EXPORT PERFORMANCE AND PRODUCT MARKET REGULATION

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Abstract *- This paper analyses the impact of product market regulation on the propensity to export at the industry level for 13 OECD countries and 13 industries over the 1977-2007 period. Recent economic policy and academic literature insists on the negative effects of product market regulation on productivity or innovation, and hence on "competitiveness", a term that we interpret as the ability to export. Similar to the conclusions of some contributions to a recent literature on competition and growth, the "common sense" is that product market regulation should be detrimental to competitiveness. Using a two-step estimation approach we test the impact of vertically-induced pressures of product-market regulation on productivity and the effect of the latter on industry-level export performance. Results show that regulatory pressures have a significantly positive impact on productivity and thereby on the capability of an industry to attract resources and to sell its production in international markets.*

Keywords: PRODUCT MARKET REGULATION, EXPORT PERFORMANCE, PRODUCTIVITY

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1. INTRODUCTION

The issue of competitiveness has gone back to the forefront of policy debates on the importance of industry for Europe after the Great Recession (European Commission, 2010). A competitive manufacturing industry is seen as indispensable for a sustainable growth and the achievement of full employment. Facing 'intensified global challenges' such as the competition of new industrialised countries or the pressure on resources, European countries would need to put competitiveness and sustainability at the centre-stage of industrial policy. In this respect, competition policy would have to play a major role because functioning competitive markets would contribute to improving the international market position of European industries. Competition would be a driver of innovation and efficiency gains and create strong incentives for firms to increase productivity. Therefore the implementation of a competition-promoting legal environment would be a central element of an economic policy for the promotion of innovation and competitiveness.

The positive influence that product market competition would play on innovation, productivity, or growth has been a central theme of the recent literature on growth (e.g. Aghion et al. 2005) and the conclusion that less product market regulation (PMR) would imply more innovation/productivity/growth has been promoted as a central policy recommendation by the OECD.[1] Although the link between PMR and export performance has received little attention in empirical academic research, there is now a quite substantial literature on the influence of product market regulation on innovation and technical progress. The mainstream view whereby higher levels of PMR should hinder innovation, slow down productivity gains and hamper macroeconomic growth has actually dominated a rapidly growing policy-oriented empirical research that links measures of PMR to measures of productivity at the industry level (Nicoletti and Scarpetta, 2003; Conway et al., 2006; Arnold et al., 2008; Bourlès et al., 2013).

Particular attention has been paid in this literature to the extent to which the (usually expected) negative effect of PMR is specially pronounced at the leading edge in technology, the so called "world technology frontier". This is motivated, in fact, by a rough translation of the results in Aghion et al. (2005) who suggest that the relationship between product market competition (PMC) and innovation is hump-shaped, and that the peak of this curve is 'larger and occurs at a higher degree of competition in more neck & neck industries',[2] that is to say in industries where firms compete at the same (leading edge) technological level. Some sort of conflation between product-market *liberalisation*, low profitability and competition, as well as between the "world technology frontier" (WTF) and "neck & neck" technological competition has implicitly

[1] See the various issues of the yearly publication of the OECD: Economic Policy Reforms: Going for Growth.
[2] Aghion et al. (2005), Proposition 5.

been assumed to structure and give a rationale to the above-mentioned empirical literature.[3]

Contrasting with this view, the traditional "Schumpeterian" insight, whereby market power does provide incentives to innovate, actually appears in most theoretical models of the standard endogenous growth literature (e.g. Romer 1990, Segerstrom et al. 1990, Grossman and Helpman, 1991, Aghion and Howitt, 1992). Moreover, once entering into the modelling details, the industrial organisation literature usually highlights ambiguities in the relationship between competition pressures and innovation, with potentially different forms of non linearity depending on the setting (Boone, 2001; Vives, 2008). Put it in another way, contrary to popular perceptions, the postulate of a strong unambiguous positive impact of competition on technical progress is, at least theoretically, unconvincing.

Within the strand of the applied literature dealing with PMR, Amable, Demmou and Ledezma, (2010, 2011), Amable, Ledezma and Robin (2013), and Ledezma (2013) have also critically examined the dominant pro liberalisation view, both theoretically and empirically. Knowledge standardisation consequences of PMR (Ledezma, 2013) and leader R&D pre-emption in an otherwise standard step-by-step model without innovative leaders *à la* Aghion et al. (2005) (Amable, Demmou and Ledezma, 2010) have been put forward to highlight, and more generally to recall, the ambiguities in the theoretical relationship between regulation, market structure and innovation.[4] They have also argued therein that their empirical results, pointing out a positive interaction between PMR and the proximity to the technology frontier in determining innovation and productivity, are by no means an isolated finding. Although the claims differ in interpretation, Nicoletti and Scarpetta (2003) and Conway et al. (2006) find parameters estimates of similar sign with other economy-wide and country level time-varying indicators of regulation.[5]

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[3] We use the term conflation in light of a recent wave of innovation models that focus on endogenous entry (See Etro, 2007 for a systematic treatment). This possibility generally leads to equilibrium market structures with a monopolist featuring persistently positive profits, so that low profitability and intense competition are by no means two faces of the same coin. Likewise, Ledezma (2013) shows non-trivial links between the dynamics of market structure and the level of PMR, with namely lower persistence of leadership in highly regulated markets.

[4] For Aghion et al. (2005), product market competition encourages innovation in a step-by-step innovation process since in a neck-and-neck technological competition firms will try to escape competition by innovating. However, at the same time, laggards' innovation will be discouraged by competition as they anticipate lower post innovation profits. As argued in the above-mentioned papers, the absence of innovative activity of leaders and more generally the lack of analysis of entry deterrence are important neglected elements.

[5] In an error correction model, the authors claim a slowing-down effect of PMR in the natural catching-up process of laggard industries.

This paper goes further on these issues and tests whether countries where industries are more regulated suffer from a technological handicap on their ability to export and therefore perform at a lower level of export activity. We use industry-level information for a sample of 13 OECD manufacturing industries in 13 countries from 1977 to 2007 and rely on a two-step estimation strategy that seeks to explain the export share of production of an industry in a given country by traditional determinants of comparative advantage such as international differences in factor endowments as well as international differences in productivity at the industry level. The latter are in turn explained by product market regulatory pressures. Hence, in our modelling framework, PMR affects export activity through its influence on technical progress.

The above mentioned debate of competitiveness cannot be treated in an underlying theoretical context of comparative advantage without some embarrassment.[6] However no empirically implementable theory of competitiveness is available and we need to put some theoretical structure into the analysis. Hence, we interpret the word "competitiveness" in its fairly popular signification of "ability to export", which still makes sense when the analysis is grounded on relative productivity measures, as it is the case here. We rely on sophisticated estimations of multifactor productivity levels provided by the Groningen Growth and Development Centre, the construction of which is relative to the United States. We focus on the export share of production, which can be interpreted as both a measure of export specialisation as well as a measure of export performance in an international comparative analysis, once national scale effects are taken into account. This variable has also an important coverage, with information starting in 1979. Robustness is tested with alternative measures of export performance, which consider imports as well as international market shares.

