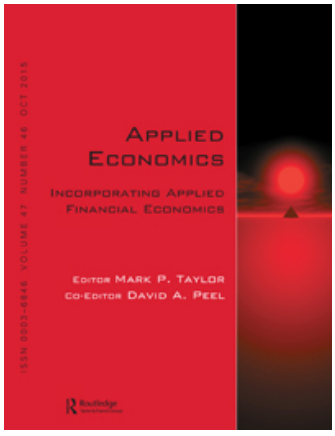

Applied Economics
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/raec20

Exports, productivity and innovation: new firm level empirical evidence

Horácio C. Faustino[a] & Pedro Verga Matos[b]
[a] SOCIUS/CSG, ISEG, Universidade de Lisboa, Lisbon, Portugal
[b] ADVANCE/CSG, ISEG, Universidade de Lisboa, Lisbon, Portugal
Published online: 26 Jun 2015.

To cite this article: Horácio C. Faustino & Pedro Verga Matos (2015) Exports, productivity and innovation: new firm level empirical evidence, Applied Economics, 47:46, 4918-4933

To link to this article: http://dx.doi.org/10.1080/00036846.2015.1039700

Applied Economics, 2015
Vol. 47, No. 46, 4918–4933, http://dx.doi.org/10.1080/00036846.2015.1039700

Routledge
Taylor & Francis Group

Exports, productivity and innovation: new firm level empirical evidence

Horácio C. Faustino[a,*] and Pedro Verga Matos[b]

[a]*SOCIUS/CSG, ISEG, Universidade de Lisboa, Lisbon, Portugal*
[b]*ADVANCE/CSG, ISEG, Universidade de Lisboa, Lisbon, Portugal*

This article examines the determinants of Portuguese exports, applying data from 277 manufacturing firms for the period 2006–2010. In 2010, these firms accounted for about 47% of total Portugal's exports. Both the static and dynamic results of the estimated models confirm the positive influence of productivity on variations in exports. The dynamic estimations also suggest that exports in the previous period hold a positive effect on contemporaneous exports, confirming the Roberts and Tybout (1997) sunk cost hypothesis for exports. In the dynamic analysis, the labour costs and the size of the firm do not have a statistically significant effect on Portuguese exports with the findings also pointing to increased expenditure on research and development (R&D) generating no statistically significant effect on exports. The lagged R&D expenditure was also insignificant in explaining the change of Portuguese exports. Thus, these results suggest that applying a product or process innovation measure returns better results than indirect measures such as R&D expenditure.

Keywords: exports; innovation; panel data; productivity; Portugal

JEL Classification: C33; F14; L25

I. Introduction

Portugal has not proven immune to the current global financial and economic crisis. As a small, open economy, the economic growth of which is partly dependent on its export performance, the effects of the recession have particularly hit the export sector. Promoting exports represents the highest priority of the Portuguese government in order to both stimulate economic growth and reduce the external deficit. Innovation and productivity are commonly accepted as the main explanatory factors behind an increased propensity to export. Export markets select the more productive and innovative firms (the self-selection hypothesis) and the export performance positively influences the productivity and innovation of exporting firms (the learning-by-exporting hypothesis or reverse causality). Many empirical studies have estimated a positive effect of innovation on exports through the productivity premium of exporting firms (Cassiman and Golovko, 2007; Cassiman and Martínez-Ros, 2007), whereas the reverse causality

*Corresponding author. E-mail: faustino@iseg.utl.pt

(the effects of exports on productivity growth through product or process innovation) has only more recently been studied (Aw *et al*., 2005; Damijan and Kostevc, 2006; Damijan *et al*., 2010; Monreal-Pérez *et al*., 2012; Love and Ganotakis, 2013).

As Portugal's economic growth is based on export growth – and there has been a political consensus around this since the onset of the crisis and recession – we chose to study the leading 277 Portuguese manufacturing firms that account for approximately 50% of Portugal's total exports. To the best of our knowledge, there have been few Portuguese empirical studies interlinking exports and their determinants at the firm level and taking bilateral trade into account. Serrasqueiro and Nunes (2008) analyse the performance and size of Portuguese SMEs, while Silva (2011) considers the link between financial constraints and exporting behaviours at the firm level. In addition, Faustino *et al*. (2012) study the determinants of Portuguese exports to Spain, considering a sample of the 97 largest exporters over the 2004–2008 period. Serra *et al*. (2012) estimate the impact of key factors upon the export propensity of British and Portuguese textile firms. Meanwhile, Janeiro *et al*. (2013) apply ordered probit regression to explain open innovation and thus assess which factors influence collaboration between successful firms and universities.

Since the seminal paper of Vernon (1966), exports have been linked with product innovation and the design of new and differentiated products. In the first stage of production, these innovative new products are created for the domestic market and the firm only enters afterwards into the export market to leverage its competitive advantage determined more by research and development (R&D) and knowledge intensity than traditional comparative advantage. Additionally, this innovation in products and processes induces an increase in productivity with competitiveness in the following stages of the product life cycle determined by productivity (or relative labour costs as Ricardian theory holds). Thus, in the empirical models, export variations are explained by R&D and by labour costs (productivity) as well as other key factors.

The relationship between exports, innovation and productivity finds theoretical support in various studies (see, e.g., Hirsch and Bijaoui, 1985; Basile, 2001; Guan and Ma, 2003; Melitz, 2003; Özçelik and Taymaz, 2004; Kimura and Kiyota, 2006; Wagner, 2007, 2008). The firm's size – measured by the number of employees, level of sales or volume of firm assets – may also bear a positive impact on firm exports. Larger firms are associated with economies of scale, product differentiation, technical efficiency and greater performance (see, e.g., Serrasqueiro and Nunes, 2008). The main obstacle to conducting such empirical studies in Portugal is the lack of available micro data since the law on data confidentiality prevents the National Institute of Statistics from providing detailed data by firm. However, at the international level, we do find several studies that incorporate data by firm (see, e.g., Kimura and Kiyota, 2006; Cassiman and Martínez-Ros, 2007). This problem ended up resolved by Dun & Bradstreet by collecting the data directly from the firms themselves.

In this article, we test the innovation–exports relationship through productivity (the learning-by-exporting hypothesis) in order to ascertain whether or not the Portuguese case confirms other empirical studies. Our static and dynamic results do confirm the results of previous studies about the positive effect of productivity on exports. Are innovative firms more productive and are they more likely to become exporters than their noninnovative peers? The static and the dynamic results report that innovation plays no statistically significant role in Portuguese exports. Thus, these results do not confirm those of Becker and Egger (2013) who return statistical evidence favouring a positive effect of product innovation on firm propensities to export after controlling for the endogeneity of innovation. However, we have applied R&D expenditure as an indirect measure of innovation whereas Becker and Egger (2013) make recourse to a direct measure of product and process innovations based on survey data. They also conclude that '… product innovation is more important for firm-level export behaviour than is process innovation. Process innovations increase a firm's probability to export only when being combined with product innovations' (p. 330). Based on the theory, we should include both explanatory variables, productivity and innovation, in the econometric model in order to avoid misspecification (lack of explanatory variables). The link between innovation–productivity–exports may depend on country-specific contexts or the R&D variable may not capture all the (product and process) innovation activities of Portuguese firms. One other possible

explanation suggested by these results incorporates how productivity does get influenced by channels other than R&D. Alternatively, innovation may stimulate exports to the most developed markets but fail to generate a significant impact on exports to less competitive markets.

The application of a dynamic specification and the GMM-system (GMM-SYS) estimator resolves some endogeneity and collinearity problems and therefore providing more robust results (see, e.g., De Mello-Sampayo, 2007, 2009, for a good explanation on applying GMM-SYS). The static panel data results are also provided in order to make comparisons with similar static estimations made by other researchers.

