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IS THERE A ROLE FOR DOMESTIC DEMAND PRESSURE ON EXPORT PERFORMANCE?

Paulo Soares Esteves and António Rua

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Paulo Soares Esteves
Banco de Portugal; e-mail: pmesteves@bportugal.pt

António Rua
Banco de Portugal; e-mail: antonio.rua@bportugal.pt

Address	Kaiserstrasse 29, 60311 Frankfurt am Main, Germany
Postal address	Postfach 16 03 19, 60066 Frankfurt am Main, Germany
Telephone	+49 69 1344 0
Internet	http://www.ecb.europa.eu
Fax	+49 69 1344 6000

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Abstract

Traditionally, exports behavior is modeled only as a function of the foreign demand and the real exchange rate. However, it is by now widely acknowledged that these variables are not able to fully explain exports developments. This paper suggests considering domestic demand pressure as an additional variable, revisiting its economic rationale and assessing its empirical importance. In particular, we consider the Portuguese case and find that domestic demand developments are relevant for the short-run dynamics of exports. Moreover, it is found that this relationship is asymmetric, being stronger and more significant when domestic demand is falling than when it is increasing.

Keywords: Exports; Domestic Demand Pressure; Error Correction Models; Asymmetry.

JEL classification: C22, C50, F10.

Non-Technical Summary

Traditionally, exports behavior is modeled only as a function of the foreign demand and the real exchange rate, i.e. considering demand factors. However, it is by now widely acknowledged that traditional variables are not able to fully explain exports developments.

Assuming some substitutability between foreign and domestic sales, this paper suggests domestic demand pressure as an additional explanatory variable. Domestic conditions can influence firms willingness or ability to supply exports and we review the economic reasoning that may underlie a negative relationship between domestic demand behavior and exports. In periods of slacking domestic demand firms may try to compensate for the decline in domestic sales through increased efforts to export, while in boom periods production can be mainly sold on the domestic market. Furthermore, we also discuss the potential asymmetry of this relationship. For instance, when domestic demand increases firms may not leave foreign markets because they already supported some sunk costs. Thus, when modeling export performance, one should take into account not only the driving forces of external demand but also domestic demand, as the former affect exports from the demand side and the latter from the supply side.

Presently, this effect can be particularly important given the strong decline of domestic demand in some European countries under a major economic adjustment process. Besides the traditional positive relationship between imports and domestic demand, this effect reinforces the role of domestic demand on external imbalances adjustment. We address the Portuguese case and we find that domestic demand behavior is relevant for modeling the short-run dynamics of exports. In particular, the estimation results suggest that lagged domestic demand developments affect significantly and negatively export performance. Moreover, we find that this relationship is asymmetric, being stronger when domestic demand is falling than when it is increasing. All these findings are supported by a thorough sensitivity analysis.

1 Introduction

Typically, export performance is modeled as a function of the foreign demand for a country's output and a country's price competitiveness indicator. In general, the foreign demand is proxied by the evolution of imports in the trade partners and its relative evolution vis-à-vis exports is used as a measure of market share developments. The relative price advantage of a country over its competitors is often captured by the real exchange rate. *Ceteris paribus*, a depreciation makes the country's products cheaper relative to its competitors in the foreign market, which will raise the corresponding demand and increase exports leading to an increase of the market share. These factors are essentially related to the demand side. In fact, most studies do not consider supply side variables explicitly when modeling exports. However, it has been recently widely acknowledged that such determinants are far from able to fully explain export performance (see, for example, Fagan *et al.* (2001, 2005), di Mauro and Forster (2008), European Commission (2010), Dieppe *et al.* (2012)). Such evidence reinforces the need to search for other factors that may influence exports dynamics.

In line with some previous literature, this paper suggests considering domestic demand pressure as an additional explanatory variable. In fact, it is likely that domestic conditions influence firms willingness or ability to supply exports. In a context of high domestic demand pressure, firms will work at full capacity and will not be able to follow, in the short-run, external demand increases. In contrast, during a domestic recession, firms will be able to allocate more resources to exports. In other words, in periods of slacking domestic demand firms try to compensate for the decline in domestic sales through increased efforts to export while in boom periods production can be mainly sold on the domestic market. Early work focusing on the short-run effects of domestic demand pressure on exports includes Ball *et al.* (1966), Smyth (1968), Artus (1970, 1973), Zilberfarb (1980), Faini (1994), Sharma (2003), among others. In those studies it was found a significant negative ef-

fect of domestic demand pressure on exports for several countries, including the United Kingdom, the United States, Germany, Israel, Turkey, Morocco and India. Thus, when modeling export performance, one should take into account not only the driving forces of external demand but also domestic demand, as the former affect exports from the demand side and the latter from the supply side. More recently, there has been theoretical and empirical research at the firm level that allows for a better understanding of the negative relationship between domestic demand and exports. Such developments will also contribute to influence the macroeconometric modeling of exports.

In this paper, we revisit the theoretical role of domestic demand pressure on exports and assess its importance on modeling the export performance of the Portuguese economy.[1] Besides the recent literature at firm level, such assessment is also motivated by the fact that the standard exports modeling approach is unable to capture properly the Portuguese export performance over the most recent period. In particular, it has been observed a significant and continuous increase of exports market share which cannot be explained by developments on price competitiveness indicators. Such phenomenon is happening along with a dramatic fall of domestic demand. In fact, this relationship could be particularly important in the current economic situation, not only in Portugal but also in other European countries under macroeconomic adjustment and facing strong declines of domestic demand.