The particularities of the indicator used to capture PMR give further precisions on the scope of the analysis. We use the "regulation impact" indicator proposed by the OECD. It measures the impact of regulatory provisions in key non-manufacturing sectors (services, retail trade, network sectors and finance) on each sector of the economy according to their use as inputs (see section 2 for details). The resulting indicator is available in a panel-data format, which explains its wide use in the industry-level PMR empirical literature. Although the OECD qualifies the underlying regulatory practices as anti-competitive, we abstract here from the deeper question about the link between *de jure* (i.e. PMR) and *de facto* (i.e. observed market structure, profitability, turnover, etc.) aspects of competition and limit ourselves to test how vertically-induced regulatory pressures affect export performance in manufacturing.[7]

Estimations obtained with these data do not support the postulate associating less-regulated industries with higher levels of export orientation. Rather,

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[6] See Krugman (1993) for an assertive point on this.
[7] This also put our tests at the centre of recent debates on *manufacturing* competitiveness, in particular with respect to the France-Germany comparisons, as they focus on the role of upstream activities and *services* (e.g. Gallois, 2012).

the contrary appears: the pressures generated in manufacturing industries from upstream provisions appear to positively influence their productivity level, which in turn translates in higher export specialisation. Such a result recalls the ambiguities in the relationship between competition and technical progress and is consistent with some previous findings.

To the best of our knowledge this is the first attempt to make a link from PMR to technology driven comparative advantage at the industry level. Since at least Leontief (1953) or Balassa (1963)**,** there is an important literature testing classical and neoclassical predictions about international trade specialisation. Recent empirical attempts (e.g. Harrigan, 1997; Redding, 2002; Nickell, Redding and Swaffield, 2008) have implemented a theoretically grounded empirical framework based on a GDP function derived from duality to incorporate both the technology and the endowment explanations of trade within the same estimation of GDP shares.[8] This approach has also proved to be compatible for new trade theories (Helpman and Krugman 1985, Feenstra and Klee 2008). The link to market institutions, however, has received scarce attention. An exception is Nickell, Redding and Swaffield (2008) who, among other analysis, establish a relationship between deindustrialisation in the OECD and labour market institutions by relating estimates of specialisation adjustments with proxies of labour market protection. In our empirical framework we integrate the role of PMR directly in the identification strategy as an excluded variable. Moreover, GDP-shares duality-based estimates usually require industry-by-industry identification, which yields directly interpretable coefficients, namely on Rybzcinsky elasticities, but does not exploit the full sample variance for other explanatory variables. Here, in this paper we have preferred to follow Romalis (2004) for an empirical strategy that considers factor endowments scaled by their respective factor intensity. Hence, it is possible to run full sample regressions and expect a positive coefficient on the composed terms of factor inputs, as the national availability of a production factor should positively influence trade specialisation when it is intensely used in the production process.[9]

The other way around (the link from trade to technical progress) has also been largely tracked in empirical studies at several levels of aggregation. There is a large body of macroeconomic literature, recently surveyed by Harrison and Rodriguez-Clare (2010), analysing how trade openness affects economic growth at the country level. After the methodological criticism of Rodriguez and Rodrik (2001) that had tempered initial claims of sizeable positive effects of trade openness, recent panel data studies have provided new evidence on a positive correlation between trade volumes and economic growth, but generally after other reforms than trade liberalisation have taken place. In any case the usefulness of using outcome measures (i.e. trade volumes) as proxies of policy measures still lacks of general agreement, even if the problem is partially ad-

[8] See Dixit and Norman (1980) for a formal presentation.
[9] Nunn (2007) also follows a similar strategy to test prediction from the application of incomplete contracts to trade theory.

dressed through instrumenting strategies. At the firm level, the empirical research is also abundant on country specific case studies testing the effects of trade on firm productivity.[10] Recent works on this research line emphasise the heterogeneous responses stemming from heterogeneous firms, with a general consensus on positive effects at least for most performing firms**.**

Although substantial, these macro and micro empirical literatures on the relationship between trade openness and productivity have not provided a consistent discussion on the role of national product market provisions. Recent papers in the PMR literature rely on firm-level data to explore the link between trade, national regulatory reforms and productivity. Ben Yahmed and Dougherty (2012) do so using micro-level data for several OECD countries. They test whether import penetration improves firm productivity according to different national regulatory environments. They find negative interactions between import penetration and PMR at the leading edge with economy-wide indicators of barriers to entrepreneurship and administrative burdens. The overall effect of PMR, however, cannot be identified as the specification considers only an interaction term for PMR, without including it alone in the linear regression, which reflects the authors' focus on the ability of national industries to face foreign competition. Our modelling framework allows for testing a larger role of PMR on the internationalisation of countries since PMR is considered at the root of technology-driven comparative advantage, while still controlling for reverse channels.

The rest of the paper gives the details of what we have announced so far. Next section presents the data and methodology used; the following section explores reduced forms relationships. We then turn to the main estimations and briefly conclude in a final section.

2. METHODOLOGY

2.1. Empirical strategy

Following standards theories of comparative advantage, we are interested in testing the following system

$$\ln(MFP_{ict}) = \alpha_0 + \sum_{j\in J} \theta_j \, I_{icjt} \ln\left(F_{cjt}\right) + \rho \ln(PMR_{ict}) + \epsilon_{ict} \qquad (1)$$

$$\ln(XP_{ict}) = \beta_0 + \sum_{j\in J} \gamma_j \, I_{icjt} \ln\left(F_{cjt}\right) + \delta \ln(MFP_{ict}) + \varepsilon_{ict} \qquad (2)$$

Equation (2) explains the export performance measure XP_{ict} of country c in industry i at time period t, by its multifactor productivity level MFP_{ict} and a set J of country's factor endowments F_{cjt} scaled-up by the respective factor intensity in production I_{icjt}. This latter transformation seeks to estimate the extent to which the increase in factor availability reinforces export performance

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[10] See the trade related works surveyed by Syverson (2011).

in sectors that intensively use them.[11] Equation (1) expresses that multifactor productivity MFP_{ict} is in turn explained by factor endowments and product market regulation PMR_{ict}, which does not *directly* participate in the explanation of export performance. As a consequence, the identification will follow an instrumental variable approach where we treat MFP_{ict} as an endogenous variable and PMR_{ict} as the instrument within a two-stage least square estimation. Equation (2) will thus be exactly identified, PMR_{ict} will be the excluded instrument and factor endowments F_{cjt} and other dummy variables will be the included instruments. We rely in fact on the hypothesis that the policy measure is exogenous to technical progress, which should be a good approximation at least in the short run of our static specification. Moreover, in the estimations that follow the null hypothesis of weak instruments is systematically rejected.

With this specification we can estimate the parameters without splitting the sample by industry, as it would be the case if factor inputs were not scaled by their relative utilisation so that different Rybczynski effects would be expected to depend on the industry. In this manner we exploit the full sample variability of regulatory environments and that of technological performance while controlling for factor inputs. From standard international trade theories we expect then γ_j and δ to be positive. Usual arguments postulating a positive impact of market liberalisation policies would suggest $\rho < 0$, which we are about to test.

Unobserved heterogeneity is supposed to come from the three dimensions of the data: country, industry and time. We consider then fixed effects for each of them in the error terms. In the robustness checks we shall also consider individual fixed effects (one for each country-industry couple) in a model where *national* industries present specific characteristics explaining their export share.