Several studies have shown that within each industry, there are export firms that do not take into account the strategic factors as well as the cultural and financial factors (Roberts and Tybout, 1997; Bernard and Jensen, 1999). Indeed, export firms face significant costs associated with the collection of information about external markets, in particular potential clients, designing or adapting new products, knowledge about legal frameworks, and so forth. However, Riding *et al*. (2012) believe that firms with greater financial strength are able to overcome barriers to exporting. They also argue that financial constraints limit access to foreign markets, even to firms that are highly innovative (see also Bell, 1997; Griffith and Czinkota, 2012). Thus, *ceteris paribus*, firms with better performances (productivity) tend to more commonly export. This correlation between financial health and export capacity has received little attention as is stressed by Sousa *et al*. (2008). Correspondingly, the aim of this article also extends to testing the relevance of firm financial characteristics – financial strength and profitability – as explanatory variables for its export levels.

The remainder of the article is structured as follows. Section II presents the literature review underpinning the econometric model and the hypotheses correspondingly formulated. Section III formulates the empirical model and the explanatory hypotheses while Section IV details the empirical study, using panel data and presenting the results for both the static and dynamic analyses. In the dynamic analysis, the article applies the system GMM estimator, with the Windmeijer (2005) correction for small samples. The respective tests are carried out to make the results robust. Finally, Section V summarizes the main conclusions.

II. Literature Review

Exports and productivity

Exporting firms display specific characteristics when compared to nonexporting firms. For example, exporting firms tend to have higher levels of productivity, economies of scale, employment and production efficiency. Exporting firms also incur high sunk entry costs when they endeavour to enter competitive international markets. According to the model developed by Choi (2003), the exporting firm faces a relatively high cost in its initial entry to a foreign market. These sunk entry costs act as a barrier to entry for many new exporting firms. However, following Roberts and Tybout (1997) 'sunk entry or exit costs produce hysteresis', that is, there is a memory and the effects on exports will remain in the future. This is a sunk cost hypothesis of entry into international markets – the past export decision has a positive impact on the decision of the next year (Cassiman and Martínez-Ros, 2007), or, '…prior export-market experience significantly affects the current decision to export, and the policy implications stressed in the hysteresis literature are empirically relevant' (Roberts and Tybout, 1997, p. 546). Testing the hypothesis that the sunk costs for exports are not zero involves applying lagged exports as an explanatory variable in the dynamic model.

Only companies with high levels of productivity are able to enter foreign markets. Girma *et al*. (2002), based on data from UK companies, found that exporting firms are, on average, larger and more productive than other firms.

There are two hypotheses justifying a positive relationship between productivity and exports. The first hypothesis considers that the most productive firms get inherently self-selected as selling goods in foreign markets involves additional costs, which constitute a barrier to entry for less competitive companies. Based on Ricardo's theory of comparative advantage, the more efficient firms attain higher productivity levels and are more likely to export (Melitz, 2003). The second hypothesis points to the importance of learning-by-exporting. Firms increasing their export results build up external market-related knowledge and experience (Aw *et al*., 2000). Exporting firms are exposed to more intense competition and have to act more quickly than firms not exporting (Wagner, 2007). Learning-by-exporting, just as learning-by-doing, is mainly acquired by

firms participating in two ways. First, contact with foreign clients promotes the transmission of knowledge and technology, allowing access to specific expertise, for example new product design and new production methods, among others. Second, the foreign demand leads to higher capacity utilization and thus driving economies of scale (Castellani, 2002). The Helpman *et al*. (2004) model proposes that higher productivity firms export whereas lower productivity firms remain in the domestic market. The model also maintains that only the highest productivity firms are able to engage in exports and in foreign direct investment (FDI). Therefore, productivity is an important factor in explaining both exports and FDI. However, both exports and FDI may improve the firm's productivity (Kimura and Kiyota, 2006). Aw *et al*. (2005) also report that both exports and R&D generate a positive effect on future productivity. This raises the issue of simultaneity and the need for appropriate econometric instruments to resolve this problem.

Other recent innovations in empirical studies on exports and productivity stem from implementing matching (propensity score matching) to assess learning-by-exporting through group comparisons, and often deployed in empirical studies of labour markets. Selection bias gets addressed via matching considering that exporters and nonexporters would otherwise have similar characteristics. Thus, we correspondingly need to identify those variables – size, firm age, productivity, and so forth – that actually affect the probability of exporting and make firms display greater export propensities (see, e.g., Bigsten *et al*., 2004; Girma *et al*., 2004; Bigsten and Gebreeyesus, 2008; Becker and Egger, 2013).

The problem of selection bias, which is not controlled by the estimation process, arises when exporters are not selected randomly from a population but are self-selected or selected according to specific criteria. Baltagi (2008) considers that in many surveys the problem of selection bias in panel data surveys occurs due to a variety of self-selection rules: the nonresponses of economic actors refusing to participate in the survey or refusing to answer particular questions. This calls into question the representativeness of the observed sample and subsequent inferences about the population. Verbeek and Nijman (1996) is cited by Baltagi (2008) as regards the distinction between ignorable and nonignorable selection rules that justify the reason for nonresponse. 'This distinction is important because, if the selection rule is ignorable for the parameters of interest, one can use the standard panel data methods for consistent estimation' (Baltagi, 2008, p. 251).

In the present article, we may consider that this selection bias problem does not arise because the Portuguese exporters firms were not selected according to certain criteria. Thus, we do not need to match the exporting firm with a nonexporting firm *j* in accordance with the nearest-neighbour matching method (Girma *et al*., 2004). The problem of selection biases nevertheless encounters multiple methods for their resolution. Propensity score matching represents one correction strategy (see Wooldridge, 2003 about truncated and censored regression models). Following Wagner (2002) and Girma *et al*. (2004), Bigsten and Gebreeyesus (2008) apply Blundell and Bond (1998, 2000) system-GMM to control for endogeneity and applied matching to control for selection bias. The matching as well as system-GMM is also performed in Stata (see Sianesi, 2001).

Exports and innovation

Regarding the relationship between exports and innovation, there are distinct strands in the literature on international trade explaining the relationship. First, in the Vernon (1966) product life cycle model, innovation is an exogenous variable that positively affects exports. According to this model, developed countries export innovative goods that are later imitated by other less developed countries. In the maturity phase, where the technology is standardized, these goods are produced in developing countries and exported to developed countries. Thus, in order to maintain their level of exports, the developed countries must innovate continuously. The more a company innovates, the greater its exports (Lachenmaier and Wößmann, 2006). Second, we have the endogenous growth models. These models endogenize innovation and consider the dynamic effects of international trade on innovative activity and vice versa (Aghion and Howit, 1998).

The results obtained by Hirsch and Bijaoui (1985) also confirm that innovative firms have substantially higher export quotas than those that do not innovate. The hypothesis that product innovation is the driving force behind exports was also confirmed by Cassiman and Martínez-Ros (2007), studying data on Spanish firms, and by Aw *et al*. (2008). The

firms that implement technological innovations, investing in innovation and R&D, and that additionally export return higher levels of performance in economic terms than firms with similar characteristics that do not innovate or export. Small firms that perform small innovations or do not have R&D departments are also less likely to export and prove better suited to supplying only the domestic market. However, Cassiman and Martínez-Ros (2007) and Cassiman *et al*. (2010) found empirical evidence that product innovation induces small firms to enter international markets.

Various empirical studies find that product innovation positively relates to the propensity to export. The innovation process is driven by high-quality internal factors such as R&D (see, e.g., Serra *et al*., 2012; Love and Ganotakis, 2013; Yi *et al*., 2013).

The empirical studies confirm a positive relationship between exports and product innovation (e.g. Aw *et al*., 2005, 2008; Girma *et al*., 2008; Monreal-Pérez *et al*., 2012; Yi *et al*., 2013). Damijan *et al*. (2010) consider that proving a direct link from innovation via higher productivity to exports represents no easy task. In the same way, Hahn and Park (2012) examine the bidirectional causal relationships among exporting, innovation and productivity. Yi *et al*. (2013) consider that the effects of innovation on exports are moderate, conditioned by institutional forces such as foreign ownership, business group affiliation and the degree of regional marketization. Innovation and internationalization may be complementary or substitutive (Kyläheiko *et al*., 2011), and Monreal-Pérez *et al*. (2012) conclude that innovation induces increasing exports activities and consider that firm productivity holds a positive and moderating effect on the relationship between exports and innovation. Cassiman and Martínez-Ros (2007), Cassiman *et al*. (2010) and Becker and Egger (2013) found strong evidence that product innovation, but not process innovation, induces nonexporting firms to enter export markets.

