
# An Aggregate View of Portuguese Exports and Competitiveness

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**Abstract**

The purpose of this paper is to study the relation between Portuguese exports of goods and a set of variables that theoretical models suggest as the main determinants of export behavior. Given that the exchange rate is one of the key variables identified by the theoretical models, we begin by reviewing the evolution of Portugal's exchange rate policy between the 1977 and 1999, when Portugal joined the European Monetary Union. In addition, we discuss how the exchange rate policy has been related to the issue of competitiveness of Portuguese firms. We then present the theoretical models and proceed to an empirical analysis of their adequacy. The results of our empirical analysis indicate that the perfect competition model does not provide an acceptable representation of the behavior of Portugal's exports of goods. The results improve when the monopolistic competition model is estimated. The estimation of a modified version of the monopolistic competition model suggests that Portugal's exports of goods are very elastic with respect to demand and productivity, but very inelastic with respect to wages. Nevertheless, certain variables are not significant, which indicates that there are problems to be solved either in the theoretical framework or in the empirical approach. The estimates reported support the conclusion that to foster exports a focus on wage costs and on exchange rate fluctuations is probably inefficient or even misguided. Productivity and demand seem to be more important determinants of exports. If one believes in this conclusion, then views of competitiveness based on the importance of wage repression or exchange rate control must be revised.

**Key words:** competitiveness, exchange rate, exports, productivity, wages.

**JEL classification:** D24, F11, F14, F31.

## 1. Introduction

Portugal's economic history in recent decades has been marked by episodes of balance of payments distress. To overcome those episodes, it has been necessary to resort to assistance from the International Monetary Fund and, in the most recent crisis, to the troika composed by the European Commission, the European Central Bank and again the International Monetary Fund.

Before Portugal adopted the euro, the exchange rate policy was a defining element of economic policy – see Bação and Duarte (2014). It was employed to enhance the competitiveness of Portuguese firms in international markets and also as an instrument to achieve price stability. After Portugal joined the Euro Area, the exchange rate instrument disappeared, taken away by the European Central Bank. Several commentators complained that this was disastrous for the Portuguese economy.

The Portuguese debt crisis, in the sequence of the international financial crisis, appeared to support the arguments of those opponents of Portugal's membership of the Euro Area. European institutions themselves have shown concern about the role of competitiveness, and the lack of it, on the accumulation of external balances that contributed to the crisis – see, e.g., Dieppe and others (2012), Karadeloglou and Benkovskis (2015), Bobeica et al. (2016) and Lommatzsch et al. (2016), or, outside the European Central Bank, Bugamelli et al. (2017), Nkusu (2013) and Sanchez and Varoudakis (2013).

In this paper we seek to analyze the relevance of several possible determinants of competitiveness (of which the exchange rate is one key element) for the evolution of Portugal's exports of goods. We begin by providing in section 2 a brief historical perspective on Portugal's exchange rate policy. In section3 we discuss the issue of competitiveness in a broader context. In section 4 we introduce the two simple theoretical models that will guide our empirical analysis. In section 5 we describe the data used in the empirical analysis. In sections 6 and 7 we estimate the empirical versions of the perfect competition and monopolistic competition models, respectively. Section 8 summarizes the conclusions.

## 2. Exchange rate regimes in Portugal and competitiveness

Since 1977, Portugal has been through different exchange rate regimes. The evolution of the exchange rate regime has been the outcome of economic and political influences, often of a short-term nature. The characterization of the different exchange rate regimes that have been in place is important for understanding the evolution of the Portuguese exchange rate policy and its impact of the competitiveness of Portuguese firms.

Between August 25, 1977, and September 30, 1990, the exchange rate regime in Portugal was a crawling peg. The increase in wages and the fall in productivity since 1973, led to an increase in unit labor costs. This harmed the attractiveness of Portuguese exports in international markets (Banco de Portugal, 1977). In view of this, policy-makers decided to use the exchange rate to try to dilute that impact on price-competitiveness. The crawling peg regime, which imposes a preannounced devaluation of effective exchange rate of the national currency (at a "crawling" rhythm), appeared ideal for the task. Thus, beginning in 1977, the escudo's exchange rate with respect to a basket of currencies (weighted according to their relevance in Portugal's international trade, tourism and remittances) was regularly adjusted (Banco de Portugal, 1978). The crawling devaluation occurred monthly. Its magnitude was variable and depended on what was viewed as required for maintaining external competitiveness and on what was necessary for counterbalancing inflationary pressures and unwanted impacts on income distribution. Nevertheless, besides the crawling devaluations, the exchange rate could also suffer discretionary adjustments.

During 1977 and 1978, the need to restore equilibrium in the balance of payments led to intensive use of the devaluation instrument. The exchange rate devaluation proceeded at the preannounced pace of 1% per month in 1977 and 1.25% per month in 1978, but there were also large discretionary devaluations (15% in 1977 and 6.1% in 1978).

In 1980, the goal of the exchange rate policy shifted away from competitiveness and towards disinflation. Thus, the monthly devaluation rate was reduced to 0.5% in June and there was actually a discretionary appreciation of 6% in February. This was the only time during the crawling-peg period that the policy-makers acted to promote the appreciation of the national currency. The discretionary devaluations in 1982 and 1983 aimed at offsetting the appreciation of the escudo, vis-à-vis other currencies besides the US dollar, produced by the strong appreciation

of the US dollar in that period. The large discretionary devaluation (12%) in June 1983 was also a result of the pressure put on the system by speculative transactions that tried to profit from the predictable nature of the crawling-peg regime. Given that the outlook for the balance of payments was favorable, between November 1985 and March 1986 the programmed devaluation of the escudo was interrupted for the purpose of consolidating the lowering of inflation expectations.