2.2. Data and sources

We have collected data on capital assets, hours worked and value added from the EU KLEMS database, constructed by the Groningen Growth and Development Centre (GGDC). Details on labour inputs are only available in the 2008 release whereas the rest of series have been drawn from the 2009 release, updated on March 2011.[12] The sample considered in the main regressions potentially contains information on 13 manufacturing industries in 13 OECD countries for the 1977-2007 period, varying from 3534 to 3781 observations for the main estimations. The latest two years are dropped when estimations include a higher level of detail for labour inputs. A superior coverage can yet be obtained in reduced-form regressions with consistent results.

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[11] See Nunn (2007) or Romalis (2004) for similar identifications strategies.
[12] http://www.ggdc.net/databases/euklems.htm. A complete description of EU KLEMS can be found in O'Mahony and Timmer (2009).

As EUKLEMS is consistent with national accounts, we have aggregated data on total hours worked by persons engaged (*L*) and data on gross fixed capital formation (*K*) for the whole economy and used them as measures of factor endowments. In alternative specifications, we also consider more detailed data on hours worked by high- medium- and low-skilled workers (resp. *HS*, *MS* and *LS*). Factor intensities are proxied via the share of the factor compensation on value added, also available in EUKLEMS.

EU KLEMS also provides measures of multifactor productivity (MFP) growth, but not of MFP levels. In order to obtain the latter, we use the GGDC Productivity Level Database, which gives a benchmark of MFP in levels relative to the United States for 1997. Since these measures need to be comparable across time, countries and industries, a specific deflation procedure is performed with heavy data details, especially to construct purchasing power parities at the industry level. For this reason MFP measures in levels are available only for the benchmark year 1997. Combining this benchmark with MFP growth of EU KLEMS, it is however possible to reproduce MFP series in levels for our sample period.[13]

These data have been completed with regulation and trade indicators available from the OECD. For regulation, we use the OECD indicator of "regulation impact" (henceforth REGIMP), which measures the extent to which industries are affected by regulation in key input sectors. The construction of REGIMP relates two sources of information: indicators of sectoral non-manufacturing regulation (NMR) and harmonised input-output tables. NMR indicators measure the intensity of regulation in the professional services (legal, accounting, engineering, and architecture professions), retail trade, as well as network sectors such as energy, transport and communications (telecoms, electricity, gas, post, rail, air passenger transport, and road). The information on regulation in network sectors covers aspects linked to entry, public ownership, vertical integration and market structure, with time series spanning from 1975 to 2007. Information on regulation in retail trade and professional services focuses on entry and conduct regulation, and is available for 1998, 2003 and 2008. In the construction of REGIMP, sectoral regulation also considers information on the financial sector regulation collected by de Serres et al. (2006) for 2003. In all cases, the construction of indicators turns qualitative information about regulatory practices into a numerical format using a system of codes devised to reflect what the OECD qualifies as "anti-competitive" regulation. Usually, the basic information tabulates answers to qualitative questions which are scored between 0 and 6, increasingly depending on the restrictiveness of the regulatory practices present in a given country. This basic information is then successively aggregated following a bottom-up scheme that yields sub-indicators of interpretable aspects of regulation which in turn are further aggregated to construct the respective NMR indicator at the sector level.

[13] See Inklaar and Timmer (2008) for details.

REGIMP is then obtained from these sectoral indicators. The idea is that the provisions captured by NMR indicators go beyond the boundaries of each concerned sector. REGIMP seeks then to measure the "knock-on" effects of regulation in non-manufacturing sectors on all sectors of the economy. They incorporate both the NMR indicator for each of the above mentioned sectors (professional services, retail trade, network sectors and finance) and the importance of these sectors as supplier in other sectors. This latter element is reflected in the coefficients of harmonized input-output tables. The indicator is then computed as $REGIMP_{ict} = \sum_k R_{kt} w_{kic}$ where $REGIMP_{ict}$is the regulation impact indicator for sector *i* country *c* at time *t*, R_{kt} is the indicator of regulation in the non-manufacturing (input) sector k at time t and w_{kic} is the input requirement of sector *i* for intermediate inputs of sector *k*. Hence, a large value of the regulation impact indicator may be the effect of a restrictive regulation in a particular input sector or a heavy use of the latter as supplier. This proxy is useful as it gives a measure of the strength of regulatory pressures in business operations and at the same time has the advantage of being available in a panel format (i.e. time-varying for each country-industry couple). For further details in the construction of REGIMP see Conway and Nicoletti (2006).[14]

For trade indicators, we use the export share of production (XSP) of each industry, obtained from the OECD STAN indicators database (v. 2009). In the robustness checks we consider alternatives indicators, namely the export to import ratio (X_M), the export market share relative to the OECD (XS_OECD) and the export market share relative to the world (XS_WORLD). All these are also available in OECD STAN.

The list of variables as well as their structure and source are summarised in Table 1. Further details on the sample definition (country and industry lists) and descriptive statistics are presented in Appendix.

3. PRELIMINARY ANALYSIS

Before starting the main econometric analysis, it is instructive to examine the empirical relationship between the regulation impact indicator (REGIMP) and the performance measures of export orientation and multifactor productivity (MFP). This is done through a set of exploratory regressions shown in Table 2. Regression in column (1) is a simple pooled OLS regression of the (log of) the export share of production and the (log of) the PMR indicator. Such a bivariate estimation gives a significantly negative correlation, which would be compatible with the dominant "common sense" (Aghion and Griffith, 2005) opinion of the negative influence of PMR on productivity and hence competitiveness. However, when this model is extended to include year dummies (column (2)), industry dummies (regression (3)) and country dummies (column (4)), the consequence is to turn progressively the significantly negative elasticity of

[14]The data can be obtained from www.oecd.org/eco/pmr.

REGIMP into a significantly positive one. Therefore, correcting for common shocks and heterogeneity across countries and industries eliminates the "common sense" negative correlation between product market regulation and export orientation. The same conclusion arises in a fixed-effect model assuming the unobserved heterogeneity at the country-industry level, that is to say, in a model where national industries present specific unobserved time-invariant characteristics explaining its export propensity.

Table 1. Main variables

Variable	Description	Panel structure	Source
K	Gross fixed capital formation	country, year	EU-KLEMS
L	Total hours worked	country , year	EU-KLEMS
HS	Total hours worked by high skilled labour	country, year	EU-KLEMS
MS	Total hours worked by medium skilled workers	country, year	EU-KLEMS
LS	Total hours worked by medium skilled workers	country, year	EU-KLEMS
I_j	Factor rewards over value added $j \in \{ K, L, HS, MS, LS\}$	country, industry, year	EU-KLEMS
MFP	Multifactor productivity relative to the US	country, industry, year	EU-KLEMS Productivity Levels Database (GGDC)
XSP	Export share of production	country, industry, year	OECD STAN
X_M	Export to import ratio	country, industry, year	OECD STAN
XS_OECD	Export market share relative to the OECD	country, industry, year	OECD STAN
XS_WORLD	Export market share relative to the OECD	country, industry, year	OECD STAN
$REGIMP$	Knock-on effect of upstream regulation	country, industry, year	OECD PMR

Regressions reported in columns (6)-(8) describe the empirical relationship between MFP and the PMR indicator. Consistent with the previous findings, the popular view portraying highly regulated environment as intrinsically inefficient is not found. With all the set of dummies included (column (6)) and even within a more exigent fixed-effect specification (column (7)) the estimated elasticities are again significantly positive. The last regression (column (7)) is a robust one in the sense that it seeks to minimise the effect of outliers, namely of those regarding the dependent variable.[15] This additional robustness check confirms the sign of the previous estimates.