Becker and Egger (2013) report statistical evidence that product innovation is more important than process innovation for a firm's propensity to export (the extensive margin of exporting, measured as export-to-GDP ratio), although process innovation '... improves a firm's probability to export if it is accompanied by product innovation' (p. 352). Process innovation has considerable effects on the intensive margin of exporting, measured as the exports-to-sales ratio. Becker and Egger (2013) consider that process and product innovations are endogenous and there is a simultaneous determination of exports and innovation. They also consider that there is a sample selection bias (firm self-selection into either innovation type). To account for endogeneity and to control for the past values of product and process innovations, they apply a bivariate probit model and a multinomial logit model with contemporaneous and lagged variables. The sample selection problem gets resolved by using matching propensity scores in order to make the two groups of firms (firms with new products and/or process innovations versus firms with no innovations) more alike.

Exports and financial autonomy

Most of the literature on financial autonomy focuses on firm financing constraints, particularly access to credit issues (see, e.g., Carpenter and Petersen, 2002), or on the relationship between the cost of equity capital and disclosure level and/or ownership, ignoring its impact on exports (see, e.g., Botosan, 1997; Gilson and Whitehead, 2007). Some empirical studies relate the size of the firm to its exports, applying employee numbers or total assets as proxy variables for the size (Basile, 2001). Serra *et al*. (2012) consider that firm size and the educational level of managers identify the key characteristics of Portuguese firms and that positively influence the export propensity. Serrasqueiro and Nunes (2008) also consider that larger companies have a competitive advantage. Equity capital also represents a proxy variable for firm size or at least bearing the same effect as firm size. Larger firms usually have longer histories, are more competitive and profitable and display greater opportunities to obtain results. Therefore, good financial autonomy may also be considered as a reverse proxy for the probability of bankruptcy (Antoniou *et al*., 2008). At the macroeconomic level, the financial autonomy of a given country has a positive effect on exports and growth (Cohen, 2007). At the microeconomic level, the financial factors affect export decisions because there are substantial input costs associated with the introduction into international markets (Greenaway *et al*., 2007).

Staying at the microeconomic level, the notion that the sunk costs are not zero and the prior export experience associated with larger firms are necessary to internationalization will probably induce firms to

increase equity capital in order to remain in those foreign markets. Thus, we may correspondingly assert that equity capital plays an important role in the firm's efforts to penetrate and remain in the international marketplace. The financial autonomy ratio (equity capital/asset) may prove a key determinant of Portuguese firm propensities to export given the sheer profile of large exporters in the sample (with 277 firms accounting for 47% of Portugal's total exports).

III. Empirical Model

In this section, we specify the econometric model, its variables and the theoretically expected results as well as the descriptive statistics for the variables.

Dependent variable

The dependent variable (EXPORTS) corresponds to the value of the exports (in millions of euros) of the 277 largest Portuguese exporters in the 2006 to 2010 period. The statistical data came from Dun & Bradstreet and were obtained directly from the sample's respective firms.

Explanatory variables

In accordance with our literature review, this article approaches the following explanatory variables:

Girma *et al*. (2004) consider that past export experiences prove a powerful determinant of current export behaviours. Thus, this article introduces the lag of the dependent variable (X_{it-1}) into the dynamic specification as an explanatory variable.

The productivity (PRODUCTIVITY) variable is measured by gross value added per employee in thousands of euros.

Remuneration per worker (WAGES) is measured by wage per employee or average salary paid out in each firm in thousands of euros.

Firm size (SIZE) is measured in terms of the total number of employees and reflects the effect of firm scale on exports through economies of scale effects.

Net income (NET INCOME) represents a measurement of firm performance in millions of euros.

In this article, the research and development expenses (R&D) variable (in thousands of euros) serves as an indirect measure for innovation.

Financial autonomy (FINANCIAL AUTONOMY) is defined as the (Equity Capital/Asset) ratio.

All explanatory variables are in logs except for net income, financial autonomy and R&D because these are all null or negative values. The recourse to logarithms provides a means of incorporating nonlinearities in regression (Wooldridge, 2003).

There are other explanatory variables influencing variations in Portuguese exports. In the fragmentation theory of production (Jones and Kierzkowski, 2001) and in the new economic geography theory (Krugman, 1991), distance constitutes an important variable for explaining the trade in final and intermediate products. When the gravity equation is applied, empirical studies report a negative correlation between trade and distance. However, we are unable to adopt this variable and the corresponding gravity model in this article because the export destinations by host country are unavailable.[1]

Hypotheses. In accordance with our literature review, this article approaches the following hypotheses:

H1: The higher the productivity of the Portuguese firm, the greater are its exports.

The theoretically expected sign for the coefficient of this variable is positive (Helpman *et al*., 2004; Kimura and Kiyota, 2006; Melitz and Ottaviano, 2008).

Aw *et al*. (2008, 2009) deem exports correlate with R&D or innovation and product processes. The main channel of productivity influence on exports derives from innovations. Thus, past productivity influences innovation and innovation influences exports. We also may consider two lags considering that productivity lagged two periods influence contemporaneous exports via the ongoing changes in the innovation. In the dynamic model, we consider a reverse causality between exports and productivity. Hence, productivity represents an endogenous variable here.

H2: An increase in Portuguese firm size will increase its exports.

[1] The gravity model emphasizes the relevance of transport costs in explaining bilateral trade flows and the physical distance between countries serves as the proxy to control for these transport cost effects.

We assume the hypothesis of asymmetry among firms; the larger exporters are the big firms, while small firms supply only the domestic market (Venables, 1994). Multinational firms also engage in innovative activities and demonstrate more export competitiveness. Thus, the expected coefficient of this explanatory variable is positive. Furthermore, empirical studies suggest that there is no inverted U-relationship between exports and firm size (Guan and Ma, 2003; Serrasqueiro and Nunes, 2008). Cassiman and Martínez-Ros (2007) test the nonlinearity of the relationship between size and exports by deploying size and its square as explanatory variables. Cassiman and Martínez-Ros (2007) also consider that firm size represents an important control for process innovation because dropping the firm size from the regressors increases the coefficient of the process innovation variable. Ito and Pucik (1993) also report that R&D constitutes a significant determinant of export performance only when the size variable gets dropped from the equation regression.

H3: The greater the remuneration per worker, the lesser the level of Portuguese firm exports.

The theoretically expected result is negative for this variable's coefficient as the higher the level of wages, the less competitive the Portuguese firm will be. Based on international trade theory, we may state that as Portugal, compared to its main trading partners (Spain, Germany, France, Italy, the UK), is relatively abundant in nonqualified and semi-qualified labour, it displays a comparative advantage in producing labour-intensive goods (the Heckscher–Ohlin theorem). Thus, as nonqualified or semi-qualified workers receive lower wages, compared with those in European partners, lower wage levels should boost Portuguese exports to these countries. However, on assuming that average wages serves as a proxy for human capital intensity (Balassa, 1979), we may also consider that increasing the intensity of human capital in the firm's production will increase its exports. This is an extension of the Heckscher–Ohlin model that conceives of human capital as a third factor of production – neo-factorial proportions theory (Stern and Maskus, 1981). Therefore, the expected sign of this explanatory variable may be ambiguous and a matter of empirical evidence. Cassiman and Martínez-Ros (2007) also consider that wage intensity (total wages divided by total employment) acts as a control for the skill level and the firm cost structure.

H4: The increase in net income holds a positive effect on the firm's export propensity.