In the last three years of the crawling-peg regime, the rhythm of devaluation was reduced with a view to mitigate its negative impact on interest rates and inflation. Following the continued devaluation of the escudo, domestically produced goods became relatively cheap, originating inflationary pressures that extended to the interest rates.

Despite the gains in terms of price-competitiveness throughout the duration of the crawling-peg regime, the regime became unsustainable from the point of view of the efficacy of monetary policy. The devaluation of the escudo was less than the domestic-foreign interest rate differential, while the trade balance was improving. Consequently, the demand for the (high-return) escudo soared and capital flowed into the Portuguese economy (Banco de Portugal, 1990). Besides the efficacy of monetary policy, the inflow of capitals also threatened the ability to meet the inflation and interest rate targets imposed by the European integration process.

In fact, inflation in Portugal in that period was very high and closely related to the exchange rate policy. Between 1977 and 1980, the exchange rate policy was characterized by a pronounced devaluation of the escudo. This was attenuated in 1980 with the slowing of the pace of devaluation and with the 6% discretionary appreciation. Nevertheless, this did not prevent inflation from topping 20%. Between 1982 and 1985, the inflation rate was again very high, reaching 30%, an outcome not unrelated to the deep devaluations of 1982 and 1983. After the interruption of crawling devaluations in 1985 and later the reduction of the pace, the inflation rate dropped to the 9%-15% band, where it remained until 1990. This suggests that during this period the association between large (small) devaluations and high (low) inflation in Portugal was clear.

At the same time, the average European inflation rate was always below 20%. Therefore, it is not surprising that the inflation differential was almost always negative (against Portugal), with the exception of the final months of 1980. During the crawling-peg period, Portugal tried to accommodate the inflation differential via successive currency devaluations, with the objective

of regaining competitiveness. However, those same devaluations also contributed to generate higher inflation, leading to a cycle of inflation-devaluation-inflation.

Similarly to the inflation rate, the evolution of the interest rate was also influenced by the devaluations of the escudo. When the devaluation was faster, the interest rate reached higher levels. Except in 1981 and 1989, the interest rate differential was always positive (higher interest rates in Portugal). In 1990, on the eve of the abandonment of the crawling-peg regime, the differential was around 7 percentage points. After the devaluation of the escudo in 1990, still inferior to the interest rate differential, the domestic assets became very attractive.

Despite the positive effect of the crawling peg on foreign trade, the high inflation and the high interest rate differential were putting at risk the success of the process of integration of Portugal in European institutions. Thus, on October 1, 1990, the crawling-peg system was replaced with a managed-floating policy. Under the new regime, preannounced devaluations were eliminated; instead the exchange rate was allowed to fluctuate according to market supply and demand, albeit within a band around a central rate chosen by the Banco de Portugal and the Government. This marked the end of the accommodation of inflation differentials, and therefore of the policy of supporting competitiveness through currency devaluation. A period of preparation for entering the Exchange Rate Mechanism (ERM) followed. This was also a period of evaluation of the ability of the Portuguese economy to adapt to the absence of the support given by the exchange rate policy to competitiveness.

After Portugal joined the ERM of the European Monetary System (EMS), on April 6, 1992, the exchange rate of the escudo with respect to the other currencies in the EMS was allowed to fluctuate inside a band of +/- 6%. The band was defined relative to a central parity between each of the national currencies and the European Currency Unit (ECU). Intervention by the national central bank was mandatory whenever the exchange rate approached the limits of the band. Fluctuation inside a band was not new for the Portuguese escudo – it was doing just so since 1990, under the managed floating policy. However, the existence of a formal band increased the credibility of the disinflation policy and facilitated the achievement of the price stability objective.

The width of the band and the central parity of the escudo changed over time, as a result of the crises that affected the EMS. In November 1992, the Spanish peseta was at the center of the speculative attacks. Given the close association between the two Iberian currencies, the markets

did not distinguish much between the two and therefore the Portuguese escudo had to be devalued by 6%. In May 1993, the Portuguese authorities decided to devalue the escudo again, now by 6.5%, also as a consequence of the attacks that were targeting the Spanish peseta. To try to frustrate the attacks, the fluctuation bands were widened from +/- 6% to +/- 15% in August, 1993. This widening of the bands introduced both greater exchange rate risk and more flexibility in the management of monetary and exchange rate policy. Despite this, the Portuguese authorities decided to respect the initial +/- 6% band and to maintain the focus on achieving price stability. Nevertheless, the attacks on the peseta continued and the escudo was again devalued in 1995, by 3.5%.

In spite of the difficulties, the Portuguese authorities were able to meet the price-stability objective and the escudo did not abandon the ERM, contrary to what the Italian lira and the pound sterling did in 1992. This effort made it possible for the inflation rate and the interest rate to fall to levels close to the European Union average. In the first quarter of 1999, the 3-month interest rate and the inflation rate were around 3%. Portugal then moved from the exchange rate regime of the ERM to the European Monetary Union (EMU) and the single European currency, the euro, in January 1, 1999.

Participation in the EMU (and also the previous convergence process) imposed important structural changes on the Portuguese economy. The monetary and exchange rate policies were lost to the European Central Bank. Therefore, Portugal could no longer rely on the exchange rate as an instrument to be adjusted when national firms lost competitiveness, as had been the case during the crawling-peg period. The escudo gave way to the euro. Since Portugal's main trade partners also joined the single currency, the nominal effective exchange rate became almost constant. However, this did not rule out real appreciations/depreciations.