Following a macroeconometric approach, it is found that domestic demand behavior is relevant for modeling the short-run dynamics of Portuguese exports. In particular, the estimation results suggest that lagged domestic demand developments affect significantly and negatively export performance. Moreover, it is found that such relationship is asymmetric, being stronger when domestic demand is falling than when it is increasing.

[1] An earlier attempt to assess the role of domestic demand pressure on Portuguese exports behaviour can be found in Cartaxo (1985).

All these findings are supported by a thorough sensitivity analysis.

The paper is organized as follows. In section 2, we revisit the theoretical rationale for the role of domestic demand on export performance. The empirical results for the Portuguese case are discussed in section 3. Finally, section 4 concludes.

2 The rationale for the role of domestic demand pressure

There are several intuitive macroeconomic arguments that can explain a negative relationship between domestic demand and exports. One possible reason is related to the demand side. In particular, when domestic demand is growing, the associated inflationary pressures can lead to a decline of the price competitiveness of exports.[2] There are also arguments from the supply side. On the one hand, during the business cycle, the availability of resources for the exporting sector is affected, which can influence the export performance. On the other hand, in the presence of very different developments for domestic and foreign markets, investment will be most probably oriented to activities that draw more heavily on the most dynamic market.

As pointed out in earlier work by, for example, Ball (1961) and Artus (1970), an analysis at the firm level is useful for the identification of the main factors underlying the relationship between domestic demand and exports at the macroeconomic level. Such a microeconomic approach makes it possible consider factors not usually taken into account at the macroeconomic level. In particular, assuming that firms are not price-takers in the

[2] In practice, this argument can be potentially refuted since one can argue that this effect is already taken into account through the real exchange rate. However, one can also argue that prices are relatively rigid in the short run (especially downward) so that they do not reflect adequately changes in domestic demand pressure (as pointed out, for example, by Zilberfarb (1980)).

domestic market can allow one to provide an economic reasoning to the negative relationship between domestic demand and exports. Let us consider the plausible case where export sales are less profitable (because of transport costs, for example) or require greater effort (such as advertising and marketing) than domestic sales. Since capacity production is limited, in the short run, firms will tend to prefer selling to the domestic market if domestic demand increases in detriment of export sales. In contrast, if domestic demand falls firms will try to increase exports as the costs of excess capacity may outweigh the additional costs and effort of selling in the foreign market rather than at home.

Additionally, Ball (1961) presents a simple model in which a short-run profit maximizing firm is faced with negatively sloped demand curves in domestic and foreign markets. In this model, where firms have some degree of pricing power in both markets, firms set marginal revenue from exports equal to marginal revenue from domestic sales and marginal costs. In such a framework, given a domestic demand change, the direction of the change in exports volume will depend on the slope of the firm's marginal cost curve in the neighborhood of the initial equilibrium output and the magnitude of this change is determined by the slope of the marginal cost curve and by the demand elasticities in the domestic and foreign markets. Consider, for instance, the case where domestic demand increases. If the marginal costs rises (falls) as output increases, exports will decrease (increase). The steeper is the slope of the marginal cost curve and the higher the foreign demand elasticity,[3] the larger will be the change in exports. In contrast, the higher is domestic demand elasticity, the smaller will be the change in exports. In practice, Ball (1961) suggests that for most British exporting firms, the slope of the marginal cost curve around the initial equilibrium output and the demand elasticities in both markets were such that, under the above

[3]Note that, under the usual small open economy assumption, the foreign demand is perfectly elastic and therefore the effect is likely to be high.

mentioned model, a decrease in domestic demand would lead to an increase of exports.

Some of the arguments raised several years ago seem to be reemerging with the recent theoretical and empirical research at the firm level. A key feature of the standard models of international trade is the assumption of constant marginal costs, which allows domestic and foreign markets to be treated independently. However, Vannoorenberghe (2012) provides strong supporting evidence that sales in the domestic and export market are negatively correlated using a large panel of French firms. This empirical pattern can be explained using a Melitz (2003) type of model of international trade with demand uncertainty in which firms face market-specific shocks and short-run convex costs of production. In such a framework, it is found that firms react to a shock in one market by adjusting their sales in the other market. As stressed by Vannoorenberghe (2012), such a result casts doubts on the standard hypothesis that firms face constant marginal costs and maximize profits on the domestic and export markets independently of each other. In fact, there is an emerging literature that emphasizes the fact that the presence of capacity constraints or increasing marginal costs may generate a negative correlation between domestic and export sales (see, for instance, Ahn and McQuoid (2012) for a thorough discussion of the sources of export-domestic sales trade-offs). In this respect, Blum *et al.* (2011) found such a negative link with Chilean firm level data, Soderbery (2011) reports similar empirical evidence for Thailand whereas Ahn and McQuoid (2012) found a similar pattern for the Indonesian firms. This suggests that, in face of a negative domestic demand shock, existing firms would sell relatively less to the domestic market and more to foreign markets.[4] Furthermore, it seems plausible to believe that new investment by existing firms or new