When the net income increases, the cash flow also increases, *ceteris paribus*, with the corresponding expectation that this raises the capacity of exporting firms to compete in international markets. Furthermore, any increase in net income provides access to bank credit on better terms. Therefore, the theoretically expected result for the coefficient of this explanatory variable is positive. There are authors that have questioned the net income measure and proposed comprehensive income as a measure of firm performance (see Dhaliwal *et al*., 1999; Skinner, 1999; Kanagaretnam *et al*., 2009). Comprehensive income, or 'all-inclusive' income, includes all revenues, expenses, gains and losses, whether extraordinary or otherwise (Dhaliwal *et al*., 1999). However, Dhaliwal *et al*. (1999) did not find any empirical evidence that comprehensive income results in a better measurement of firm performance than net income with the same conclusion also reached by Skinner (1999).

H5: An increase in R&D expenditure leads to increased exports.

Several empirical studies have estimated positive relationships between innovation and the propensity to export (e.g. Brouwer and Kleinknecht, 1993; Aw *et al*., 2005, 2008; Girma *et al*., 2008; Monreal-Pérez *et al*., 2012; Yi *et al*., 2013). R&D expenditure serves as an indirect measure of innovation. Some empirical studies did not conclude that this relationship was positive. Hirsch and Bijaoui (1985) also consider that lagged R&D expenditure proves statistically significant in explaining the rate of change in exports by Israeli firms. Cassiman and Martínez-Ros (2007), in turn, reveal that a smaller number of empirical studies have shown that applying R&D expenditures returns no significant impact for this variable on the export propensity prevailing (see Schlegelmilch and Crook, 1988; Ito and Pucik, 1993; Lefebvre *et al*., 1998; Becchetti and Rossi, 2000). Yi *et al*. (2013) maintain that the effects of innovation on exports are conditioned by institutional forces while Kyläheiko *et al*. (2011) propose that innovation and internationalization may be complementary or substitutive. Thus, these results suggest it is preferable to apply a product or process innovation measure than an indirect measure such as R&D expenditure. The results of Lachenmaier and Wößmann (2006) and Becker and Egger (2013) furthermore suggest that considering

innovation as an exogenous variable may lead to downward-biased estimates of this variable's coefficient. Thus, the usage of the lag of this variable in the dynamic model controls for the effect of past R&D on exports. In the dynamic panel data model, we consider R&D as an endogenous variable.

H6: An increase in financial autonomy leads to increased exports

The OECD (2008) states that limited access to finance is an obstacle that SMEs often face, especially exporters. Furthermore, the ability to internationalize very much depends on the ability to obtain financial autonomy.

Equity may be viewed from two different perspectives. On the one hand, equity reflects one possible means of financing investment activities and owning firms. On the other hand, this represents company assets at a given moment in time. Taking into account both definitions, equity reflects the 'financial health' of the firm, i.e., high levels of capital provide greater security and the capacity of the firm to invest in exploring overseas markets. Thus, increasing equity represents the only effective means for firms to obtain an increase in production. Larger firms experience greater financial autonomy enabling them to access better conditions with lower interest rates and more favourable terms of payment when making recourse to bank credits. Therefore, we may forecast that increased financial autonomy holds a positive effect on Portuguese exports. In the globalized world economy, adopting export-oriented strategies closely links to financial autonomy (see, e.g., Luo and Peng, 1999). The question we should address, at the macro and micro levels, is thus how does financial autonomy influence export behaviour? What are the linkages between financial autonomy, competition and export performance? Filatotchev *et al.* (2005, p. 9) consider that the export orientation positively associates with financial performance and that 'gains from export orientation may be particularly strong in transition economies, where firms could face limited opportunities at home'. The link between export performance and financial performance stems from the firm's strategic dynamics. Firms turning in better financial autonomy performances are more likely to be exporters (Aulakh *et al.*, 2000). It is also expected that good financial autonomy in the previous year has a positive effect on contemporaneous exports (expected positive sign for the coefficient of the lagged variable FINANCIAL AUTONOMY).

IV. Discussion and Results

The static model

The following model tests for the effects of the explanatory variables on Portuguese firm exports:

$$LogX_{it} = \beta_0 + \beta_1 LogPROD_{it} + \beta_2 LogSIZE_{it} + \beta_3 LogW_{it} + \beta_4 NI_{it} + \beta_5 (R\&D)_{it} + \beta_6 FA_{it} + U_{it}$$

$$U_{it} = \eta_i + \delta_t + \varepsilon_{it}$$

where X_{it} are the EXPORTS for firm i in the period t; PRODUCTIVITY (*PROD*), *SIZE*, WAGES (*W*), *R&D*, NET INCOME (*NI*), FINANCIAL AUTONOMY (*FA*) are the explanatory variables defined above; η_i is the unobserved time-invariant firm-specific effects which allows for heterogeneity across individuals; δ_t captures a common deterministic trend; and ε_{it} is a random disturbance.

The static model considers all explanatory variables to be exogenous. Thus, the model assumes that all variables are independent of the random residual term, ε_{it}, for all t.

By hypothesis, η_i is not observable and invariant for each firm over time even while differing from firm to firm. Following Wooldridge (2003, p. 43), the usage of logs incorporates many nonlinearities into the regression model. Thus, instead of the level–level model, we may apply the log–log model (where elasticity is given by the explanatory variable coefficients), or the log–level model (where the coefficient is the semi-elasticity). The level–log model is less commonly applied in empirical studies.

The dynamic model

Do exports contribute to increased productivity? This is the reverse effect or the problem of possible simultaneity. Furthermore, past export experiences may provide a significant predictor of contemporaneous export behaviours. This is the Roberts and Tybout (1997) sunk cost hypothesis for exports – in the presence of sunk costs, current decisions over

exporting get shaped by past export decisions. Therefore, firms exporting in previous periods were more likely to export than firms that did not previously export. Thus, we need to control for the effect of past exports and test the sunk cost hypothesis. Should the estimated coefficient of lagged exports prove positive and significant, the results thus confirm the sunk cost of entry hypothesis. In the same way, we may consider that productivity, net income, R&D and financial autonomy in the previous period all cause positive effects on contemporaneous exports. Thus, in the dynamic model, we apply the lagged forms of these explanatory variables to control for these effects.

The problem of endogeneity arises when encountering certain possible situations: omitted variables, unobserved heterogeneity, measurement error and simultaneity. In such situations, the regressors are not strictly exogenous and there is correlation between the error term and the predetermined or endogenous regressors.

The lagged dependent variable, $Y_{i,t-1}$, serves as an example of an endogenous variable – it is correlated with the fixed effects resulting in dynamic panel bias whenever applying OLS. How to resolve this endogeneity problem and to draw the fixed effects out of the error term? The fixed effects or within-group transformation does not provide any solution because the dependent variable is a function of η_i and the lagged dependent variable also correlates with the error term after the transformation ($Y_{i,t-1}$ correlates with ε_{it-1}). However, when the sample number is small and the number of periods is large the fixed effects estimator becomes consistent (Baltagi, 2008).

This is not the case in micro panel data where we have a small number of time periods and a larger number of cross-sectional units (individuals). When the sample time dimension is short, we cannot ignore the influence of the initial observations on subsequent observations. We thus need estimation methods that obtain consistent estimates in micro panel data. In the case of continuous dependent variables, the system GMM estimator (GMM-SYS) resolves this type of problem. In dynamic panel data models, the GMM-SYS estimator eliminates the unobserved firm-specific effects through first difference equations without introducing future shocks (lagged values for the disturbances) into the transformed error term. The GMM-SYS constitutes an estimator containing both first-differenced and level equations. A standard assumption regarding additional moment conditions (a set of orthogonal restrictions or serial correlation properties of the error term and explanatory variables that do not exclude for arbitrary forms of heteroscedasticity across individuals and time) allows for the application of endogenous lagged variables for two or more periods as valid instruments, whenever there are no serial correlations (Arellano and Bover, 1995; Blundell and Bond, 1998, 2000). When the levels of explanatory variables correlate with the unobserved effect, but when the first differences of these variables are uncorrelated with this individual effect, this additional momentary condition allows for the usage of suitable lags (one or two periods) for the first differences of these explanatory variables as instruments for equations in levels (Arellano and Bover, 1995; Blundell and Bond, 1998, 2000). In summary, this method involves transforming the data using first differences in order to eliminate the fixed effects leading to the first-difference GMM estimator. However, in the lagged dependent variable $\Delta Y_{i,t-1} = Y_{i,t-1} - Y_{i,t-2}$, the term $Y_{i,t-1}$ correlates with ε_{it-1} and $\Delta Y_{i,t-1}$ still remains potentially endogenous. Instruments for the lagged dependent variable in the first-differenced equation may be the subsequent lags of $Y_{i,t-1}$, that is $Y_{i,t-2}$, $Y_{i,t-3}$, and so forth. It estimates simultaneously the level equations with instruments for $Y_{i,t-1}$ the first-differences $\Delta Y_{i,t-1.}$ Should the explanatory variable, $R\&D_{it}$, be contemporaneously endogenous, then the two-periods and subsequent lagged values of the variable $R\&D_{it}$ ($R\&D_{i,t-2}$, $R\&D_{i,t-3}$, and so on) may serve as instruments in the first-differences equations and the first differences of R&D lagged to one or two periods ($\Delta R\&D_{it-1}$; $\Delta R\&D_{it-2}$) may be deployed as instruments for level equations. Whenever the regressor is predetermined, or weakly exogenous, only the lagged values represent valid instruments (Blundell and Bond, 1998).