## 3. The competitiveness question

According to the description given in the previous section, the crawling devaluations of the Portuguese escudo had the main goal of accommodating the inflation differential between Portugal and the main competitors in the markets for its exports. In that way, the exchange rate instrument was a means to obtain gains in terms of price-competitiveness. The policy framework nowadays is much different: Portuguese authorities cannot pursue an autonomous monetary or

exchange rate policy and thus cannot steer the exchange rate in the direction that would be preferred by Portuguese exporters. It is not possible to accommodate the inflation differential and to buttress competitiveness through exchange rate devaluations. During the recent Eurozone crisis, Portugal (like the other countries afflicted) had to deal with difficulties posed by a very adverse scenario without an instrument that, according to Amaral (2010), had been fundamental to the "mini golden age" of 1986-1992.

Given the context and the perceived lack of competitiveness of many firms, two main views emerged on the issue of the competitiveness of Portuguese firms.

On one hand, some authors (Ferreira do Amaral, 2010) point the finger at the euro and argue that Portugal's membership of the Euro Area has been detrimental to the Portuguese economy. These authors assert that the euro is too strong a currency for an economy with the structure of the Portuguese economy. The exchange rate instrument is indispensable for firms in an economy such as the Portuguese to regain competitiveness. An exit from the Euro Area, if only temporarily, would be needed to restore the health of the economy.

On the other hand, supporters of Portugal's membership of the Euro Area (e.g., Alexandre et al., 2017) downplay the importance of the exchange rate instrument. Membership of the Euro Area provides benefits, such as lower transaction costs, reduced uncertainty and greater openness to the rest of the world, not just for trade flows, but also for flows of people and ideas. However, membership of a currency union should be supported by greater wage flexibility and greater labor and capital mobility (Ahearne and Pisani-Ferry, 2006). It is in this context that Krugman (2010) recommended a 30% fall in wages in the Euro Area countries viewed as less competitive.

Macedo (2007) argues that between 1995 and 2005 Portugal did not implement the structural reforms required to accompany a gradual change of economic regime. As a consequence, the benefits of price and exchange rate stability were dissipated by a poor institutional setting and by the absence of complementary reforms. The lack of competitiveness of Portuguese firms, therefore, is not due to Portugal not having an independent exchange rate policy, but rather to the lack of adequate policies and institutions.

There is abundant literature on the factors that help, or hinder, competitiveness and the exporting performance of firms in different countries. Bond (1987) built and estimated a model of the demand for exports and a model for the supply of exports between 1963 and 1982. The aim was to analyze the relation between global economic activity and the growth of exports of

commodities in developing countries. As drivers of demand, Bond considered the real income of the importing countries and the ratio between the price of the good in the exporting country and the price in the international markets (all in US dollars). As drivers of the supply of exports, Bond selected the ratio (current and lagged) between the price of exports and the price level in the exporting countries, an index of overall productive capacity in the exporting region, a measure of supply shocks, as well as a linear trend. Bond concluded that the supply of exports is sensitive to price variations. Therefore, the exchange rate can be useful as a tool for influencing the trade balance.

More recently, Ahmed (2009) sought to measure the sensitivity of Chinese exports to an appreciation of the renminbi. As determinants of exports, Ahmed used the export price, consumption in the importing countries, the real exchange rate and the capital stock (in the end replaced by the cumulative foreign direct investment in China). The equations were estimated in growth rates due to the short time span of the data (1996 to 2009, quarterly data). Ahmed concludes that an appreciation of the real exchange rate harms export growth.

In a different framework, Wagner (2005) employs microeconomic data for Germany, in the period 1995-2004, to analyze the relation between productivity and the export status. Wagner concludes that exporting firms are more productivity than non-exporting firms. It should be noted that there is a discrepancy between aggregate and firm-level estimates of the exchange rate-elasticity of exports. Dekle et al. (2016) related this discrepancy to the omission of cost and demand factors, with special relevance given to the issue of heterogeneity of firm-level productivity. Productivity is also highlighted by Romero and McCombie (2018) as a fundamental measure of "non-price competitiveness" and is an integral part of the concept of "foundational competitiveness" proposed by Delgado et al. (2012). An alternative approach to competitiveness employs constant market share analysis (e.g, Gilbert and Muchova, 2018).

The performance of exporting firms, in its many dimensions, has always been a cause for concern among politicians, businesspersons, researchers and the general public. Most importantly, it has been linked in several ways to fluctuations in unemployment and to external imbalances (e.g., Bação et al., 2015, and Bação et al., 2017). Esteves and Prades (2018) argues that export concentration played a role in the difficulties experienced by the Greek economy. In the same vein, but for Argentina, Albornoz etal (2018) conclude that greater sophistication –

translated into more diversified markets – contributed to continued growth of exports, despite the appreciation of the national currency.

## 4. Modeling the behavior of exporters

In this section we derive the behavior of a firm under standard assumptions. The main difference between our derivations and those presented in any microeconomics textbook is that we take the firm to be an exporter. Therefore, we will need to take into account variables such as the exchange rate, the international price level and foreign demand. Although the results are well-known, we view this section as worthy of inclusion in this paper because it provides important guidance on the variables that should be present in the empirical model of exports that will be estimated in the empirical sections. We view the "firm" as a "representative agent". In other words, we assume that the behavior of the aggregate of firms that exist in the economy may be represented by the behavior of a single firm.

We begin by deriving the behavior of the (representative) firm under the assumption that the firm operates in a perfectly competitive market for its output, i.e., assuming that the (international) price of the exported good is given. (We will always assume that the markets for the production inputs are competitive, that is to say, the firm always takes as given the prices of the production inputs.) The firm makes its decisions with the goal of maximizing profits:

$$\Pi = PY - WL - RK - QZ \qquad (1)$$

In the equation above, $\Pi$ denotes profits, $P$ is the price of the exported good (in units of the national currency), $Y$ is the quantity produced (and exported – as is usual, inventories are ignored), $W$ is the cost ("wage") of a unit of labor, $L$ is the quantity of labor employed by the firm, $R$ is the cost of a unit of capital (the "rental cost of capital"), $K$ is the quantity of capital used in production, $Q$ is the price of the intermediate goods used in the production of the exported good, $Z$ is the quantity of those intermediate goods consumed by the firm.