Table 2. Exploratory regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$ln(XSP)$	ln(XSP)	ln(XSP)	ln(XSP)	ln(XSP)	ln(MFP)	ln(MFP)	ln(MFP)
$ln(REGIMP)$	-0.153***	0.052	0.070**	0.219***	0.125***	0.335***	0.510***	0.453***
	(0.035)	(0.037)	(0.033)	(0.041)	(0.04)	(0.055)	(0.067)	(0.045)
Fixed-effects	No	Year	Industry, Year	Country, Industry, Year	Individual (country-industry), Year	Country, Industry, Year	Individual (country-industry), Year	Country, Industry, Year
Obs.	4977	4977	4977	4977	4977	5518	5518	5518
Estimation	POLS	POLS	POLS	POLS	WG	POLS	WG	RR

Note : Standard errors in parentheses. $*$ *p<0.10, ** p<0.05, *** p<0.01. All regressions consider a constant term. POLS stands for pooled OLS regression, WG for within group estimates and RR for robust regression to outliers in the sample.*

In the same spirit of tracking the effect of possible outliers on the previous estimates, the upper panels of Figure 1 plot the partial elasticity relating the PMR indicator to the export share of production as specified by regression in column (4), which controls for country, industry and time fixed effects.[16] This regression is run twice, including (Panel (a)) and excluding (Panel (b)) the Coke, refined petroleum products and nuclear fuel industry (23), the rubber and plastic industry (25) as well as Ireland. There we observe the most extreme values of multifactor productivity, performing in general more than five times the efficiency level of the US (see appendix for a larger discussion on dispersion and central tendency of our main variables). Clearly, instead of weakening the conclusions obtained so far, using such a filter implies a significantly higher and more precise elasticity of REGIMP.

Finally, given the important heterogeneity in the sample, one may ask whether the fit performed at the mean is actually representative of the relationship in other location of the distribution. Panel (c) in Figure 1 plots the coefficients and confidence intervals stemming from quantile regressions having the

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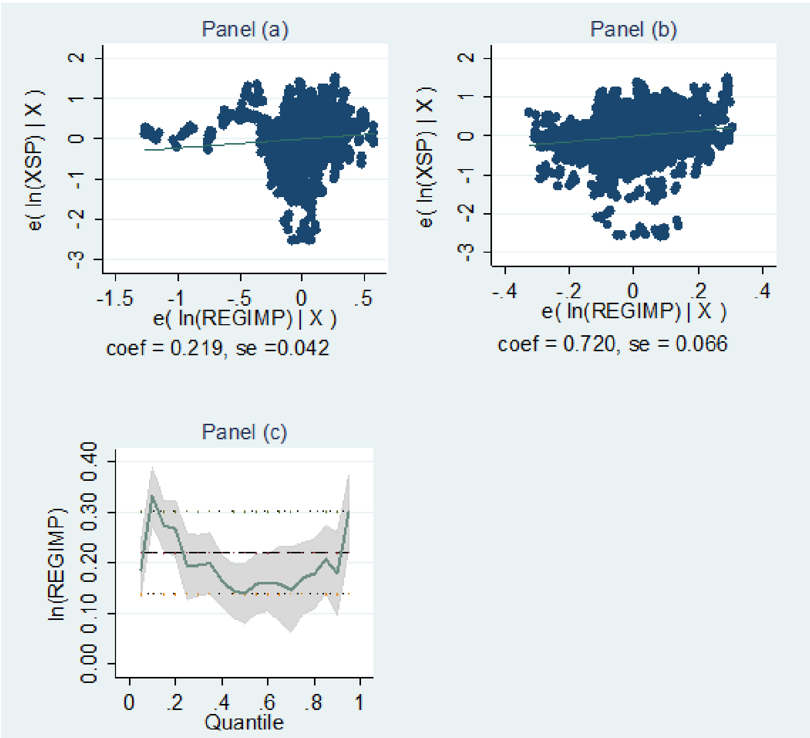
[15] The method used performs an iterative process of assessment of outliers based on residuals which are in turn weighted accordingly to their magnitude (See Hamilton, 1991).

[16] This is done in a two dimensional space by plotting expected conditional residuals, which is an application of the Frisch-Waugh theorem.

same specification as regression in column (4). Basically, these estimations seek to fit the model at different quantiles of the conditional distribution of the export share of production, instead of fitting the model at the expected conditional mean as in a standard OLS (see Koenker and Hallock, 2001). The graph also presents the OLS elasticity with its confidence intervals (the horizontal lines depicted in the figure). This exercise reveals that the estimated OLS elasticity provides a fairly representative picture of the relationship between the export share of production and the regulation indicator in most of the conditional distribution.

Figure 1. Regression plots



Note : Panel (a) and (b) presents the partial elasticity of the regression of the export share of production on the PMR indicator (in log form) after controlling for time, country and industry fixed effects. Panel (a) considers the full sample whereas panel (b) exclude potential outliers (industry 23, 25 and Ireland). Panel (c) presents the estimates of the elasticity of the PMR indicator after performing quantile regressions at different percentiles of the conditional distribution of the dependent variable (see Koenker and Hallock, 2001).

To sum up, the "common sense" notion that PMR pressures should lead to lower productivity and lower export orientation is not supported by this preliminary inspection of the data. In order to assess the robustness of these findings, we now turn to the estimation of the system of equation discussed above, which includes, in a more parsimoniously way, traditional determinants of comparative advantage.

4. ESTIMATION RESULTS

Tables 3 and 4 present the estimation results for the first stage equation linking PMR to MFP (Tables 3.a and 4.a) and for the second stage where the export share of production is determined by the MFP level measured relative to the US (Tables 3.b and 4.b). Results of instrumentation tests for underidentification and weak identification are presented along with the second-stage estimates: the Angrist-Pischke of excluded instruments, the Anderson canonical correlations test for underidentification, the Stock-Wright S statistic for underidentification, and the Anderson-Rubin test of endogenous regressors. Test results do not signal any major problem with the instruments: all tests reject the corresponding null hypothesis. The higher p-values for the Anderson-Rubin and Stock-Wright (2000) tests are the consequence of the joint hypothesis tested: the coefficient of the endogenous regressor in the structural equation is equal to zero, and, in addition, the overidentifying restrictions are valid.[17]

Table 3.a. First-stage estimations

	(1) $ln(MFP)$	(2) $ln(MFP)$	(3) $ln(MFP)$
$I_K ln(K)$	-0.056***	0.019**	-0.027***
	(0.009)	(0.009)	(0.006)
$I_L ln(L)$	-0.163***		-0.130***
	(0.012)		(0.007)
ln(REGIMP)	0.126**	0.398***	0.160***
	(0.060)	(0.059)	(0.060)
$I_{HS} ln(HS)$		0.167***	
		(0.051)	
$I_{MS} ln(MS)$		-0.138***	
		(0.028)	
$I_{LS} ln(LS)$		-0.008	
		(0.034)	
Fixed Effects	Country, Industry, Year	Country, Industry, Year	Individual (country-industry), Year
Adjusted R2	0.43	0.41	0.14
Obs.	3781	3534	3781
Estimation	IV	IV	FE-IV

*Note : Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All regressions consider a constant term. IV stands for instrumental variable and FE for fixed effects*