The validity of instruments is performed by the Sargan test for overidentification restrictions. First-order and second-order serial correlations in the first-differenced residuals get tested by using the AR(1) and AR(2) statistics developed by Arellano and Bond (1991). This statistical test proves important because the consistency of the GGM estimator relies upon the fact that there is no second-order serial correlation and that the instruments prove correspondingly valid.

As the variance estimator may be biased downward in small samples, the article also applies the Windmeijer (2005) small sample correction implemented through programs such STATA and OX and provides accurate estimates of estimator variance (two-step estimates). To reduce the source of finite sample bias, we also need to reduce the number of lagged instruments applied (Baltagi, 2008).

An alternative method for resolving the endogeneity problem applies a semi-parametric approach using observable information as a proxy to control for part of the error term, the unobserved effect, correlated with the explanatory variable (Olley and Pakes, 1996).

The dynamic panel data model is the following:

$$\begin{aligned} LogX_{it} = {} & \alpha_0 + \alpha_1 LogX_{it-1} + \alpha_2 LogPROD_{it} \\ & + \alpha_3 LogPROD_{it-1} + \alpha_4 LogSIZE_{it} \\ & + \alpha_5 LogW_{it} + \alpha_6 LogNI_{it} + \alpha_7 LogNI_{it-1} \\ & + \alpha_8 LogR \wedge D_{it} + \alpha_9 R \wedge D_{it-1} \\ & + \alpha_{10} FA_{it} + \alpha_{11} FA_{it-1} + U_{it} \end{aligned}$$

$$U_{it} = \eta_i + \delta_t + \varepsilon_{it}$$

Analysis of results

Descriptive statistics for the data are given in Table 1.

For all variables, we find the mean to be higher than the median. Hence, the distribution is asymmetric and positive – asymmetric distribution to the left. The variable with the fewest observations is that of R&D. This variable returns many null values meaning that during some years firms incurred no R&D-based expenditure. This leads to a median value close to 0. This reflects how R&D does not constitute the main concern to Portuguese exporting firms and this surely gets reflected in the coefficient variable estimations. Regarding the data, they demonstrate how the export variable has the mean of €58.8 million and that the labour productivity mean is €49.715 thousands per year. The average wage is €24.175 thousands per year. Average R&D expenditure totals only €108.8 thousand, which is very low. The variable net income returns a mean of €4.7 million and the mean financial autonomy variable ratio is 41.1%, which is satisfactory.

Static results. In Table 2, we present the fixed effects (FE) estimates. While the unobserved heterogeneity, η_i, is uncorrelated with all explanatory variables, the random effects (RE) estimator does prove appropriate. Should η_i correlate with some explanatory variables, we then need to apply the FE estimator (Wooldridge, 2003). The Hausman test – computed based on the perspective that RE is more efficient – rejected the null hypothesis RE versus FE. Therefore, the regression coefficients are calculated according to the FE estimator.

Table 2. Fixed effects estimates. Dependent variable: LogExports

Variables	Coefficients	Expected Sign
LOGPRODUCTIVITY	0.544 (13.10)***	(+)
LOGWAGES	0.472 (1.75)*	(−; +)
LOGSIZE	1.856 (18.01)***	(+)
NET INCOME	−0.002 (−2.12)**	(+)
R&D	3.0 E-05 (−1.02)	(+)
FINANCIAL AUTONOMY	−0.002 (−1.91)*	(+)
CONSTANT	−1.46 (−1.29)	
N	1075	
R^2	0.899	

Notes: *t*-Statistics are given in round brackets. SE is obtained with the White covariance matrix robust by clusters.
***, ** and * are statistically significant at the 1%, 5% and 10% levels, respectively.
Hausman test (RE versus FE): chi-square statistic = 183.89 (6); *p*-value = 0.0000.

Table 1. Descriptive statistics

	Exports	Productivity	Wages	Size	Net Income	R&D	Financial Autonomy (%)
Mean	58.816	49.715	24.175	369.4	4.708	108.888	41.1
Median	26.993	35.968	21.376	262	1,004	0.000	38.7
Maximum	1836.091	528.277	424.905	3405	358.67	5865.017	100
Minimum	0.021	0.224	5.122	3	−254.70	0.000	−132.6
SD	150.07	45.969	16.054	396.4	23.437	430.386	20.73
Observations	1366	1346	1358	1359	1375	1104	1370

Note: Exports and Net Income are in 10^6 euros and Productivity, Wages and R&D are in 10^3 euros.

The estimated equations report a total of five statistically significant explanatory variables (LogProductivity, LogWages, LogSize, Net Income, R&D) with two variables strongly significant with the expected positive coefficient (LogProductivity and LogSize). The results demonstrate that increasing the productivity of labour generates a positive and strong effect on Portuguese exports and that dimension matters. Whenever firm size increases, this leads to increasing levels of exports. Regarding the coefficients of these two variables, we may conclude that productivity rising by 10% drives an increase in Portuguese exports of 5.44% and when firm size grows by 10%, then exports put on 18.56%. The estimated coefficient for the LogWages variable is positive and equal to 0.472. In this case, when the average wage increases by 10%, Portuguese exports rise by 4.72%. As the average wage may be considered a proxy for human capital intensity (Balassa, 1979), the result may convey how Portugal holds a comparative advantage in human intensive capital goods. However, in the dynamic analysis, this idea is not confirmed because this explanatory variable turns out statistically insignificant. The financial autonomy variable only attains significance at 10% and returns a negative coefficient that was not theoretically expected. Potentially financial autonomy only impacts on exports in the subsequent periods or financial autonomy influences export behaviours through other mechanisms. We did expect firms enjoying financial autonomy to be more likely to become exporters with rising levels of exports improving overall financial autonomy (Silva, 2011). However, in the dynamic analysis, the financial autonomy and the lag of financial autonomy do not attain statistical significance. We applied the cash flow variable as a replacement for financial autonomy as a measure of financial constraints, however, this variable also proved statistically insignificant.

Analysing the statistically significant estimated variable coefficients, net income also negatively influences Portuguese export variations. The unexpected negative result for the net income variable coefficient becomes partially resolved in the dynamic analysis where the lagged net income coefficient is positive and superior to the negative effect of the contemporaneous variable. The static results also show that R&D expenditure is the only explanatory variable reporting statistical insignificance. This result suggests that the Portuguese competitive export advantage is not R&D based. This result gains confirmation by the dynamic analysis. Furthermore, as we discuss later, there are also other empirical studies reaching the same conclusion. In this case, some authors defend that choosing other measures of innovation resolves the problem.

In sum, these results indicate that we need dynamic analysis in order to incorporate the sunk cost hypothesis and resolve the endogeneity problems.