The maximization of profits is constrained by the given price of the good, by the given prices of the production factors and of the intermediate goods, and by the state of technological development embodied in the production function:

$$Y = AK^{\alpha}L^{\beta}Z^{\gamma} \tag{2}$$

In the equation above, *A* denotes the level of technology. In the empirical sections we will assume that it can be measured by estimates of "total factor productivity". We will also assume that, in the aggregate, returns to scale are decreasing: $\alpha + \beta + \gamma < 1$. This additional assumption is used to prevent possible inconsistencies in the theoretical framework and also to eliminate any ambiguity concerning the sign of the coefficients of the explanatory variables of our model (see equation 3 below).

Given the assumptions mentioned, the firm chooses how many units of labor to hire, how many units of the capital good to rent and how many units of the intermediate good to purchase. The optimal quantities will be a function of the givens of the maximization problem (productivity, output price and input prices), and will determine the optimal quantity to produce, i.e., the exports of the representative firm. The optimal quantity of exports is given by the following formula:

$$Y = A^{\frac{1}{1-\alpha-\beta-\gamma}} \left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta-\gamma}} \left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta-\gamma}} \left(\frac{\gamma}{q}\right)^{\frac{\gamma}{1-\alpha-\beta-\gamma}} \tag{3}$$

In this formula, *r*, *w* and *q* denote the "real" prices of the production inputs, that is, the nominal prices (*W*, *R* and *Q*) divided by the price of the output good (*P*). Equation 3 tells us that exports are increasing in productivity and decreasing in the real prices of inputs. This is an example of an "export supply model" (see Bayar, 2018). By supposing that the market for the firm's output is competitive, the model effectively assumes that the firm can sell everything it desires at the going price, and therefore it assumes that demand does not constrain exports. This is an implication that sounds somewhat implausible, at least in the Portuguese case, for the export performance is often related to fluctuations in the fortunes of the destination countries. It would also imply that any increasing trend in exports must be the result of either an increasing trend in productivity or a decreasing trend in real input prices. Therefore, given that a strong direct impact on productivity seems unlikely, this model predicts that, for example, the international financial crisis of 2007-2008 would only have negatively affected Portuguese exports insofar as it caused

an increase in the real prices of inputs. Presumably, the increase in the real prices of inputs would be the result of a fall in the export price measured in units of the national currency. This means that the export price would be a sufficient summary of all the signals coming from the destination countries and relevant for the decisions on how much to produce of the export good. An analysis of export performance based on this approach would put the emphasis on indicators of competitiveness (see Siggel, 2006), especially on the real exchange rate and on measures of production costs.

In order to introduce demand-side factors into our model, we now assume that the representative firm behaves as a monopolist in monopolistic (or imperfect) competition. Essentially, this entails adding an equation to the previous model, the new equation being a constraint given by the behavior of the demand curve that the monopolist firm faces. We employ the usual functional form:

$$Y = \left(\frac{P^*}{EP}\right)^{\sigma} Y^* \tag{4}$$

In this equation, *P** is the foreign price index (the foreign price is measured in units of the foreign currency), *E* is the nominal exchange rate (units of foreign currency necessary to purchase one unit of the national currency, a decrease corresponds to a depreciation of the national currency), *Y** is the measure of foreign demand and σ is a parameter that measures the price-elasticity of demand (assumed to be larger than one).

In this new theoretical framework, the firm again chooses how many units of labor to hire, how many units of the capital good to rent and how many units of the intermediate good to purchase. However, the optimal quantities will no longer be a function of the output price, since this is now also endogenous. The optimal quantities and output price depend not only on productivity and input prices (still assumed to be exogenous), but also on the exchange rate, on the foreign price index and on the foreign demand measure. The optimal quantity of exports is now given by the following formula:

$$Y = A^{\frac{1}{\theta}} \left(\frac{\sigma-1}{\sigma}\right)^{\frac{\alpha+\beta+\gamma}{\theta}} \left(\frac{\alpha}{r^*}\right)^{\frac{\alpha}{\theta}} \left(\frac{\beta}{w^*}\right)^{\frac{\beta}{\theta}} \left(\frac{\gamma}{q^*}\right)^{\frac{\gamma}{\theta}} Y^{*\frac{\alpha+\beta+\gamma}{\sigma\theta}} \tag{5}$$

In the equation above, $\theta = 1 - \frac{\sigma-1}{\sigma}(\alpha + \beta + \gamma)$. The "real" prices of the production inputs (*r**, *w** and *q**) are now defined by the ratio of the nominal prices to the foreign price index (*P**) converted to the national currency (i.e., *P** divided by the exchange rate *E*). Consequently, "competitiveness" of domestic factor costs should now be assessed with reference to the prices of the competitors (in a very broad sense, depending on how broad the foreign demand measure is chosen to be) rather than with reference to the price of the good produced by the firm.

Aside from that, equation 5 now assigns a role to foreign demand, alongside productivity and cost elements. In that way, the new model integrates both supply and demand factors in the determination of exports. An increasing trend in exports may now be just a reflection of the increase in foreign demand; continued productivity increases or forever decreasing real input prices are no longer required for the explanation of a growth trend in exports. If the increase in foreign demand becomes, in a sense, excessive, putting visible pressure on the demand for domestic resources, the prices of those resources should increase to restore equilibrium. Clearly these would be general equilibrium effects, which go beyond the partial equilibrium analysis that we have just presented.