[4] One should note that, in the Portuguese case, there seems to be scope for this relocation in terms of market destination. For instance, in the manufacturing sector, in 2010, only one third of the firms were exporting and for those firms the export intensity, defined as the exports to sales ratio, was on average around 30 per cent.

firms entering the market would tend to be export oriented given the depressed domestic demand conditions, strengthning the negative relationship between domestic demand and exports.[5]

In addition, the relationship between domestic demand and exports performance may be asymmetric. Consider the case where firms need to pay a sunk cost to enter a foreign market (as in Baldwin and Krugman (1989)). For instance, Roberts and Tybout (1997) have found that sunk entry costs are significant using data on Colombian plants. In the presence of sunk costs and uncertainty, the decision to start or stop exporting can be studied following the literature on investment under uncertainty. Based on Dixit (1989) model, Impullitti *et al.* (2012) consider the export market entry and exit decision in a general equilibrium framework with heterogeneous firms. One can argue that, in the presence of a negative domestic demand shock, it may be worthwhile for firms to pay the sunk entry costs and start exporting. However, in order to avoid repaying the entry cost, incumbent exporters may not leave easily the export market if economic conditions turn to be less favorable. In fact, there is empirical evidence supporting the idea of a noteworthy persistence in a firm's export status (see, for example, Bernard and Wagner (2001) for German firms, Campa (2004) for Spanish firms and Bernard and Jensen (2004) for U.S. plants).

[5] Nevertheless, one should bear in mind that, both at the theoretical and empirical levels, the relationship between exports and domestic sales is not clear cut. For instance, on the theoretical front, one may have a positive correlation between domestic sales and exports through overall efficiency improvements (as in the case of learning-by-doing or learning-by-exporting effects). Another reason that may induce such a positive link is related to liquidity constraints (see Berman *et al.* (2011)). Concerning the empirical front, the results by Berman *et al.* (2011) suggest that exports and domestic sales are complementary for a panel of French firms.

3 The Portuguese experience

3.1 Data

Due to data availability constraints the sample period herein studied ranges from the first quarter of 1980 up to the second quarter of 2012, which corresponds to 130 quarterly observations. The foreign demand index for Portugal, computed as a weighted average of the import volumes of the Portuguese trade partners, is provided by the European Central Bank and it has been adjusted for the impact of the tax fraud in the United Kingdom (see, for example, Bank of England (2006)). The series for exports and domestic demand, in real terms, correspond to the release of Quarterly National Accounts by INE in September 2012, covering the period since the first quarter of 1995 up to the second quarter of 2012, which have been extended with the historical quarterly series available at the Banco de Portugal website. The real effective exchange rate for Portugal is based on GDP deflators and is provided by the ECB under the branch Harmonized Competitiveness Indicators at the ECB Statistical Data Warehouse. Since it is available only since the first quarter of 1993, we considered a proxy for the previous period (based on the major Portuguese trade partners) to obtain a longer time series. An increase of the real effective exchange rate corresponds to a real appreciation.

3.2 Evolution of the Portuguese exports market share

Figure 1 presents the evolution of the Portuguese exports market share from 1980 onwards. During the 80's, and in particular after 1982, Portuguese exports volume grew almost twice the foreign demand. The index measuring export market shares (1999Q1 = 100) increased from a minimum close to 55 at the beginning of 1982 to a figure close to 105 in 1990. After some decline in 1991 and 1992, exports market share returned to an upward trend, reaching its historical maximum at the end of 1995. During the second half of the

90's, there was a continuous decline of the market share.

Concerning its evolution in the current century, it should be mentioned that exports market share stood relatively stable until mid-2004, which was followed by a huge decline in a context of the phasing-out in 2005 of the trade barriers established in the Multifiber Agreement on Textiles and Clothing[6] and reflecting the impact related to the entrance of China in the World Trade Organization (WTO) in 2001.[7] After this adjustment, exports market share remained once again relatively stable until the end of 2010. Thereafter, exports performance improved significantly, with market share increasing consecutively over several quarters in an amount of almost 10 per cent. A natural question that arises is how can one explain this recent increase of market share considering the usual export modeling strategies.

Firstly, it is important to question if this increase of exports market share is or is not statistically relevant. The answer seems to be affirmative. Despite the volatility of the quarterly series, this recent increase appears to be noteworthy. The observed increase during five quarters in a row since 2011Q1 is the third longest period of consecutive gains in exports market share. Until 1985Q2 exports market share increased continuously during thirteen quarters, while until 1990 Q2 the consecutive increase lasted eight quarters. Moreover, the average growth during five consecutive quarters was 1.9 per cent and it has never been observed such an accumulated market share gain in a time span of five quarters.

Considering the usual exports modeling strategy, the main (and only) candidate to explain this recent behavior of exports is the real effective exchange rate. However, considering its recent evolution, the price com-

[6] For more details see, for example, Francois *et al.* (2007).

[7] For example, Cabral and Esteves (2006) show that the significant Portuguese market share losses recorded in 2004 and 2005 occurred in sectors where it has been observed market share gains for some developing countries, namely China. One should note that the main conclusions drawn from the empirical results do not change when one controls for such a period.