Dynamic results. The results of the dynamic estimations (two-step estimations) are displayed in Table 3. The equation considers the same explanatory variables analysed by the static model and the lagged dependent variable. In order to address potential persistent components in some variables, the

Table 3. Dynamic estimates: GMM-SYS estimator

Variables	Coefficients	Expected sign
LOGEXPORTS$_{t-1}$	0.667 (2.88)***	(+)
LOGPRODUCTIVITY	0.504 (2.01)**	(+)
LOGPRODUCTIVITY$_{t-1}$	−0.355 (−0.844)	(+)
LOGWAGES	0.038 (0.378)	(−; +)
LOGSIZE	−0.236 (−0.519)	(+)
NETINCOME	−0.0045 (−2.0)**	(+)
NETINCOME$_{t-1}$	0.0064 (2.23)**	(+)
R&D	−0.0002 (−0.63)	(+)
R&D $_{t-1}$	0.0004 (0.866)	(+)
FINANCIAL AUTONOMY	0.0039 (0.29)	(+)
FINANCIAL AUTONOMY$_{t-1}$	−0.006 (−0.322)	(+)
Constant	2.20 (0.826)	
Year2008	0.077 (0.965)	
Year2009	0.041 (0.44)	
Year2010	0.157 (1.27)	
WALD	66.30 [0.000]	
AR(1)	−1.225 [0.221]	
AR(2)	−0.172 [0.864]	
SARGAN	3.479 [1.000]	
N	782	

Notes: *t*-Statistics (heteroscedasticity corrected) are given in round brackets. *p*-values are in square brackets.
***, ** and * are statistically significant at the 1%, 5% and 10% levels, respectively.
For the variables R&D and Productivity, considered endogenous, the instruments used are lagged $t-2$ and subsequent lags. We applied finite simple correction SEs – Windmeijer (2005) correction. The estimates were computed using dpd for OX (Doornik *et al*., 2002).

dynamic analysis also considered both contemporaneous and lagged variables such as lagged productivity, lagged R&D and lagged financial autonomy. Following Blundell and Bond (1998, 2000), this analysis applies the GMM system as the instrumental-variables approach to control for endogeneity. The results demonstrate that lagged exports, productivity, net income and the lagged net income are statistically significant and their coefficients return the expected positive signs with the exception of the net income variable. However, by adding the contemporaneous effect (−0.0044) to the lagged effect (0.0063) the net income effect on exports turns positive. The results also indicate that exports in the previous period generate a strong and significant positive effect on contemporaneous exports, confirming that past export experience proves a good predictor of current export performance (the Roberts and Tybout hypothesis). The productivity variable also attains statistical significance with the expected positive coefficient and thus confirming the static result. This result suggests that the more productive Portuguese firms engage in exports whereas the less productive firms concentrate on the domestic market. However, as the sample does not contain any nonexporters, we cannot make any comparison between the performance of exporter and nonexporter firms. The dynamic results do not confirm the static results as regards the statistical influence of size on firms. Furthermore, the wages per worker variable also does not attain significance and thus suggesting that wage variations do not have any statistical influence on variations in export levels.

The difference between the static results and the dynamic results also extends to the Financial Autonomy variable. The financial autonomy variable, contemporaneous and lagged one period, is not statistically significant in the dynamic model. This potentially means that the link between financial autonomy and exports at the firm level depends on country-specific contexts or that this traditional financial measure needs complementing with other nontraditional financial measures.

In the dynamic estimation, the R&D and lagged R&D variables hold no statistical influence on Portuguese exports whereas the static estimation results for these variables also do not achieve statistical significance. This is surprising because we did not consider R&D as an exogenous variable and we did control for past R&D expenditure. Combining the static and dynamic results, we may therefore state that Portugal incurs a comparative disadvantage in R&D intensive products. However, the explanation for this result may be the choice of the proxy for innovation. Instead of an indirect measure of innovation, such as R&D expenditure, most studies are based on firm questionnaires and employing survey data with explicit information on the actual product and process innovations. Thus, applying a more direct measure of innovation might potentially enable the confirmation of a positive and significant influence of product and/or process innovation on Portuguese exports. Becker and Egger (2013), that considered the endogeneity of product and process innovations, conclude that product innovation holds greater importance than process innovation for firm export behaviour. They also defend that process innovation only increases a firm's export-to-sales ratio when combined with product innovation.

V. Conclusions

In the model explaining variations in Portuguese exports, the static results indicate that increases in productivity, wages and size by 1% increases exports by 0.544%, 0.472% and 1.856%, respectively. The positive effects of the wages variable on exports are in accordance with the neo-factorial proportions theory that considers average wages act as a proxy for human capital. In this sense, the austerity policy and the objective of reducing wages in Portugal in order to become more competitive gains no support from our results. In the static estimations, the results also convey how increasing the net income and financial autonomy by 1% generates the same effect on the exports logarithm (−0.002%). This result was not theoretically expected even while the effect of financial constraints on exports remains theoretically controversial. On analysing the dynamic results, they suggest that net income in the previous year has a positive effect on exports, as was indeed expected. However, the increase in contemporaneous net income generates a negative effect on exports in the same year. As the lagged effect (0.0064%) proves higher than the contemporaneous negative effect (−0.0045%), hence, the sum of both effects is positive and boosting the exports of the 277 Portuguese firms. With respect to the financial autonomy

variable, the dynamic results suggest that financial constraints, contemporaneous and in the previous year, bear no statistically significant effects on the variation of Portuguese exports. The positive coefficient estimated for the lagged exports confirms the Roberts and Tybout (1997) sunk cost hypothesis for exports revealing that exports in previous period positively influence exports in the contemporaneous period (with elasticity equal to 0.667). The results also show that labour productivity rising by 1% advances the level of exports by 0.504%. However, the previous year's productivity contains no statistical influence for contemporaneous exports. The dynamic estimates also concur that the increase in labour costs and firm size plays no statistically significant influence on exports. The financial autonomy variable does not attain statistical significance in the dynamic model and presents a significantly negative result (at the 10% level of significance) in the static model. Silva (2011, p. 5) focusing on the Melitz (2003) and Chaney (2005) models considers 'At the extensive margin both factors matter: more liquid (wealthier) and more productive firms are more likely to export than others; however at intensive margins only productivity (and not liquidity) seems to affect the exported volumes'. Manova (2010) considers that extensive and intensive margins of exports are both negatively impacted by financial constraints. Thus, the effects of financial autonomy on exports still remain far from attaining any consensus and deserve further research.

Expenditure on R&D is a theoretically important variable in explaining variations in exports as duly confirmed by different studies at the international level. In both models, the static and dynamic estimates also concur that the increase in R&D expenditures plays no statistically significant role in Portuguese exports. Thus, in accordance with international trade theory, we might conclude that Portugal does not hold any competitive advantage in R&D intensive products. These results should be interpreted carefully because the article applies the traditional indirect measure of innovation and some empirical studies also did not report a significant R&D expenditure impact on the export propensity (see, e.g., Lefebvre *et al*., 1998; Becchetti and Rossi, 2000). As Becker and Egger (2013) also demonstrate, the application of a direct measure of product innovation may resolve this apparent paradox in Portuguese exports. Finally, one source of endogeneity stems from the omitted variables and future research should apply survey data that enable the inclusion of product innovation and process innovation variables. In this article, the relationship between R&D expenditure, productivity and exports was estimated with the system GMM estimator that took into account the endogenous nature of these variables and produced reliable results. Traditionally, in explaining variations in exports, the productivity and R&D variables are deemed endogenous. This problem was overcome by recourse to the system GMM with the appropriate choice of instruments. However, the lack of information on product and process innovations and the usage of R&D expenditure as an indirect measure of innovation represent limitations to the analysis.

Acknowledgements

The authors would like to thank Dun & Bradstreet (D&B) for the free availability of data.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Funding

The authors would like to thank Fundação para a Ciência e Tecnologia (FCT Portugal) for financial support to ADVANCE by the R&D Unit Multi-Year Funding Program UID/SOC/04521/2013.

References

Aghion, P. and Howit, P. (1998) *Endogenous Growth Theory*, The MIT Press, Cambridge.

Antoniou, A., Guney, Y. and Paudyal, K. (2008) The determinants of capital structure: capital market oriented versus bank-oriented institutions, *Journal of Financial and Quantitative Analysis*, **43**, 59–92.