Whether the variables interact in this way or not, according to the model, both demand and supply elements will play a fundamental role in the determination of exports. Besides that, the exchange rate will also matter: regardless of whether the exchange rate is fixed or, by any measure, floating, in this model its value is pivotal in the comparison of domestic production costs to foreign prices. If, for some reason (but keeping foreign and domestic prices constant), the national currency depreciates (*E* decreases), the domestic production costs will decline relatively to the foreign prices, making domestic production more attractive and increasing exports.

## 5. The data

To proceed to the econometric analysis, we collected data that might, at least approximately, match the variables present in the theoretical models. Given that tourism-related exports may have specific characteristics, not envisaged in our theoretical framework, we limit our attention to exports of goods. The data series that we collected are the following:

- Portuguese exports of goods (chained values), from Banco de Portugal (the Portuguese central bank);

- price index for the Portuguese exports of goods (chained values), from Banco de Portugal;

- price index for the Portuguese gross domestic product, from Banco de Portugal;

- total factor productivity in Portugal, from AMECO;

- compensation of employees (nominal), per employee, from Banco de Portugal;

- gross domestic product of OECD countries (constant prices, constant exchange rates), from OECD;

- price index for the OECD gross domestic product, from OECD;

- the exchange rate of the Portuguese escudo with respect to the US dollar, from the Banco de Portugal;

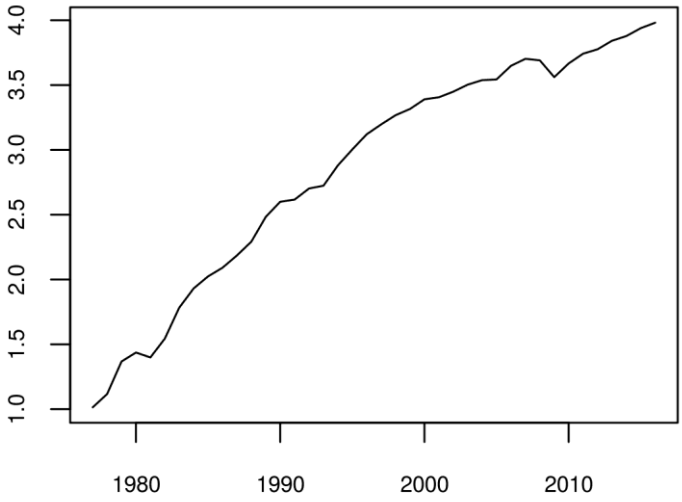
- the exchange rate of the euro with respect to the US dollar, from the Banco de Portugal.

After treatment, all the series we will employ are annual and cover the period 1977-2016. The exchange rates are yearly averages of quarterly averages.

The Portuguese real exports will be matched to variable *Y* in the theoretical models. The corresponding price index will be matched to variable *P*. The AMECO estimate of total factor productivity will be used as a proxy for variable *A*. It is possible that, being a broad measure covering agriculture, industry and services, the series underestimates the productivity gains in sectors that manufacture goods for exporting. Nominal compensation of employees (per employee) will be used to represent variable *W*. Whether such an average value is representative of wage costs in the export sector is also open to discussion. The price index of the Portuguese GDP will be used as a proxy for the prices of intermediate consumption goods used in the production of exported goods (*Q*). Again, whether this is a reasonable assumption is debatable, but we could not think of an obviously superior proxy. The OECD's gross domestic product will be our measure of foreign demand (*Y**, but see also Fischer et al., 2018). Therefore, the corresponding deflator will represent the foreign price in units of the foreign currency (*P**). The series for the exchange rate (*E*) was computed from the exchange rates with respect to the US dollar of the Portuguese escudo (Portugal's national currency before the introduction of the euro) and of the euro. As for the rental rate of capital, we estimated it by applying the formula for the user cost of capital. For that purpose, we used the deflator for the gross fixed capital formation in

Portugal, the short-term real interest rate in Portugal and the depreciation rate of the capital stock in Portugal, all series obtained from AMECO. However, note that the resulting estimate of variable *R* is not always positive. Therefore, we will not take the logarithm of this series, differently from what we will do to the other series.

**Figure 1:** Portugal's exports of goods (logarithm, chained volume, reference year: 2011)

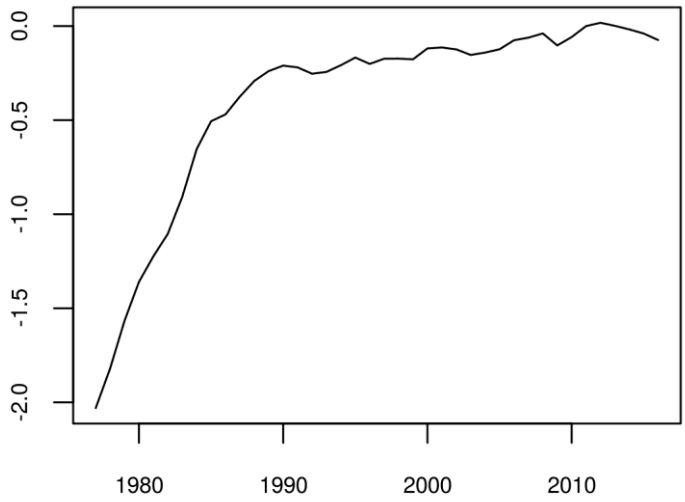



**Source:** Banco de Portugal.

Figure 1 shows the evolution of Portugal's exports of goods (in volume) between 1977 and 2016. There is a clear overall growth trend, albeit with a lower slope since the mid-1990s. The impact of the international financial crisis is also clearly visible in 2009, but it was quickly overcome. This will be the dependent variable in the empirical sections that come next.