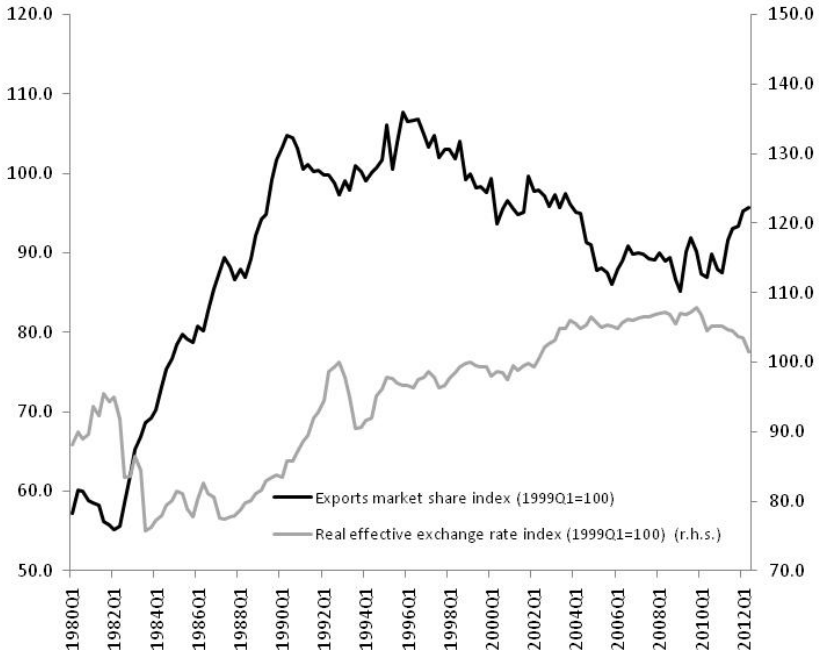

Figure 1: Portuguese exports market share and real effective exchange rate.

petitiveness indicator is not able to explain these striking gains. Since the beginning of 2011, the real depreciation reached only 3.5 per cent, and this depreciation was particularly noticeable during 2012.[8]

In this paper, we suggest that the evolution of domestic demand plays an important role in explaining the recent exports market share gain. Since the first quarter of 2011, domestic demand recorded six consecutive negative quarter-on-quarter growth rates, attaining a cumulative fall close to 12 per cent. This has never happened before in the Portuguese economy and could contribute to overcome the failure of the traditional approach to model exports. Moreover, we investigate the non-linearity of this effect on exports performance.

3.3 Modeling exports behavior for Portugal

Firstly, it is worth mentioning that it is particularly difficult to estimate an exports function for Portugal. In fact, following the traditional approach where exports market share is explained only by the real exchange rate leads frequently to non-reliable results. The same problem occurs in other countries. For example, Fagan *et al.* (2001, 2005), when developing the well-known area wide model at the ECB, included a deterministic trend to assure a long run relationship between the exports market share and the real exchange rate. In this respect, di Mauro and Forster (2008) also mention the statistical significance of a trend to explain the euro area exports performance since 1999. In particular, a negative trend was found to be stronger in the more recent period which could be related with the global integration of China. It should be mentioned that the lack of explanatory power of price competitiveness indicators occurs even when first differences

[8] Furthermore, the recent evolution of price competitiveness indicators could be biased given the public wages cuts. These cuts tend to favor the usual price competitiveness indicators that are computed for the overall economy. Hence, it would be better to account only for the private sector, which, however, is not done given the lack of timely, reliable and coherent information across countries.

models are considered (i.e. disregarding the long-run relationship). This highlights the importance of other factors than price competitiveness to understand not only the long-run but also the short-run dynamics of exports. In fact, European Commission (2010) presents a panel regression for the euro area countries where the external demand and the real exchange rate are able to explain around half of the export variance. Dieppe *et al.* (2012) also stress that price competitiveness indicators are not able to fully explain the differences in terms of export performance across euro area countries.

Concerning the Portuguese case, since 1985 and during several consecutive years there was simultaneously a strong increase of the exports market share and a remarkable appreciation of the Portuguese currency (see Figure 1). Thus, given this positive correlation, a simple regression to estimate a long-run relation between the two variables leads to a real exchange rate coefficient with the "wrong" economic sign. In this respect, at that time, several Portuguese authors presented some evidence linking the Portuguese real appreciation trend with real adjustments in the Portuguese economy (see, for example, Rebelo (1993), Cunha and Machado (1993), Esteves (1993), Gaspar and Pinheiro (1994), Pereira and Gaspar (1999)). Thus, when one considers a long time span, the real exchange rate might not be an adequate indicator to evaluate export competitiveness, as it may reflect some structural changes in the economy.

In the Portuguese case, this problem can be tackled by including a deterministic variable that captures all the other factors explaining exports behavior and at the same time allowing to get the right sign for the real exchange rate. Given this ad-hoc procedure, the results obtained for the long-run solution for exports should be carefully interpreted. Typically, this additional variable is called as a non-price competitiveness indicator (see, for example, Fagan *et al.* (2001, 2005)). However, this type of deterministic trend does not allow for understanding and measuring the several effects underlying a simultaneous real appreciation and an increase of exports market

share.