Six different specifications are considered, depending on whether all variables are considered relative to the US (Table 4) or not (Table 3), whether the labour input is detailed according to the skill level (high, medium, low, present-

[17] As can be seen in Table 4b, the coefficient of *ln(MFP)* in column (3) is itself significant at the 10% level.

ed in column (2) in each table) or not, and whether the model considers individual (i.e. country-industry) fixed effects (column (3) in each table) or not. The simplest specification is an instrumental variable (IV) regression distinguishing only aggregate capital and labour input in absolute terms (column (1) of Table 3). In this estimation, the first stage results show a negative influence of factor inputs variables on MFP, which may reflect a smaller than unity scale effect or an inaccurate accounting of factor inputs in value added, but a significantly positive influence of PMR. Recall that factor input variables are multiplicative terms that interact the national availability of the factor with the intensity of their use in production. Hence, as expected, the availability of factors intensely used in an industry has a positive impact on its export share of production at the second stage. Moreover, MFP also significantly boosts export orientation of the industry. Therefore, this IV estimation suggests that PMR has a positive influence on productivity, which in turns favourably impacts exports.

Table 3.b. Second-stage estimations

	(1)	(2)	(3)
	$ln(XSP)$	ln(XSP)	ln(XSP)
$ln(MFP)$	1.778*	0.518***	1.310**
	(0.909)	(0.145)	(0.581)
$I_K ln(K)$	0.115**	0.009	0.035*
	(0.057)	(0.009)	(0.018)
$I_L ln(L)$	0.303*		0.181**
	(0.158)		(0.078)
$I_{HS} ln(HS)$		0.283***	
		(0.055)	
$I_{MS} ln(MS)$		0.052	
		(0.033)	
$I_{LS} ln(LS)$		0.039	
		(0.033)	
Fixed Effects	Country, Industry, Year	Country, Industry, Year	Individual (country-industry), Year
Obs.	3781	3534	3781
Estimation	IV	IV	FE-IV
Angrist-Pischke test of excluded instruments	0.036	0.000	0.008
Anderson canonical correlations test	0.035	0.000	0.008
Stock-Wright S statistic	0.000	0.000	0.000
Anderson-Rubin test of endogenous regressors	0.000	0.000	0.000

*Note : Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All regressions consider a constant term. IV stands for instrumental variable and FE for fixed effects. p-values reported for instrumentation test statistics.*

Table 4.a. First-stage estimations (equations relative to the US)

	(1) $ln(MFP)$	(2) ln(MFP)	(3) ln(MFP)
$I_K ln(K) - I_K^{US} ln(K^{US})$	-0.056***	0.021**	-0.033***
	(0.009)	(0.009)	(0.006)
$I_L ln(L) - I_L^{US} ln(L^{US})$	-0.155***		-0.120***
	(0.011)		(0.006)
$ln(REGIMP) - ln(REGIMP^{US})$	0.153**	0.415***	0.226***
	(0.060)	(0.059)	(0.062)
$I_{HS} ln(HS) - I_{HS}^{US} ln(HS^{US})$		0.167***	
		(0.045)	
$I_{MS} ln(MS) - I_{MS}^{US} ln(MS^{US})$		-0.147***	
		(0.027)	
$I_{LS} ln(LS) - I_{LS}^{US} ln(LS^{US})$		-0.012	
		(0.035)	
Fixed Effects	Country, Industry, Year	Country, Industry, Year	Individual (country-industry), Year
Adjusted R2	0.43	0.41	0.13
Obs.	3781	3534	3781
Estimation	IV	IV	FE-IV

*Note : Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All regressions consider a constant term. IV stands for instrumental variable and FE for fixed effects.*

Distinguishing several skill levels gives different estimations of the contributions of factor inputs (column (2) of Table 3). In the first stage only the medium skilled labour input obtains a significantly negative coefficient, but high skill labour input is significantly positively contributing to productivity. As in the previous estimation, the coefficient of the regulatory indicator is substantially higher and still significantly positive. In the second stage, the positive contributions of capital and high-skill labour inputs can be noted, which means that the export share is higher when these factors are proportionally heavily used in production. Here also, productivity favourably influences exports, but the coefficient is somewhat lower than in the regression reported in column (1).

Table 4.b. Second-stage estimations (equations relative to the US)

	(1) $ln\left(\frac{XSP}{XSP^{US}}\right)$	(2) $ln\left(\frac{XSP}{XSP^{US}}\right)$	(3) $ln\left(\frac{XSP}{XSP^{US}}\right)$
$ln(MFP)$	1.447**	0.479***	0.423*
	(0.627)	(0.137)	(0.252)
$I_K ln(K) - I_K^{US} ln(K^{US})$	0.102**	0.021**	0.027***
	(0.041)	(0.009)	(0.010)
$I_L ln(L) - I_L^{US} ln(L^{US})$	0.242**		0.070**
	(0.105)		(0.032)
$I_{HS} ln(HS) - I_{HS}^{US} ln(HS^{US})$		0.247***	
		(0.049)	
$I_{MS} ln(MS) - I_{MS}^{US} ln(MS^{US})$		0.097***	
		(0.032)	
$I_{LS} ln(LS) - I_{LS}^{US} ln(LS^{US})$		0.036	
		(0.033)	
Fixed Effects	Country, Industry, Year	Country, Industry, Year	Individual (country-industry), Year
Number of Obs.	3781	3534	3781
Estimation	IV	IV	FE-IV
Angrist-Pischke test of excluded instruments	0.011	0.000	0.000
Anderson canonical correlations test	0.011	0.000	0.000
Stock-Wright S statistic	0.000	0.000	0.089
Anderson-Rubin test of endogenous regressors	0.000	0.000	0.087

*Note : Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All regressions consider a constant term. IV stands for instrumental variable and FE for fixed effects. p-values reported for instrumentation test statistics.*

The regression reported in column (3) takes a more precise account of heterogeneity. Besides time fixed effects it includes individual country-industry fixed effects. Remarks regarding the impact of factor inputs at each stage are similar to those made with the other specifications. The positive impact of PMR is somewhat higher in fixed-effect specifications than in the equivalent IV regressions and the impact of productivity on exports slightly lower.

The estimates presented in Table 4 take into account all right-hand side variables relative to the US. This is done as a robustness check on the fact that the measures of productivity levels that we can obtain are only available relative to the US, which means that equations are more meaningful if expressed in relative terms. Results reported in Table 4 are not substantially different to their respective counterpart in Table 3. One may note however that the positive impact of PMR is larger in specifications relative to the US.

Overall, the conclusions drawn from these estimations are that, contrary to the "common sense" regarding the consequences of product market regulation, the impact of the latter on productivity is significantly positive, which translates in better export performance at the industry level.