Figure 2 shows the evolution of the corresponding price deflator. There was a steep increase until circa 1990. Since then the inflation has been much lower. The impact of the international financial crisis is again visible, but does not stand out as much as the impact on the volume of exports.

**Figure 2:** Deflator of Portugal's exports of goods (logarithm, reference year: 2011)

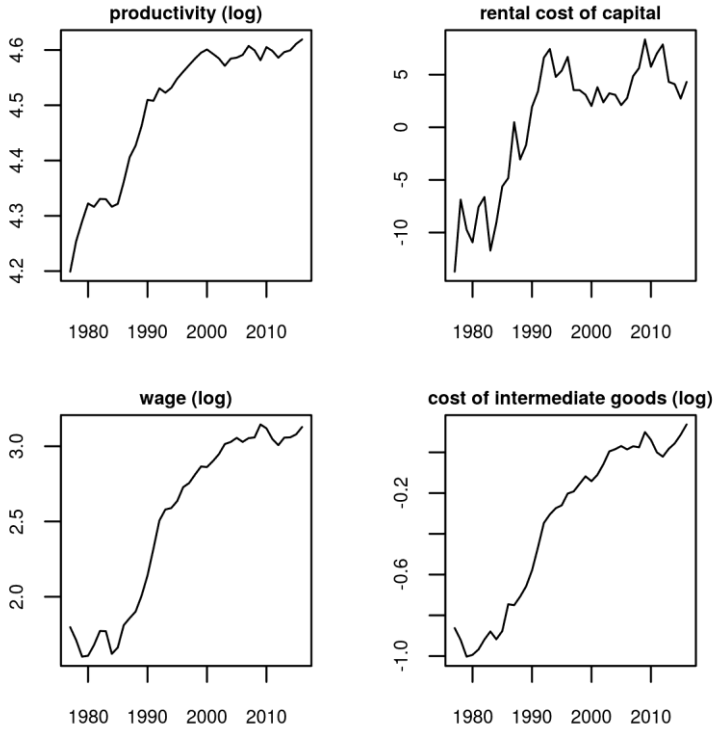



**Source:** Banco de Portugal.

## 6. The perfect competition model

In this section we investigate the suitability of the perfect competition model discussed in the section 5 for modeling the behavior of Portuguese exports of goods. That model suggests that the main determinants of exports are productivity and the real prices of inputs, obtained by dividing the nominal prices by the price of the exported goods (shown in Figure 2). Figure 3 shows the behavior of these series. All series share a common feature: an initial fast growth trend that somewhere in the 1990s gives way to a slower growth trend, if not to a horizontal pattern (as in the case of the estimate of the rental cost of capital).

**Figure 3:** Explanatory variables for the perfect competition model




**Source:** Authors' computations based on data from AMECO and Banco de Portugal.

The theoretical model implies that there should be some sort of cointegrating relation between exports and the four explanatory variables depicted in Figure 3. Therefore, we begin by testing the stationarity of the series, as a first check of the conditions for cointegration. All computations were performed with the econometrics software Gretl, version 2016d.

The results of the unit-root/stationarity tests are in Table 1. The ADF test suggests that all series have one unit root. The picture produced by the KPSS test is not as clearcut for the exports and productivity series, implying that these might have a second unit root.

**Table 1:** ADF and KPSS tests – series for the perfect competition model

| | Level | | First-difference | |
|---|---|---|---|---|
| Series | ADF | KPSS | ADF | KPSS |
| exports | -1.2837[0.877] | 0.2800[<.01] | -4.6087[0.001] | 0.7770[<.01] |
| productivity | -1.8095[0.681] | 0.2672[<.01] | -3.0969[0.027] | 0.5039[0.043] |
| r.c.capital | -3.0330[0.123] | 0.2128[<.01] | -8.2177[0.000] | 0.2815[>.10] |
| wage | -1.4630[0.842] | 0.1999[0.017] | -3.8511[0.005] | 0.1889[>.10] |
| int.goods | -1.0663[0.922] | 0.2147[<.01] | -4.3992[0.001] | 0.1593[>.10] |

**Notes:** p-values in parentheses. The tests applied to the levels include a trend. The tests applied to the first difference only include a constant. ADF is the Augmented Dickey-Fuller test; the null hypothesis is that the series has a unit root. KPSS is the Kwiatkowski–Phillips–Schmidt–Shin test; the null hypothesis is that the series is trend-stationary.

Assuming that the series have one unit root, the next step is to test for cointegration. The most common tests are the Engle-Granger and the Johansen. Given our small sample, the opt for the Engle-Granger, despite its well-known limitations. In Table 2 we report the outcome of the Engle-Granger test procedure to our data. The procedure begins by estimating the following equation:

$$\ln Y_t = \beta_1 + \beta_2 \ln A_t + \beta_3 r_t + \beta_4 \ln w_t + \beta_5 \ln q_t + \epsilon_t \qquad (6)$$

The residuals are then tested for a unit root. If the null hypothesis of a unit root is rejected, the test's outcome will be favorable to the existence of cointegration between the series. The results in Table 2 therefore go against the hypothesis of cointegration. Besides that, the estimates of the coefficients are not as expected. Namely, the coefficient on the price of intermediate goods is positive, which is contrary to the hypothesis that an increase in production costs will lower the attractiveness of exporting. One possible interpretation of this result is that, of the explanatory variables in the model, the price of intermediate goods displays the growth trend that is closest to the profile of the growth trend in exports. As we mentioned before, in the absence of a demand measure in the model, the growth in exports must be the result of a trend in the explanatory variables. The estimates show that the growth trend in exports is being assigned to the growth trend in the price of intermediate goods. Clearly, this makes the interpretation of the result as the consequence of an omitted-variable bias look very plausible. The unit root test and the "wrong" sign indicate that the perfect competition model does not appear to provide an adequate

description of the behavior of Portuguese exports of goods. In the next section we turn to the monopolistic competition model.