In light of the above discussion, let us first consider for the long-run relationship the case where the exports market share depends on the real exchange rate plus a log trend.[9] Concerning the short-run dynamics, besides the usual determinants of exports, we also consider domestic demand behavior while allowing for a maximum lag of four quarters for each variable.[10] As usual, the estimated models are checked by a battery of diagnostic tests. All variables are measured in logarithmic terms and a one step approach is pursued for the estimation of the error correction model. The estimation of the ECM in a single step has several advantages over the two stage procedure where the residual from the equilibrium regression is used to estimate the ECM. For instance, with the two stage approach any mistake introduced in the first step is carried forward in the second step (see, for example, Banerjee *et al.* (1986)). Moreover, an unrestricted ECM can be at least as efficient as a two step procedure in defining long run relationships and short run dynamics.

The resulting estimated model for the whole sample period, running from the beginning of the 80's up to the second quarter of 2012 is given by

[9] A log trend seems to be a relatively suitable choice for the Portuguese case. In fact, looking at the evolution of the Portuguese exports market share, the effect of this non-price competitiveness indicator seems to be particularly more relevant in the first part of the sample.

[10] One should mention that the domestic demand variable did not prove to be significant in the long run relationship in the ECM models. In fact, from a theoretical point of view, it is also not clear the way the effects of domestic demand pressure operate on the long-term export performance (see, for example, Renton and Duffy (1970)). On the one hand, periods of high domestic demand pressure may stimulate investment allowing for a higher trend growth rate of exports. On the other hand, the absence of periods of very low pressure may lead to a general neglect of export opportunities.

$$\begin{aligned}\Delta X_t - \Delta D_t^* &= \underset{(3.72)}{0.83} + \underset{(4.21)}{0.29}\Delta D_{t-4}^* - \underset{(-1.91)}{0.33}\,\Delta DD_{t-1} + \\ &\quad - \underset{(-2.19)}{0.26}\,\Delta DD_{t-2} - \underset{(-2.28)}{0.039}\left(X_{t-1} - D_{t-1}^*\right) + \\ &\quad - \underset{(-3.38)}{0.11}\,E_{t-1} + \underset{(1.42)}{0.010}\ln Trend \qquad (1)\end{aligned}$$

$$\widehat{\sigma} = 0.0196 \quad R^2 = 0.269 \quad F(6,118) = 7.234[0.000]$$

where X denotes exports, D^* corresponds to the foreign demand, E is the real effective exchange rate, DD denotes domestic demand (including private and public consumption and investment) and $Trend$ is a linear trend. The HACSE t-ratios for the estimated coefficients are presented between brackets.[11] It is also reported the standard error, $\widehat{\sigma}$, the goodness of fit statistic R^2 and the usual F statistic along the corresponding p-value between square brackets.

Concerning the long run relationship, in line with Laxton *et al.* (1998) and Fagan *et al.* (2001, 2005), an elasticity of one was imposed for the external demand coefficient which is not rejected by the data. It is also worth mentioning that the coefficient of the error correction term (i.e. the coefficient of the exports level lagged one period) is small, which denotes some persistence concerning the evolution of exports towards its long-run path. Regarding the short-run dynamics, the results do not reject a coefficient of one concerning the contemporaneous evolution of external demand, which allows to model directly exports market share behavior (see also Laxton *et al.* (1998) and Fagan *et al.* (2001, 2005)). Moreover, the results point towards an importance of lagged effects of external demand and a strong negative effect of lagged domestic demand changes. In addition, the overall goodness of fit statistics are also in line with those obtained in previous

[11] Although the coefficient associated with $\ln Trend$ is not statistically different from zero at the usual significance level, the exclusion of such deterministic variable would result in a non-significant error correction term.

empirical work on modeling exports market share (for example, Fagan *et al.* (2001) report a R^2 around 0.2 for the euro area).

In addition, we also allow for an asymmetric impact of domestic demand evolution on exports performance. In particular, we split domestic demand in two different variables, depending of its change being positive (ΔDD^+) or negative (ΔDD^-), that is[12]

$$\Delta DD_t = \begin{cases} \Delta DD_t^+ \text{ if } \Delta DD_t > 0 \\ \Delta DD_t^- \text{ if } \Delta DD_t < 0 \end{cases} \tag{2}$$

Allowing for an asymmetric impact, the resulting estimated model is the following

$$\begin{aligned} \Delta X_t - \Delta D_t^* \;=\; & \underset{(2.82)}{0.73} + \underset{(4.69)}{0.28}\Delta D_{t-4}^* - \underset{(-2.96)}{0.71}\,\Delta DD_{t-1}^- + \\ & - \underset{(-2.78)}{0.54}\,\Delta DD_{t-2}^- - \underset{(-2.12)}{0.041}\left(X_{t-1} - D_{t-1}^*\right) + \\ & - \underset{(-2.27)}{0.085}\,E_{t-1} + \underset{(0.87)}{0.0075}\ln Trend \end{aligned} \tag{3}$$

$$\widehat{\sigma} = 0.0195 \quad R^2 = 0.282 \quad F(6,118) = 7.707[0.000]$$

Overall, the results are similar to those obtained in (1), with the exception of the asymmetric effects of domestic demand changes on exports behavior which cannot be disregarded. When domestic demand is falling the effects are strong and statistically significant. In contrast, when domestic demand growth is positive, it has also a negative impact on exports behavior but it is, however, not statistically significant.[13] This means that, when domestic demand falls one observes, on average, an exports performance improvement in the short-run while when domestic demand increases a negative impact is recorded, although clearly more limited in absolute terms.