Table 5.a. Further robustness checks. First-stage estimations

	(1)	(2)	(3)	(4)
	$ln(MFP)$	$ln(MFP)$	$ln(MFP)$	$ln(MFP)$
$I_K ln(K)$	-0.054***	-0.072***	-0.086***	-0.101***
	-0.009	-0.009	-0.014	-0.015
$I_L ln(L)$	-0.155***	-0.162***	-0.121***	-0.118***
	-0.012	-0.013	-0.016	-0.017
$ln(REGIMP)$	0.139**	0.159**	0.450***	0.476***
	-0.068	-0.068	-0.103	-0.122
Obs.	3781	4145	1703	1235
Adjusted R2	0.4	0.34	0.43	0.45

*Note : Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All regressions consider a constant term as well as country, industry, year and country-year fixed effects. All results stem from instrumental variable estimations.*

Table 5 report additional robustness checks over the base-line specification of column (1) in Table 3. We seek to address here two issues: the dependent variable choice and unobserved time-varying country-level determinants. Indeed, it can be argued that the export share of production loses part of the picture as it only focuses on the export side without paying attention to import penetration. Moreover, it is constructed on a country-level basis without taking into account export performances relative to other countries. Therefore, we consider three alternative indicators: the export to import ratio (X_M), the export market share relative to the OECD (XS_OECD) and the export market share relative to the world (XS_WORLD). These two latter present lower time-series coverage (from 1997 and from 2000, respectively) so that the number of observations is substantially reduced. On the other hand, they consider the export performance relative to international markets, which renders more intuitive their link to international differences in factor endowments and productivity closely related to traditional revealed comparative-advantage indicators. This should be specially the case with XS_WORLD as all observable forms of trade are included.[18]

Table 5.b. Further robustness checks. Second-stage estimations

	(1) ln(XSP)	(2) ln(X_M)	(3) ln(XS_OECD)	(4) ln(XS_WORLD)
$ln(MFP)$	1.841**	3.215**	1.237***	1.036***
	-0.923	-1.357	-0.329	-0.339
$I_K ln(K)$	0.116**	0.278**	0.179***	0.172***
	-0.058	-0.111	-0.039	-0.045
$I_L ln(L)$	0.304**	0.516**	0.164***	0.136**
	-0.154	-0.238	-0.054	-0.054
Obs.	3781	4145	1703	1235
Angrist-Pischke test of excluded instruments	0.042	0.020	0.000	0.000
Anderson canonical correlations test	0.034	0.015	0.000	0.000
Stock-Wright S statistic	0.000	0.000	0.000	0.001
Anderson-Rubin test of endogenous regressors	0.000	0.000	0.000	0.001

*Note : Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All regressions consider a constant term as well as country, industry, year and country-year fixed effects. All results stem from instrumental variable estimations. p-values reported for instrumentation test statistics.*

Finally, one may also argue that the different dummy structures considered so far, as detailed as they might appear, are static and may fail to account for the evolution of unobserved determinants export activity. We then include in the regressions, besides country, industry and time fixed-effects, a full set of country-year interaction terms that seek to control for national-level evolutions (e.g. remoteness, macro-level shocks, demand trends, etc.). Results are qualitative similar than those presented above: PMR exhibits a significantly positive

[18] The joint OECD-WTO Trade in Value-Added (TiVA) database provides indicators for foreign trade flows in value added and in gross value. Since this project is relatively recent, year and industry coverage is considerably lower than the one considered in the paper. Data is available for five years (1995, 2000, 2005, 2008 and 2009) and eight industries with larger scope of aggregation. It would thus be impossible to replicate the empirical analysis performed in the paper. Besides, although the consideration of trade in value added vs. trade in gross value may emphasise tremendous differences in some specific cases (e.g. the famous iPhone example), the picture may remain essentially the same when one considers the whole trade pattern. For instance, using the TiVA data base, one sees that the correlation coefficient between the revealed comparative advantage expressed in value added and the same indicator in gross value is 0.987 (estimated from the full sample proposed by http://stats.oecd.org). A regression of one indicator on the other gives a coefficient not statistically different from 1. This remains true for most countries (resp. industry) when one regresses by country (resp. industry).

impact on relative MFP, which in turn has a significantly positive effect on each of the alternative measures of export performance. Test results (Table 4c) validate the instrumentation.

5. CONCLUSION

This paper has analysed the impact of PMR on ability of national industries to export at the industry level for 13 OECD countries and 13 industries over the 1977-2007 period. Recent economic policy and academic literature insists on the negative effects of PMR on productivity or innovation. Since the latter can be held to be positive factors influencing a broadly defined "competitiveness", the conclusion from the dominant opinion on that matter is that PMR should be detrimental to exports. The results of the tests performed in this paper lead to a different conclusion. Using various estimation specifications, it is shown that the knock-on effect of PMR in key input sectors (energy, transport and communication, retail and distribution, finance and professional services) has a positive influence on the productivity of industries. In turn, productivity exerts, as expected, a positive effect on the propensity to export. Therefore, the common sense opinion that PMR harms competitiveness is not supported. These results confirm previous findings on the influence of PMR on innovation (Amable, Demmou and Ledezma, 2010, 2011; Amable, Ledezma and Robin, 2013; Ledezma, 2013).

ANNEX 1. SAMPLE DETAILS

Table A1. List of industries

Code	Description
15t16	FOOD , BEVERAGES AND TOBACCO
17t19	TEXTILES, TEXTILE , LEATHER AND FOOTWEAR
20	WOOD AND OF WOOD AND CORK
21t22	PULP, PAPER, PAPER , PRINTING AND PUBLISHING
23	Coke, refined petroleum and nuclear fuel
24	Chemicals and chemical products
25	Rubber and plastics
26	OTHER NON-METALLIC MINERAL
27t28	BASIC METALS AND FABRICATED METAL
29	Machinery,
30t33	ELECTRICAL AND OPTICAL EQUIPMENT
34t35	TRANSPORT EQUIPMENT
36t37	MANUFACTURING NEC; RECYCLING

Note : capital letters indicate 2-digit industry aggregation.

Table A2. List of countries

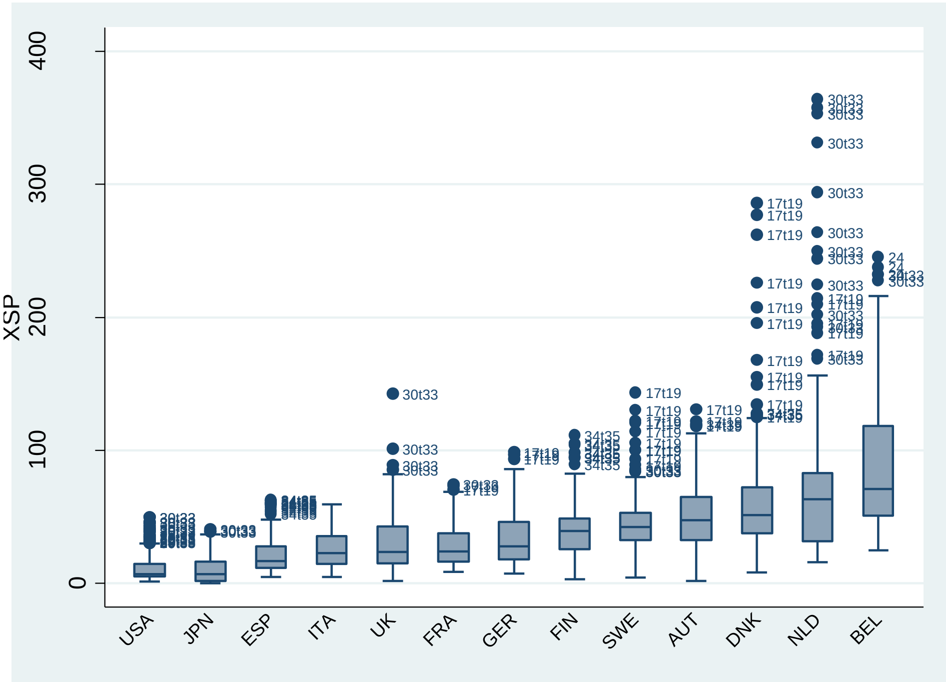
Code	Description
AUT	Austria
BEL	Belgium
DNK	Denmark
ESP	Spain
FIN	Finland
FRA	France
GER	Germany
ITA	Italy
JPN	Japan
NLD	Netherland
SWE	Sweden
UK	United Kingdom
USA	United States
AUS *	Australia
CZE *	Czech Republic
HUN *	Hungary
IRL *	Ireland
SVN *	Slovenia

Note : * indicates countries without information on export share, but considered in the exploratory regression of multifactor productivity.