Arellano, M. and Bond, S. (1991) Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, *Review of Economic Studies*, **58**, 277–97.

Arellano, M. and Bover, O. (1995) Another look at the instrumental variable estimation of error-components models, *Journal of Econometrics*, **68**, 29–51. doi:10.1016/0304-4076(94)01642-D

Aulakh, P., Rotate, M. and Teegen, H. (2000) Export strategies and performance of firms from emerging economies: evidence from Brazil, Chile and Mexico, *Academy of Management Journal*, **43**, 342–61. doi:10.2307/1556399

Aw, B., Chung, S. and Roberts, M. (2000) Productivity and turnover in the export market: micro-level evidence from the Republic of Korea and Taiwan (China), *The World Bank Economic Review*, **14**, 65–90. doi:10.1093/wber/14.1.65

Aw, B., Roberts, M. and Winston, T. (2005) The complementary role of exports and R&D investments as sources of productivity growth, NBER Working Papers No. 11774, National Bureau of Economic Research, Cambridge, MA.

Aw, B., Roberts, M. and Xu, D. (2008) R&D investments, exporting, and the evolution of firm productivity, *American Economic Review*, **98**, 451–56. doi:10.1257/aer.98.2.451

Aw, B., Roberts, M. and Xu, D. (2009) R&D investment, exporting, and productivity dynamics, NBER Working Paper No. 14670, National Bureau of Economic Research, Cambridge, MA.

Balassa, B. (1979) A 'stages approach' to comparative advantage, in *Economic Growth and Resources*, Vol. IV, Adelma, I. (Ed), Macmillan, London.

Baltagi, B. (2008) *Econometric Analysis of Panel Data*, John Wiley & Sons, Great Britain.

Basile, R. (2001) Export behaviour of Italian manufacturing firms over the nineties: the role of innovation, *Research Policy*, **30**, 1185–201. doi:10.1016/S0048-7333(00)00141-4

Becchetti, L. and Rossi, S. (2000) The positive effect of industrial district on export performance of Italian firms, *The Review of Industrial Organizations*, **16**, 53–68. doi:10.1023/A:1007783900387

Becker, S. and Egger, P. (2013) Endogenous product versus process innovation and a firm's propensity to export, *Empirical Economics*, **44**, 329–54. doi:10.1007/s00181-009-0322-6

Bell, J. (1997) A comparative study of the export problems of small computer software exporters in Finland, Ireland and Norway, *International Business Review*, **6**, 585–604. doi:10.1016/S0969-5931(97)00033-4

Bernard, A. and Jensen, J. (1999) Exceptional exporter performance: cause, effect, or both?, *Journal of International Economics*, **47**, 1–25. doi:10.1016/S0022-1996(98)00027-0

Bigsten, A., Collier, P., Dercon, S. *et al*. (2004) Do African manufacturing firms learn from exporting?, *Journal of Development Studies*, **40**, 115–41. doi:10.1080/0022038042000213229

Bigsten, A. and Gebreeyesus, M. (2008) Firm productivity and exports: evidence from Ethiopian manufacturing, Working Papers in Economics No. 303, School of Business, Economics and Law, University of Gothenberg, Gothenberg.

Blundell, R. and Bond, S. (1998) Initial conditions and moment restrictions in dynamic panel data models, *Journal of Econometrics*, **87**, 115–43. doi:10.1016/S0304-4076(98)00009-8

Blundell, R. and Bond, S. (2000) GMM estimation with persistent panel data: an application to production functions, *Econometric Reviews*, **19**, 321–40. doi:10.1080/07474930008800475

Botosan, C. (1997) Disclosure level and the cost of capital, *The Accounting Review*, **72**, 323–49.

Brouwer, E. and Kleinknecht, A. (1993) Technology and firm's export intensity: the need for adequate innovation measurement, *Konjunkturpolitik*, **39**, 315–25.

Carpenter, R. and Petersen, B. (2002) Capital market imperfections, high-tech investment, and new equity financing, *The Economic Journal*, **112**, F54-72. doi:10.1111/ecoj.2002.112.issue-477

Cassiman, B. and Golovko, E. (2007) Innovation and export-productivity link, CEPR Discussion Paper No. 6411, Centre for Economic Policy Research, London.

Cassiman, B., Golovko, E. and Martínez-Ros, E. (2010) Innovation, exports and productivity, *International Journal of Industrial Organization*, **28**, 372–6. doi:10.1016/j.ijindorg.2010.03.005

Cassiman, B. and Martínez-Ros, E. (2007) Product innovation and exports: evidence from Spanish manufacturing, Working Paper, IESE Business School, Madrid.

Castellani, D. (2002) Export behavior and productivity growth: evidence from Italian manufacturing firms, *Weltwirtschaftliches Archiv*, **138**, 605–28. doi:10.1007/BF02707654

Chaney, T. (2005) Liquidity constrained exporters, Working Paper, University of Chicago, Department of Economics, Chicago, IL.

Choi, H. (2003) *Exports Penetration Cost and International Business Cycles*, PhD dissertation. The Ohio University. UMI.

Cohen, J. N. (2007) The impact of neoliberalism, political institutions and financial autonomy on economic development, 1980–2003. PhD dissertation, Princeton University.

Damijan, J. and Kostevc, Č. (2006) Learning-by-exporting: continuous productivity improvements or capacity utilization effects? Evidence from Slovenian firms, *Review of World Economics*, **142**, 599–614. doi:10.1007/s10290-006-0083-7

Damijan, J., Kostevc, Č. and Polanec, S. (2010) From innovation to exporting or vice versa?, *The World Economy*, **33**, 374–98. doi:doi:10.1111/j.1467-9701.2010.01260.x

De Mello-Sampayo, F. (2007) The location of the United States' FDI under the share gravity model, *International Economic Journal*, **21**, 491–519. doi:10.1080/10168730701529942

Demello-Sampayo, F. (2009) Competing-destinations gravity model: an application to the geographic

distribution of FDI, *Applied Economics*, **41**, 2237–53. doi:10.1080/00036840701765346

Dhaliwal, D., Subramanyam, K. and Trezevant, R. (1999) Is comprehensive income superior to net income as a measure of firm performance?, *Journal of Accounting and Economics*, **26**, 43–67. doi:10.1016/S0165-4101(98)00033-0

Doornik, J., Arellano, M. and Bond, S. (2002) Panel Data Estimation Using DPD for OX. Available at www.nuff.ox.ac.uk/Users/Doornik (accessed 18 June 2015).

Faustino, H., Lima, J. and Matos, P. (2012) Exports, productivity and innovation: evidence from Portugal using micro data, Working Paper 13, ISEG, Department of Economics, Lisboa.

Filatotchev, I., Isachenkova, N. and Mickiewicz, T. (2005) Corporate governance, managers' independence, exporting and performance of firms in transition economies, Working Paper No. 805, William Davidson Institute, University of Michigan, Detroit.

Gilson, R. and Whitehead, G. (2007) Deconstructing equity: public ownership, agency costs, and complete capital markets, ECGI Working Paper No. 86, European Corporate Governance Institute, Brussels.

Girma, S., Görg, H. and Hanley, A. (2008) R&D and exporting: a comparison of British and Irish Firms, *Review of World Economics*, **144**, 750–73. doi:10.1007/s10290-008-0168-6

Girma, S., Greenaway, D. and Kneller, R. (2002) Does exporting lead to better performance? A microeconometric analysis of matched firms, GEP Research Paper Series 2002/09, University of Nottingham, Nottingham.

Girma, S., Greenaway, D. and Kneller, R. (2004) Does exporting lead to better performance? A microeconometric analysis of matched firms, *Review of International Economics*, **12**, 855–66.

Greenaway, D., Guariglia, A. and Kneller, R. (2007) Financial factors and exporting decisions, *Journal of International Economics*, **73**, 377–95. doi:10.1016/j.jinteco.2007.04.002

Griffith, D. and Czinkota, M. (2012) Release the constraints: solving the problems of export financing in troublesome times, *Business Horizons*, **55**, 251–60. doi:10.1016/j.bushor.2012.01.003

Guan, J. and Ma, N. (2003) Innovative capability and export performance of Chinese firms, *Technovation*, **23**, 737–47. doi:10.1016/S0166-4972(02)00013-5

Hahn, C. and Park, C.-G. (2012) Direction of causality in innovation-exporting linkage: evidence on Korean manufacturing, ERIA Discussion Paper Series No. 2012-07, Economic Research Institute for Asean and East Asia, Jakarta.