[12] One should mention that domestic demand change is negative in one fourth of the total number of observations.

[13] The most relevant term would be the ΔDD_{t-2}^+ with a coefficient of -0.18 and a t-ratio of -0.83.

Despite the strong evidence regarding the significance of the domestic demand variable, one should note that the above results should be interpreted with caution. In particular, in both models (1) and (3) one can argue that the evidence of cointegration is at most very weak as denoted by the low speed adjustment to the long run equilibrium. Within the single step framework, testing for cointegration can be performed through the significance testing of the error correction term (see, for example, Banerjee *et al.* (1998) and Ericsson and Mackinnon (2002)). In practice, this can be accomplished through the t-ratio of the error correction term coefficient which is called the ECM statistic. This t-ratio is used to test the null hypothesis of no cointegration (*i.e.*, a zero coefficient for the error correction term) and the critical values can be found in Banerjee *et al.* (1998). As expected, based on this cointegration test, one would not reject the null hypothesis of no cointegration at the usual significance levels.

As extensively discussed above, the second half of the 80's seems to present a distinct nature. Hence, to avoid the modeling dificulties mentioned earlier, we consider the sample period starting only at the beginning of the 90's. The estimated ECM model is the following

$$\begin{aligned} \Delta X_t - \Delta D_t^* &= \underset{(3.84)}{1.91} + \underset{(3.48)}{0.24}\Delta D_{t-4}^* - \underset{(-2.14)}{0.41}\,\Delta DD_{t-1} + \\ &\quad - \underset{(-2.69)}{0.36}\,\Delta DD_{t-2} - \underset{(-3.19)}{0.12}\left(X_{t-1} - D_{t-1}^*\right) + \\ &\quad - \underset{(-4.00)}{0.17}\,E_{t-1} \end{aligned} \tag{4}$$

$$\widehat{\sigma} = 0.0190 \quad R^2 = 0.224 \quad F(5,84) = 4.847[0.001]$$

while allowing for an asymmetric impact one obtains

$$\begin{aligned}\Delta X_t - \Delta D_t^* &= \underset{(3.36)}{1.75} + \underset{(3.50)}{0.22}\Delta D_{t-4}^* - \underset{(-3.25)}{0.75}\Delta DD_{t-1}^- + \\ &\quad - \underset{(-3.12)}{0.58}\Delta DD_{t-2}^- - \underset{(-3.12)}{0.12}\left(X_{t-1} - D_{t-1}^*\right) + \\ &\quad - \underset{(-3.14)}{0.13}E_{t-1} \qquad (5)\end{aligned}$$

$$\widehat{\sigma} = 0.0188 \quad R^2 = 0.240 \quad F(5, 84) = 5.317[0.000]$$

Drawing on the estimated models (4) and (5) one should highlight the following. As expected, when one disregards the 80's, the $\ln Trend$ can be discarded without affecting the significance of the error correction term and the sign of the real effective exchange rate coefficient. Moreover, the error correction term is now much more statistically significant and one is able to reject the null of no cointegration with a significance level of 10 per cent and almost with a significance level of 5 per cent (the asymptotic critical values are 2.89 and 3.19, respectively). In addition to this evidence in favour of cointegration, one should also mention that the coefficient of the error correction term, that is, the speed of adjustment to the long-run equilibrium, is the same found by Fagan *et al.* (2001, 2005) for the euro area. Concerning domestic demand, such variable appears again quite significant in both models and the finding that negative changes in domestic demand are clearly more relevant that positive ones holds.

In particular, regarding the market share gains observed since the beginning of 2011 (corresponding to an accumulated gain of almost 10 per cent), model (5) would have predicted a market share gain above 11 per cent, conditional on the observed evolution for the independent variables over that period. Such prediction is almost entirely explained by domestic demand developments which highlights its importance in the latest episode of exports market share gain observed in the Portuguese economy.

3.4 Robustness analysis

Herein, a sensitivity analysis is conducted to assess the robustness of the results obtained in the previous section along several dimensions. To save space, the focus is on the latter model presented in the previous section,[14] namely by considering the sample period starting at the beginning of the 90's and allowing for an asymmetric impact of domestic demand while redoing the specification process.