ANNEX 2. DESCRIPTIVE STATISTICS

We present here an overview of data patterns, mainly driven by its three dimensional structure (country, industry and time). We do so through box-plots displayed in Figure 1 to 6, which show the central tendency and dispersion for our main variables, available on a yearly basis for each industry in each country.[19] In order to better assess the specificity of our sample heterogeneity, the graph on each variable is displayed twice, by industry and by country, which are the most structuring dimensions of the data.

Figure A.1



Figures A.1. and A.2 present the export share of production (XSP). The hierarchy of countries is in conformity with expectations, large countries (the US or Japan) have lower and less dispersed export shares than smaller countries. For several countries, the export shares of textiles (17t19), electrical and

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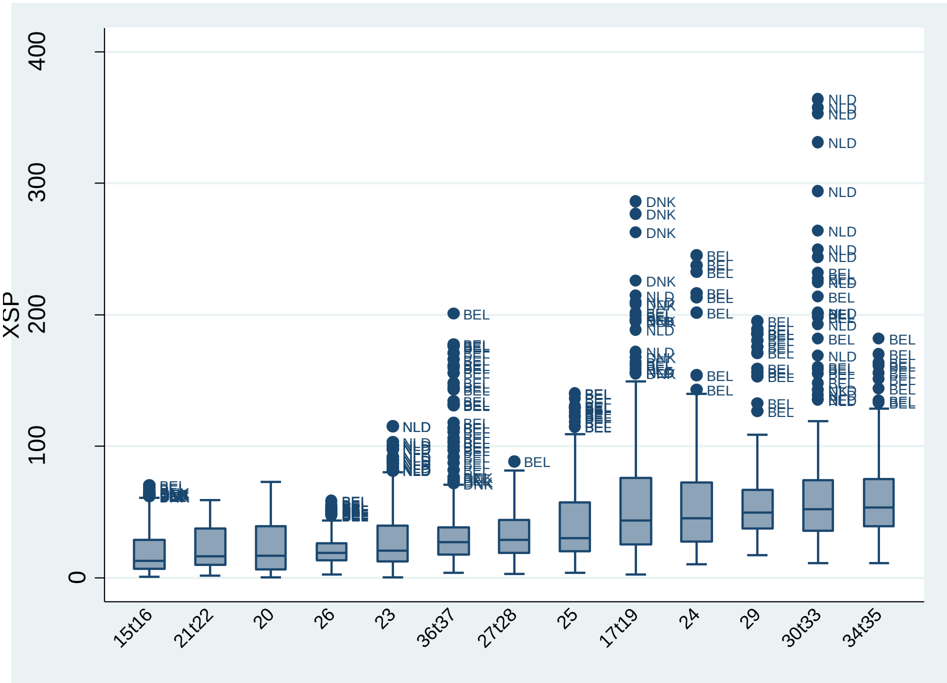
19 Each box displays the interval between the 25th percentile and the 75th percentile (i.e. the interquartile range), with the horizontal line inside the box showing the median. The length of the vertical lines (portrayed bellow the lower quartile and above the upper one) are given by the so-called adjacent values. These values are computed as the most extreme values within an interval equal to one and a half times the length of the interquartile range.

optical equipment (30t33) as well as chemical products (24), are substantially higher in the respective country sample distribution. However, if one considers the country by country representation, there is in general one specific outlier industry exhibiting an exceptional export performance. In an analogous fashion, for a given industry there is in general one specific country outperforming the rest in relative terms, with the smaller highly dispersed countries (notably, the Netherland, Belgium and Denmark) being remarkable in this respect.

Figure A.2



Figures A.3 and A.4 give the median and the dispersion of the regulation indicator (REGIMP), which measures the strength of downstream restrictiveness caused by upstream regulation. Considering the country specificity rather than the industry specificity leads to clearer data patterns, although any observable association between the regulation indicator and the size of the country appears. Interestingly, however, the top and the bottom of the country hierarchy of the export share of manufacturing and the knock-on effect of upstream regulation are inverted. Whereas Belgium appears as having the strongest average knock-on effects of upstream regulation it is the country featuring highest export orientation, which is also consistent with its small size. The opposite is true for the US.