Helpman, E., Melitz, M. and Yeaple, S. (2004) Export versus FDI with heterogeneous firms, *American Economic Review*, **94**, 300–16. doi:10.1257/000282804322970814

Hirsch, S. and Bijaoui, I. (1985) R&D intensity and export performance: a micro view, *Weltwirtschaftliches Archiv/Review of World Economics*, **121**, 238–51. doi:10.1007/BF02705822

Ito, K. and Pucik, V. (1993) R&D spending, domestic competition, and export performance of Japanese manufacturing firms, *Strategic Management Journal*, **14**, 61–75. doi:10.1002/(ISSN)1097-0266

Janeiro, P., Proença, I. and Gonçalves, V. (2013) Open innovation: factors explaining universities as service firm innovation sources, *Journal of Business Research*, **66**, 2017–23. doi:10.1016/j.jbusres.2013.02.027

Jones, R. W. and Kierzkowski, H. (2001) A framework for fragmentation, chapter 2, in *Fragmentation: new Production Patterns in the World Economy*, Arndt, S. W. and Kierzkowski, H. (Eds), Oxford University Press, USA, pp. 17–34.

Kanagaretnam, K., Mathieu, R. and Shehata, M. (2009) Usefulness of comprehensive income reporting in Canada, *Journal of Accounting and Public Policy*, **28**, 349–65. doi:10.1016/j.jaccpubpol.2009.06.004

Kimura, F. and Kiyota, K. (2006) Exports, FDI and productivity: dynamic evidence from Japanese firms, *Review of World Economics*, **142**, 695–719. doi:10.1007/s10290-006-0089-1

Krugman, P. (1991) *Geography and Trade*, MIT Press, Cambridge.

Kyläheiko, K., Jantunen, A., Puumalainen, K. *et al*. (2011) Innovation and internationalization as growth strategies: the role of technological capabilities and appropriability, *International Business Review*, **20**, 508–20. doi:10.1016/j.ibusrev.2010.09.004

Lachenmaier, S. and Wößmann, L. (2006) Does innovation cause exports? Evidence from exogenous innovation impulses and obstacles using German micro data, *Oxford Economic Papers*, **58**, 317–50. doi:10.1093/oep/gpi043

Lefebvre, É., Lefebvre, L. and Bourgault, M. (1998) R&D-related capabilities as determinants of export performance, *Small Business Economics*, **10**, 365–77. doi:10.1023/A:1007960431147

Love, J. and Ganotakis, P. (2013) Learning by exporting: lessons from high-technology SMEs, *International Business Review*, **22**, 1–17. doi:10.1016/j.ibusrev.2012.01.006

Luo, Y. and Peng, M. (1999) Learning to compete in a transition economy: experience, environment and performance, *Journal of International Business Studies*, **30**, 269–95. doi:10.1057/palgrave.jibs.8490070

Manova, K. (2010) Credit constraints, heterogeneous firms, and international trade, NBER Working Paper 14531, National Bureau of Economic Research, Cambridge, MA.

Melitz, M. and Ottaviano, M. (2008) Market size, trade, and productivity, *Review of Economic Studies*, **75**, 295–316. doi:10.1111/roes.2008.75.issue-1

Melitz, M. J. (2003) The impact of trade on intra-industry reallocations and aggregate industry productivity, *Econometrica*, **71**, 1695–725. doi:10.1111/ecta.2003.71.issue-6

Monreal-Pérez, J., Aragón-Sánchez, A. and Sánchez-Marín, G. (2012) A longitudinal study of the relationship between export activity and innovation in the Spanish firm: the moderating role of productivity, *International Business Review*, **21**, 862–77. doi:10.1016/j.ibusrev.2011.09.010

OECD. (2008) *Removing Barriers to SME Access to International Markets*, OECD Publishing, Paris. ISBN 9789264040243.

Olley, G. and Pakes, A. (1996) The dynamics of productivity in the telecommunications equipment industry, *Econometrica*, **64**, 1263–97.

Özçelik, E. and Taymaz, E. (2004) Does innovativeness matter for international competitiveness in developing countries? The case of Turkish manufacturing industries, *Research Policy*, **33**, 409–24. doi:10.1016/j.respol.2003.09.011

Riding, A., Orser, B. J., Spence, M. *et al*. (2012) Financing new venture exporters, *Small Business Economics*, **38**, 147–63. doi:10.1007/s11187-009-9259-6

Roberts, M. and Tybout, J. (1997) The decision to export in Colombia: an empirical model of entry with sunk costs, *American Economic Review*, **87**, 545–64.

Schlegelmilch, B. and Crook, J. (1988) Firm-level determinants of export intensity, *Managerial and Decision Economics*, **9**, 291–300. doi:10.1002/mde.v9.4

Serra, F., Pointon, J. and Abdou, H. (2012) Factors influencing the propensity to export: a study of UK and Portuguese textile firms, *International Business Review*, **21**, 210–24. doi:10.1016/j.ibusrev.2011.02.006

Serrasqueiro, Z. and Nunes, P. (2008) Performance and size: empirical evidence from Portuguese SMEs, *Small Business Economics*, **31**, 195–217. doi:10.1007/s11187-007-9092-8

Sianesi, B. (2001, May) Implementing propensity score matching estimators with Stata, UK Stata users group, VII Meeting, London.

Silva, A. (2011) Financial constraints and exports: evidence from Portuguese manufacturing firms, FEP Working Paper, No. 402, Faculdade de Economia do Porto, Porto.

Skinner, D. (1999) How well does net income measure firm performance? A discussion of two studies, *Journal of Accounting and Economics*, **26**, 105–11. doi:10.1016/S0165-4101(99)00005-1

Sousa, C., Martínez-López, F. and Coelho, F. (2008) The determinants of export performance: a review of the research in the literature between 1998 and 2005, *International Journal of Management Reviews*, **10**, 343–74. doi:10.1111/ijmr.2008.10.issue-4

Stern, R. and Maskus, K. (1981) Determinants of the structure of US foreign trade 1958–1976, *Journal of International Economics*, **11**, 207–24. doi:10.1016/0022-1996(81)90016-7

Venables, A. (1994) Integration and the export behaviour of firms: trade costs, trade volume and welfare, *Review of World Economics*, **130**, 118–32.

Verbeek, M. and Nijman, T. E. (1996) Incomplete panels and selection bias, Chapter 18, in *The Econometric of Panel Data: A Handbook of the Theory with Applications*, Mátyás, L. and Sevestre, P. (Eds), Kluwer Academic Publishers, Dordrecht, pp. 449–90.

Vernon, R. (1966) International investment and international trade in the product cycle, *Quarterly Journal of Economics*, **80**, 190–207.

Wagner, J. (2002) The causal effects of exports on firm size and labor productivity: first evidence from a matching approach, *Economics Letters*, **77**, 287–92. doi:10.1016/S0165-1765(02)00131-3

Wagner, J. (2007) Exports and productivity: a survey of the evidence from firm-level data, *The World Economy*, **144**, 695–722.

Wagner, J. (2008) International firm activities and innovation: evidence from knowledge production functions for German firms, *The ICFAI Journal of Knowledge Management*, **6**, 47–62.

Windmeijer, F. (2005) A finite sample correction for the variance of linear efficient two-step GMM estimators, *Journal of Econometrics*, **126**, 25–51. doi:10.1016/j.jeconom.2004.02.005

Wooldridge, J. (2003) *Introductory Econometrics. A Modern Approach*, Thomson, USA.

Yi, J., Wang, C. and Kafouros, M. (2013) The effects of innovative capabilities on exporting: do institutional forces matter?, *International Business Review*, **22**, 392–406. doi:10.1016/j.ibusrev.2012.05.006