3.4.1 Domestic demand weighted by the non-imported content

Firstly, we assess the sensitivity of the results to the domestic demand variable. The domestic demand variable considered so far includes private and public consumption as well as investment. In practice, part of such demand is satisfied with imports. Hence, it may be reasonable to argue that a more relevant concept of domestic demand pressure in the case of exports would reflect the developments of domestic demand by domestic products. Therefore, we consider an alternative measure of domestic demand, namely, domestic demand weighted by its non-imported content (DDW). In particular, each component of domestic demand is weighted by its non-imported content, that is, $DDW = \sum_i (1 - m_i)\, DD_i$ where DD_i denotes the component i of domestic demand and m_i is the corresponding imported content. Based on the imported content for the year 2005,[15] the estimated model is the following

$$\begin{aligned} \Delta X_t - \Delta D_t^* \;=\; & \underset{(3.44)}{1.78} + \underset{(3.23)}{0.21}\,\Delta D_{t-4}^* - \underset{(-3.08)}{0.91}\,\Delta DDW_{t-1}^- + \\ & - \underset{(-2.45)}{0.68}\,\Delta DDW_{t-2}^- - \underset{(-3.21)}{0.12}\left(X_{t-1} - D_{t-1}^*\right) + \\ & - \underset{(-3.15)}{0.13}\,E_{t-1} \end{aligned} \tag{6}$$

[14] All the remaining results are available from the authors upon request.

[15] One should note that the imported content of domestic demand in the Portuguese case has not changed substantially over the last decades.

$$\widehat{\sigma} = 0.0190 \quad R^2 = 0.228 \quad F(5, 84) = 4.95[0.001]$$

In general, the estimation results are very similar to those obtained with model (5). The main difference concerns the coefficients of the domestic demand variable which continue to be statistically significant, being higher in absolute terms when domestic demand is weighted by its non-imported content. Hence, considering such a variable reinforces the evidence regarding the negative effect of domestic demand pressure.

3.4.2 Other price competitiveness indicators

Another issue relates with the choice of the relevant price-competitiveness indicator. As widely acknowledged, all the available indicators have conceptual problems as their computation is strongly constrained by data availability (see, for example, Schmitz *et al.* (2012)). For instance, the use of Consumer Price Index (CPI) data has the advantage of being available on a monthly frequency, but it only covers consumer goods, it includes nontradable services and reflects changes on indirect taxes. By its turn, the GDP deflator is more related with production costs, but it also captures the nontradable sector and indirect taxes. Concerning Unit Labour Costs (ULC), the data availability and corresponding quality, the inclusion of nontradable services in the case of whole economy, the strong influence of productivity cyclical fluctuations, the problems steaming from aggregating heterogeneous sectors and the coverage of just one production cost are some of the disadvantages frequently pointed out to this type of data.[16] Nevertheless, there is some supporting evidence that the choice of the price indicator used to deflate the nominal effective exchange rate is not crucial. For example,

[16] Frequently, the Industrial Production Price Index is pointed out as a potential alternative indicator because it also covers other production costs and it is possible to be computed exclusively for the manufacturing sector. Unfortunately, this indicator is not available for several countries.

Ca'Zorsi and Schnatz (2008) have empirically assessed which indicators perform better in terms of explaining exports for the euro area and found that no particular indicator appears consistently superior while, more recently, Alistair *et al.* (2012) have shown that the evolution of the several indicators are very similar for a panel of euro area countries.

Bearing in mind the above discussion, we consider two alternative measures for the price-competitiveness indicator, namely a real exchange rate based on CPI data as well as a real exchange rate based on ULC data for the manufacturing sector (both provided by the International Monetary Fund in the International Financial Statistics database). The estimated model with the real exchange rate based on CPI data (E^{CPI}) is the following

$$\begin{aligned}\Delta X_t - \Delta D_t^* &= \underset{(3.03)}{1.47} + \underset{(2.89)}{0.20}\Delta D_{t-4}^* - \underset{(-3.38)}{0.78}\,\Delta DD_{t-1}^- + \\ &\quad - \underset{(-3.36)}{0.60}\,\Delta DD_{t-2}^- - \underset{(-2.65)}{0.10}\left(X_{t-1} - D_{t-1}^*\right) + \\ &\quad - \underset{(-3.10)}{0.12}\,E_{t-1}^{CPI} \end{aligned} \tag{7}$$

$$\widehat{\sigma} = 0.0190 \quad R^2 = 0.226 \quad F(5,84) = 4.91[0.001]$$

whereas the estimation results with the real exchange rate based on ULC (E^{ULC}) are given by

$$\begin{aligned}\Delta X_t - \Delta D_t^* &= \underset{(2.19)}{1.13} + \underset{(3.52)}{0.24}\Delta D_{t-4}^* - \underset{(-3.27)}{0.77}\,\Delta DD_{t-1}^- + \\ &\quad - \underset{(-3.19)}{0.56}\,\Delta DD_{t-2}^- - \underset{(-2.07)}{0.082}\left(X_{t-1} - D_{t-1}^*\right) + \\ &\quad - \underset{(-1.97)}{0.080}\,E_{t-1}^{ULC} \end{aligned} \tag{8}$$

$$\widehat{\sigma} = 0.0193 \quad R^2 = 0.204 \quad F(5,84) = 4.313[0.002]$$

Although the speed of adjustment to the long-run equilibrium in models (7) and (8) is slightly lower and with a smaller t-ratio than in model (5),

the long-run elasticity for the real exchange rate is relatively similar across models, being close to one. More importantly, the estimated coefficients for the domestic demand variable and its high significance hold with different price-competitiveness indicators.