Figure A.3

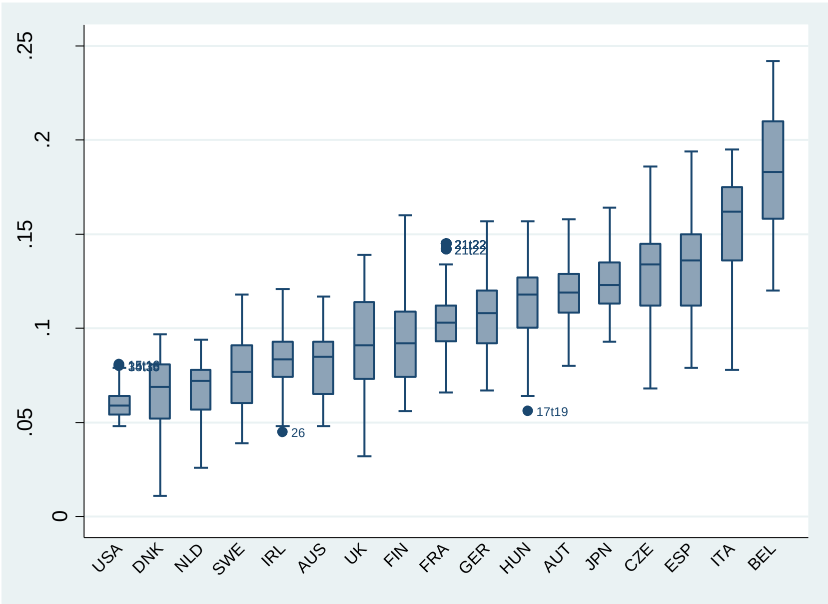


Figure A.4

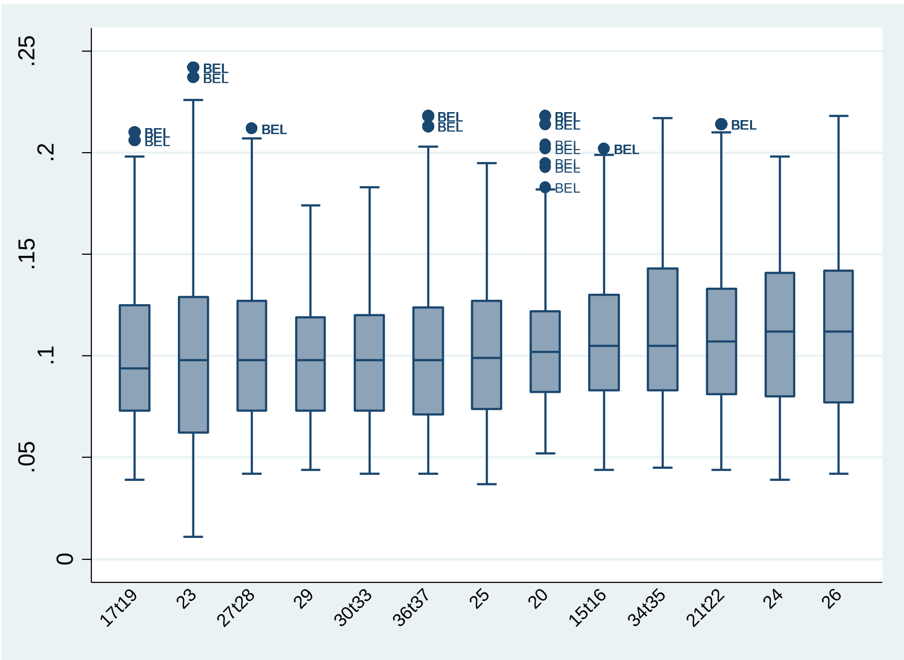


Figure A.5

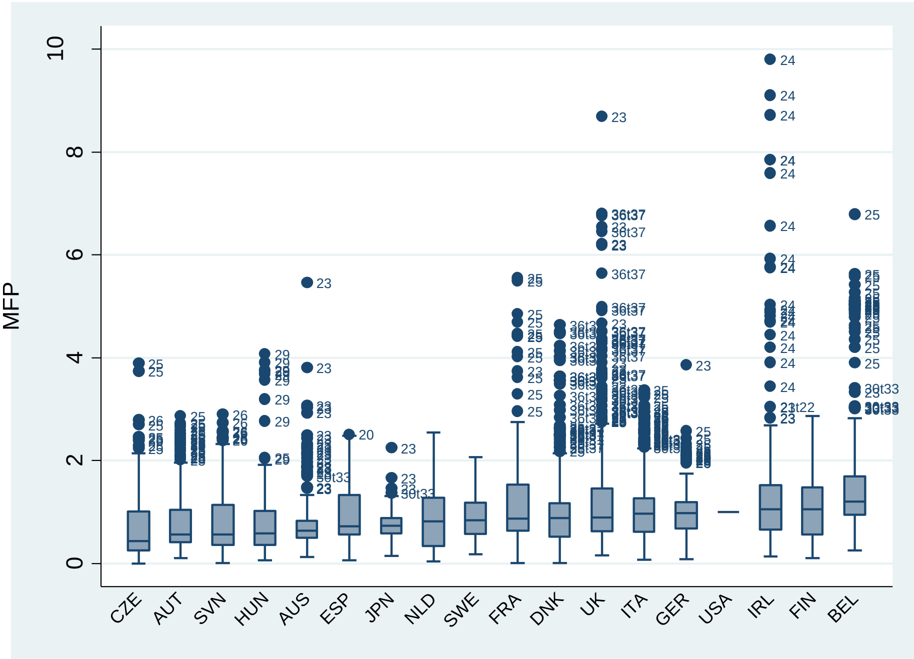
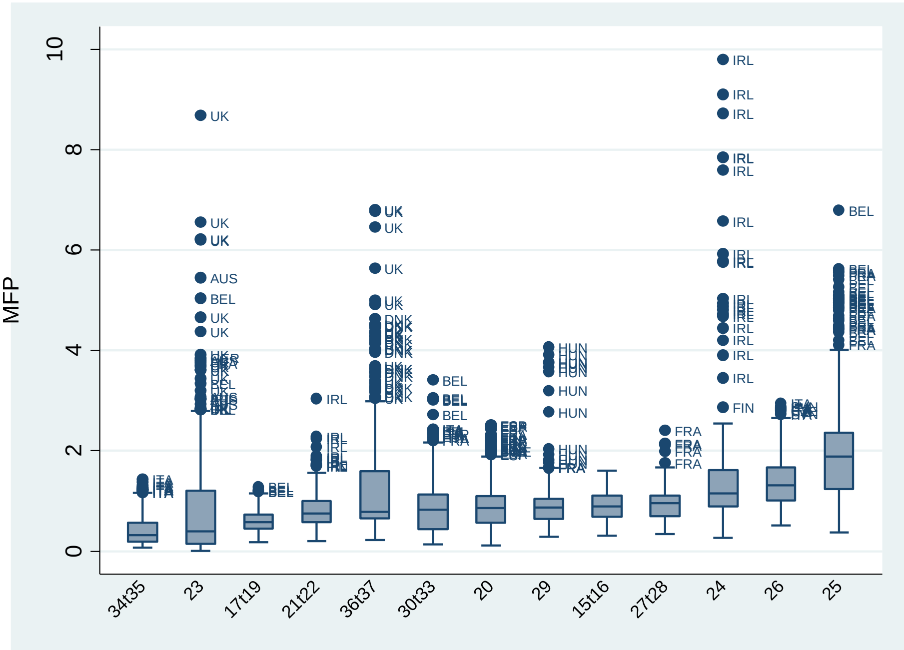


Figure A.6



A similar graphical analysis is displayed for the levels of multifactor productivity (relative to the US) in Figures A.4 and A.5. As can be seen, there is substantial dispersion in the levels of productivity according to both country and industry dimensions. The US is not on average the most productive country. Some industries seem to be characterised by extreme values of the productivity level, in particular industries belonging to the chemical, rubber, plastics and fuel products (23 to 25). Some countries exhibit that pattern too, notably Ireland and UK. The highest multifactor productivity level in the sample belongs actually to Ireland in the chemical industry (24), however, excluding Ireland, this industry presents substantially less extreme values.

This first descriptive analysis suggests that data patterns are heavily structured by country and industry specificities that should be kept in mind at the moment of explaining different export industry-level orientation in our sample. The next section goes further on this by proposing an exploratory regression on reduced-form relationships.

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PERFORMANCE A L'EXPORTATION ET RÉGLEMENTATION DES MARCHÉS DES PRODUITS

Résumé *- Cet article étudie l'impact de la réglementation des marchés des produits sur les performances d'exportation sur un panel composé de 13 industries manufacturières appartenant à 13 pays de l'OCDE, sur la période 1977-2007. Une littérature appliquée croissante, orientée vers la politique économique, insiste sur les effets négatifs de la réglementation des marchés des produits sur la productivité ou l'innovation, et par voie de conséquence sur la « compétitivité », un terme que nous interprétons ici comme la capacité à exporter. D'après ces idées, qui font par ailleurs écho à des contributions récentes analysant le lien entre concurrence et croissance, le « sens commun » indiquerait alors la présence des effets néfastes de la réglementation des marchés des produits sur la compétitivité. A travers une estimation en deux étapes, nous testons l'impact des pressions exercées par la réglementation de marchés de produits dans les secteurs en amont de l'économie sur la productivité des industries manufacturières ainsi que l'impact de cette dernière sur leur propension à exporter. Nos résultats montrent un effet positif des réglementations en amont de la chaîne productive sur la productivité des industries qui se traduit ensuite par une capacité plus importante d'exportation.*

Mots-clés : RÉGLEMENTATION DES MARCHÉS DES PRODUITS, PRODUCTIVITÉ, PERFORMANCE A L'EXPORTATION