports[(d)] **(X)**	-0.7324 (0.9622)	-1.2670 (0.6333)	0.5790 (0.8365)	-1.3158 (0.8709)	-0.1757 (0.9339)	5.1688 (1.0000)	-1.3042 (0.8704)	-2.0737 (0.2560)	2.6454 (1.0000)
Imports[(d)] **(M)**	-1.7091 (0.7252)	-0.4660 (0.8859)	0.3201 (0.7723)	-2.3187 (0.4155)	-0.0745 (0.9458)	4.4902 (1.0000)	-1.5237 (0.8019)	-1.7974 (0.3756)	6.4296 (1.0000)
Real Effective Exchange Rate[(d)] **(p)**	-2.2480 (0.4494)	-2.4456 (0.1374)	0.5817 (0.8371)	-1.7047 (0.7324)	-1.6033 (0.4725)	-0.1128 (0.6392)	-1.1542 (0.9041)	-1.1513 (0.6837)	0.4006 (0.7935)
Foreign Demand[(d)] **(y^W)**	-0.2832 (0.9678)	-1.6139 (0.4641)	0.4333 (0.8000)	-0.8105 (0.9566)	-1.7992 (0.3759)	0.6956 (0.8613)	-3.3886 (0.0693)	0.9234 (0.9947)	4.3674 (1.0000)
Real Domestic Investment[(d)] **(I^D)**	-2.2038 (0.4724)	-0.9869 (0.7468)	0.4940 (0.8169)	-2.0267 (0.5705)	-0.5933 (0.8615)	1.9751 (0.9871)	-2.0492 (0.5550)	-1.1010 (0.7036)	1.6683 (0.9745)
Real Domestic Consumption[(d)] **(y^D)**	-2.2760 (0.4350)	-0.5444 (0.8700)	1.6607 (0.9741)	-3.1428 (0.1114)	-1.5396 (0.5025)	8.9553 (1.0000)	-0.5791 (0.9772)	-1.3338 (0.6028)	0.8473 (0.8890)
Cointegration Tests									
	Engle and Granger		**Hansen**	**Engle and Granger**		**Hansen**	**Engle and Granger**		**Hansen**
Equations	**τ**	**z**		**τ**	**z**		**τ**	**z**	
Exports equation[(d)]	-4.7338 (0.0292)	-37.6184 (0.0003)	0.1865 (>0.20)	-3.2417 (0.3347)	-28.1410 (0.0272)	0.3609 (>0.20)	-5.2240 (0.0097)	-29.7946 (0.0106)	0.4886 (>0.20)
Imports equation[(d)]	-4.3790 (0.1008)	-25.5074 (0.0850)	0.2664 (>0.20)	-4.3782 (0.1010)	-26.9527 (0.0900)	0.3511 (>0.20)	-5.4721 (0.0143)	-31.2375 (0.0173)	0.7042 (0.1416)

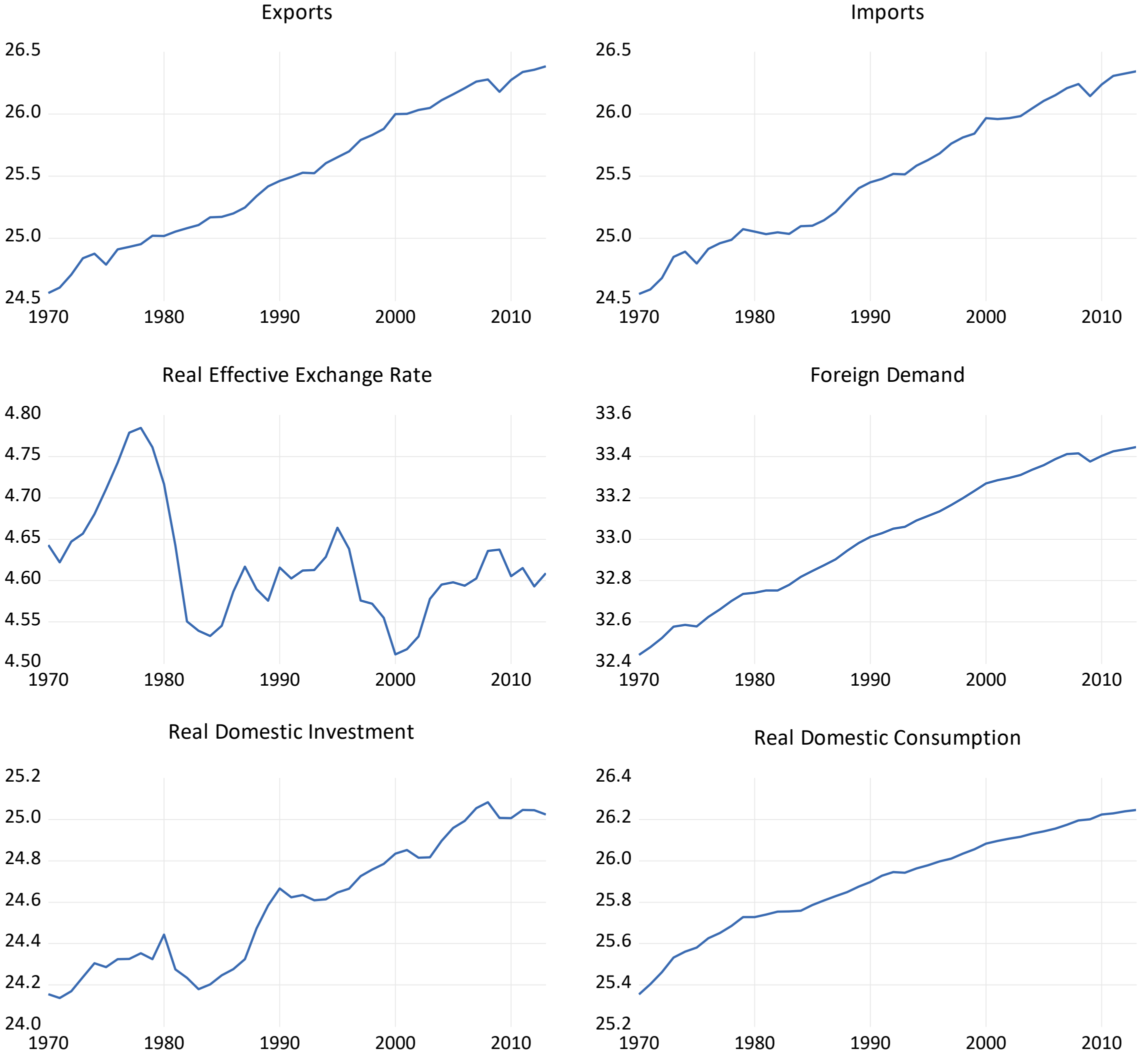
Notes: (a) sample 1982-2013 (b) sample 1970-2013 (c) sample 1979-2013. (d) Variables in logarithms. The p-values are in parentheses. ADF stands for Augmented Dickey-Fuller test. "T&I" indicates that the model includes trend and intercept, and "I" that only intercept is included. In the Hansen cointegration test (Hansen, 1992), the null hypothesis is cointegration, while in the Engle-Granger test (Engle and Granger, 1987) it is non-cointegration.