**Table 2:** Engle-Granger test for cointegration - perfect competition model

| series | coefficient | std.error | t-ratio | p-value |
|---|---|---|---|---|
| constant | −3.19779 | 3.58095 | −0.8930 | 0.3780 |
| productivity | 4.25734 | 0.716753 | 5.940 | 9.27e-07*** |
| r.c.capital | −0.0227370 | 0.00888979 | −2.558 | 0.0150** |
| wage | −1.90802 | 0.476243 | −4.006 | 0.0003*** |
| int.goods | 3.98672 | 0.726983 | 5.484 | 3.70e-06*** |
| Dickey-Fuller test on the residuals: statistic -3.13905, p-value 0.5481 | | | | |

**Note:** the sample is 1977-2016.

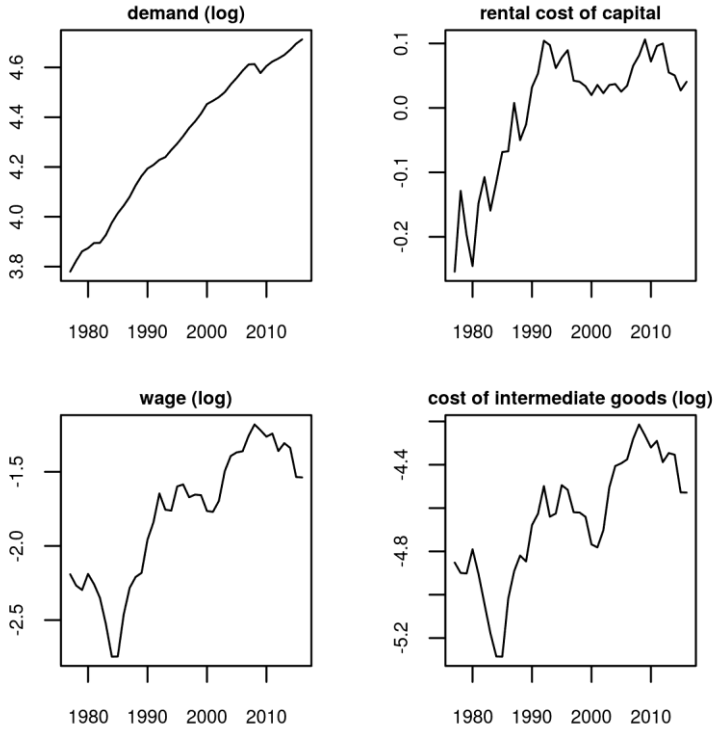
## 7. The monopolistic competition model

In this section we apply the same procedure as in the previous section, to evaluate the adequacy of the monopolistic competition model discussed in the section 5. In the monopolistic competition model, the set of explanatory variables also includes a measure of foreign demand, besides productivity and the real prices of inputs. In addition, the real prices of inputs are now computed by dividing the nominal prices by the foreign price level converted to the national currency. Figure 4 shows how these explanatory variables behave in our sample (with the exception of productivity, already shown in Figure 3).

Compared with the corresponding series for the perfect competition model, the new series for the rental cost of capital is not very different. However, the new series for the wage and the price of intermediate goods do look different: the new series display a much more irregular growth trend. On the other hand, the model now includes a measure of foreign demand, and this measure has a very well defined growth trend, in which the dip caused by the international financial crisis is easily spotted.

As before, we begin by testing the series for stationarity/unit roots; the results are in Table 3. The conclusions from the tests are not very sharp. The ADF test suggests that the wage, the price of intermediate goods and demand all have one unit root, while the rental cost of capital may have two. However, the KPSS test suggests that the wage and the price of intermediate goods may be trend-stationary, while the rental cost of capital and the measure of demand may not be stationary, not even after taking the first difference.

**Figure 4:** Explanatory variables for the monopolistic competition model.




**Source:** Authors' computations based on data from AMECO and Banco de Portugal.

**Table 3:** ADF and KPSS tests – monopolistic competition model

| | Level | | First-difference | |
|---|---|---|---|---|
| Series | ADF | KPSS | ADF | KPSS |
| r.c.capital | -2.6801[0.245] | 0.2271[<.01] | -1.5580[0.504] | 0.4185[0.070] |
| wage | -1.4057[0.844] | 0.0998[>.10] | -4.1863[0.002] | 0.1179[>.10] |
| int.goods | -1.8263[0.673] | 0.0661[>.10] | -4.5886[0.001] | 0.0864[>.10] |
| demand | -0.6776[0.968] | 0.2468[<.01] | -4.3284[0.001] | 0.4451[0.058] |

**Notes:** p-values in parentheses. The tests applied to the levels include a trend. The tests applied to the first difference only include a constant. ADF is the Augmented Dickey-Fuller test; the null hypothesis is that the series has a unit root. KPSS is the Kwiatkowski–Phillips–Schmidt–Shin test; the null hypothesis is that the series is trend-stationary.

As in the previous section, we proceed under the assumption that the series have one unit root, and move to test for cointegration. Now the equation to be estimated is:

$$\ln Y_t = \beta_1 + \beta_2 \ln A_t + \beta_3 r_t^* + \beta_4 \ln w_t^* + \beta_5 \ln q_t^* + \beta_6 \ln Y_t^* + \epsilon_t \qquad (7)$$

The results of the Engle-Granger procedure are in Table 4. Relative to the perfect competition model, the results are more palatable. Nevertheless, the fact that the rental cost of

capital has the "wrong" sign is troublesome. Given that this variable appears to have little importance, we decided to delete it from the model. When we do that, the wage and price of intermediate goods series continue not to be significant at the 10% level. Further eliminating one of the two made the other become significant. However, in the end the best model appeared to be the one in which we eliminated the price of intermediate goods. That is the model on which we will report here.