3.4.3 First differences model

In what concerns the modeling strategy, one should note that models with all the variables measured in first differences (*i.e.* without the long-run relationship) can also contribute to a better understanding of the evolution of exports market share. In fact, the estimation of the long-run equilibrium is very sensitive to structural breaks and omitted variables, which one can easily argue that could have played a role in the Portuguese economy over the last three decades.[17] Therefore, the estimation of first difference models can allow to overcome some of the potential caveats of the previous analysis and may constitute a useful sensitivity exercise. The resulting estimated model in first differences is given by

$$\begin{aligned}\Delta X_t - \Delta D_t^* \;=\; & \underset{(-2.45)}{-0.0068} - \underset{(-4.12)}{0.31}\,\Delta X_{t-1} + \underset{(3.13)}{0.52}\Delta D_{t-1}^* + \\ & - \underset{(-3.37)}{0.37}\,\Delta D_{t-2}^* + \underset{(4.36)}{0.30}\Delta D_{t-4}^* + \\ & - \underset{(-4.06)}{0.88}\,\Delta DD_{t-1}^- - \underset{(-2.84)}{0.56}\,\Delta DD_{t-2}^- \end{aligned} \tag{9}$$

$$\widehat{\sigma} = 0.0181 \quad R^2 = 0.307 \quad F(6,83) = 6.116[0.000]$$

[17] For instance, in the seminal paper of Engle and Granger (1987) it has been suggested that the evidence against cointegration may result from omitted variables. In particular, considering wages and prices in the US, they argue that the lack of cointegration found between the two variables could be due to the omission of a third variable such as productivity. In addition, Granger and Lee (1991) argue that, in practice, one may expect to encounter structural shifts as the economy evolves over time and therefore the assumption of a stable long-run relationship among economic variables may not be valid.

From the comparison between models (5) and (9), one should note that despite some diferences in terms of the short-run dynamics specification, the lagged behavior of domestic demand continues to appear highly significant and the estimated coeficients are not that different. Once again, domestic demand evolution, in particular, negative changes, proves to be a valuable variable when modeling exports short-term developments.

3.4.4 The potential endogeneity of domestic demand

In this type of analysis based on a single equation approach, the potential endogeneity of some of the explanatory variables is an issue that should also be addressed. This can be particularly important in the case of domestic demand. Suppose that there is a variable that simultaneously leads to a negative evolution of domestic demand and a positive behavior of exports in the near term. This would result in a spurious correlation between domestic demand and exports due to a misspecification problem.

In our case, the lagged real exchange rate emerges as the main candidate. Consider, for instance, a depreciation. On the one hand, the depreciation could contract private consumption given its negative impact on the real disposable income, as prices tend to react faster than the nominal variables underlying households disposable income. On the other hand, the depreciation tends to increase exports given the improvement on price-competitiveness.

To assess if any lagged effects of the real exchange rate are being omitted, a robustness exercise is done by relaxing the maximum number of lags considered for the real exchange rate (which was initially set to four for the sake of parsimonious). Considering up to twelve lags for the real exchange

rate, the estimated model is given by

$$\begin{aligned}\Delta X_t - \Delta D_t^* &= \underset{(3.32)}{2.00} + \underset{(2.47)}{0.19}\Delta D_{t-4}^* - \underset{(-3.45)}{0.77}\Delta DD_{t-1}^- + \\ &\quad - \underset{(-2.14)}{0.53}\Delta DD_{t-2}^- - \underset{(-3.02)}{0.13}\left(X_{t-1} - D_{t-1}^*\right) + \\ &\quad - \underset{(-3.21)}{0.17}E_{t-1} + \sum_{i=0}^{12}\widehat{\beta}_i \Delta E_{t-i} \end{aligned} \tag{10}$$

$$\widehat{\sigma} = 0.0191 \quad R^2 = 0.342 \quad F(18,71) = 2.049[0.017]$$

The coefficients for the lags of the real exchange rate changes are not presented to save space. The results are basically the same. In particular, a statistically significant and asymmetric relationship between domestic demand and exports performance still holds.

4 Conclusions

Usually, exports market share evolution is modeled only as a function of the real exchange rate. However, as widely acknowledged in the literature, price competitiveness indicators are far from enough to explain export performance. This paper intends to revisit the macroeconometric modeling of exports behavior and it considers domestic demand pressure besides the traditional determinants of exports.

From a theoretical point of view, several arguments have been put forward to support the role of domestic demand developments on export performance. We review the economic reasoning that may underlie a negative relationship between domestic demand behavior and exports. A decline of domestic sales may lead firms to try to increase sales on foreign markets. Furthermore, we also discuss the potential asymmetry of the relationship between domestic demand and exports. For instance, when domestic demand increases, firms may not leave foreign markets because they already supported some sunk costs.

Contrarily to what occurred in the past, this effect can be particular important given the strong decline of domestic demand in some European countries under a major economic adjustment process. Besides the traditional positive relationship between imports and domestic demand, this effect reinforces the role of domestic demand on external imbalances adjustment. We consider the Portuguese case and we estimate error correction models for exports based on quarterly data covering the last three decades. We find that, besides external demand and real exchange rate, the domestic demand evolution also appears highly significant when modeling exports behavior. We identify a strong negative relationship between lagged domestic demand developments and export performance in the short-run. Additionally, when testing for asymmetry, the results suggest that the effect is clearly asymmetric, being stronger and statistically more significant when domestic demand is declining than when it is increasing. All these findings are supported by a thorough robustness analysis.

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