Figure A.I.1: Ireland



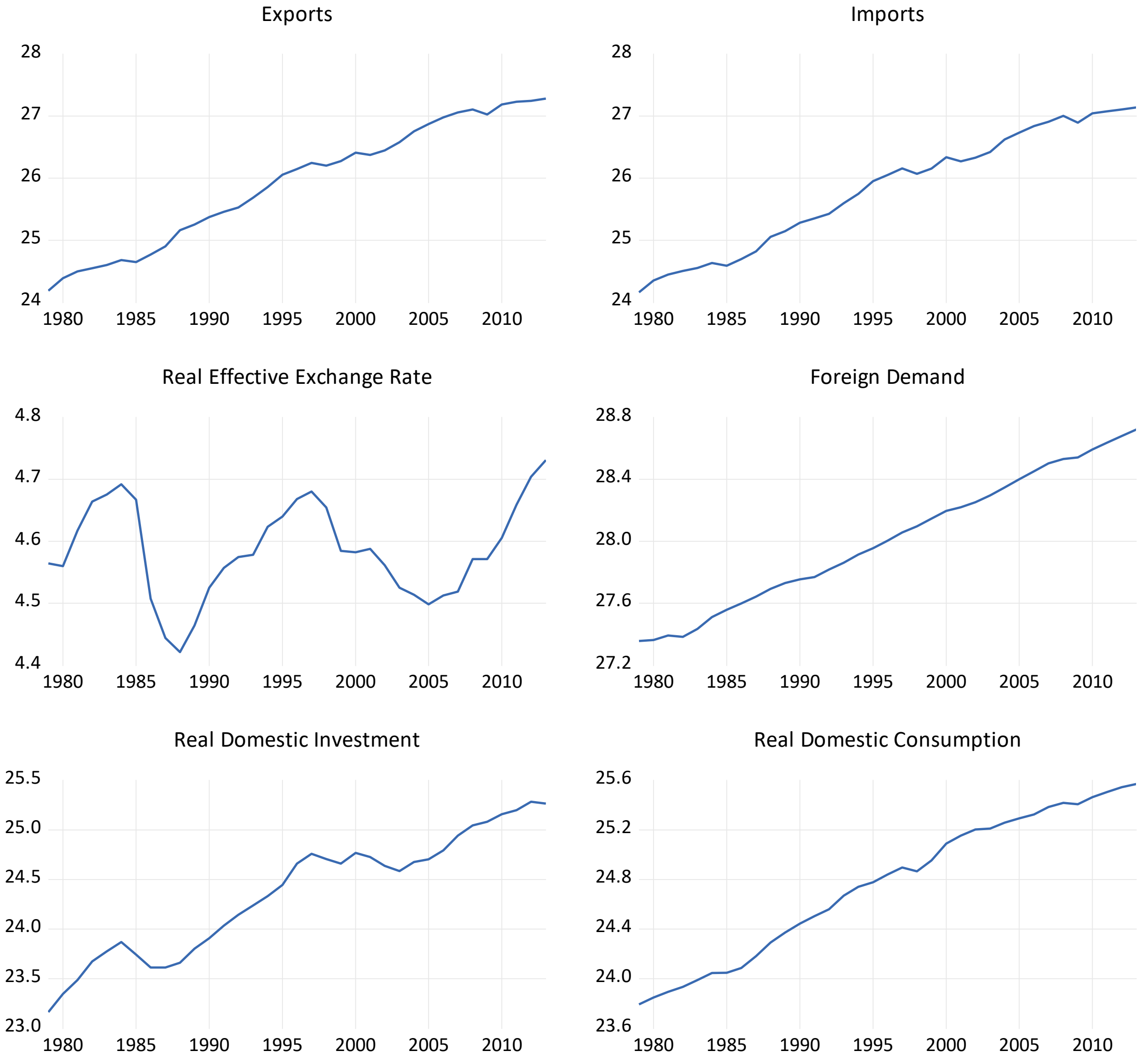
Note: Variables in logarithms

Figure A.I.2: Belgium



Note: Variables in logarithms

Figure A.I.3: Singapore



Note: Variables in logarithms