**Table 4:** Engle-Granger test - monopolistic competition model

| series | coefficient | std.error | t-ratio | p-value |
|---|---|---|---|---|
| constant | −11.2608 | 1.18077 | −9.537 | 3.87e-11*** |
| productivity | 2.10358 | 0.346964 | 6.063 | 7.14e-07*** |
| r.c.capital | 0.368612 | 0.234451 | 1.572 | 0.1252 |
| wage | −0.0699288 | 0.166041 | −0.4212 | 0.6763 |
| int.goods | −0.238773 | 0.207803 | −1.149 | 0.2586 |
| demand | 2.39739 | 0.114411 | 20.95 | 5.12e-21*** |
| Dickey-Fuller test on the residuals: statistic -4.47805, p-value 0.08846 | | | | |

**Note:** the sample is 1977-2016.

Deleting the rental cost of capital and the price of intermediate goods from the model produced the estimates presented in Table 5. At the 10% significance level, the test points towards cointegration between the series. This does not mean that the model is fully satisfactory: the fact that we eliminated two variables from the set of explanatory variables derived from the theoretical model implies that the empirical model is not completely congruent with the theoretical model and that omitted-variable bias is very likely to be a problem. A review of the theoretical framework, or a renewed search for more adequate proxies for the theoretical variables, is in order. We leave this for future research. For now we continue the analysis of this second empirical version of the monopolistic competition model.

**Table 5:** Engle-Granger test – monopolistic competition model II

| series | coefficient | std.error | t-ratio | p-value |
|---|---|---|---|---|
| constant | −12.3481 | 0.848622 | −14.55 | 1.19e-16*** |
| productivity | 2.53128 | 0.242293 | 10.45 | 1.91e-12*** |
| wage | −0.251583 | 0.0488826 | −5.147 | 9.59e-06*** |
| demand | 2.38525 | 0.111734 | 21.35 | 5.00e-22*** |
| Dickey-Fuller test on the residuals: statistic -3.96181, p-value 0.07018 | | | | |

**Note:** the sample is 1977-2016.

The models represented by equations 6 and 7 depict the long-run relation between the series. We now estimate a model that also attempts to explain short-run fluctuations. The model is given by:

$$\Delta \ln Y_t = \gamma_1 + \gamma_2 \Delta \ln A_t + \gamma_3 \Delta \ln w_t^* + \gamma_4 \Delta \ln Y_t^* + \gamma_5 \hat{\epsilon}_{t-1} + \nu_t \quad (8)$$

In equation 8, the new explanatory variable is the lagged residual from the long-run model:

$$\hat{\epsilon}_{t-1} = \ln Y_t - \hat{\beta}_1 - \hat{\beta}_2 \ln A_t - \hat{\beta}_4 \ln w_t^* - \hat{\beta}_6 \ln Y_t^* \quad (9)$$

Estimation of equation 8 gives the results reported in Table 6. The estimated coefficient for the lagged residual is negative, implying an adjustment of exports towards the long-run equilibrium relation. The short-run coefficients are not far, in terms of magnitude, from the long-run elasticities reported in Table 5. Thus, exports of goods appear to be very sensitive to productivity and to demand. On the other hand, exports appear to be very insensitive to wage costs (contrast Kangur, 2018, for the Italian case).

**Table 6:** Short-run model

| series | coefficient | std.error | t-ratio | p-value |
|---|---|---|---|---|
| constant | −0.00386570 | 0.0146805 | −0.2633 | 0.7939 |
| d_productivity | 1.10795 | 0.513891 | 2.156 | 0.0382** |
| d_wage | −0.121144 | 0.0708249 | −1.710 | 0.0963* |
| d_demand | 2.97011 | 0.611532 | 4.857 | 2.63e-05*** |
| lagged residual | −0.465824 | 0.139088 | −3.349 | 0.0020*** |
| R-squared | 0.620894 | | Durbin-Watson | 1.520584 |
| LM test | 3.4087[0.0738] | | Ljung-Box | 1.71977[0.19] |

**Note:** the sample is 1977-2016. The prefix "d_" denotes the first difference. "LM test" is the Lagrange multiplier test for autocorrelation. P-values for the LM and Ljung-Box tests are in parentheses.

## 8. Conclusion

In this paper we discussed the usefulness of two alternative models of the behavior of exports: a model that assumes perfect competition and a model that assumes monopolistic competition, both expressed in terms of a representative firm. Estimation of the perfect competition model revealed shortcomings that lead us to conclude that it does not provide an

acceptable representation of export behavior for the Portuguese case. The monopolistic competition model fared a bit better. Nevertheless, the results suggest that not all of the variables that the model predicts to be relevant do matter for explaining the observed behavior of exports. This lack of accordance between the theoretical and the empirical models indicate that something is not well, either in the theoretical model or in the empirical version that we estimated. One obvious possibility is that the series that we collected are not good-enough proxies for the theoretical counterparts. But alternative explanations may be worth considering in future research, namely the impact of the rise of global value chains, the impact of the enlargement of the European Union to Eastern European countries, and the impact of China's integration in the World Trade Organization.

Nevertheless, if we take at face value the results obtained from the estimation of a modified empirical version of the monopolistic competition model, then we conclude that Portuguese exports appear to be very sensitive to demand fluctuations and to productivity gains, but very insensitive to wage costs. Therefore, to focus on price-competitiveness (based on cheap labor or on exchange rate manipulation) seems to be an inefficient way to promote exports.

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