Government Size, Institutions, and Export Performance among OECD Economies

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Abstract

We investigate the effect of the size of government, captured by the tax revenue as a share of GDP, and institutional features on countries' export performance (export shares in international markets). Theoretically, we show in a model of endogenous extent of domestically-produced goods that there exists a well-defined government size that optimally promotes exports. Empirically, we show in a panel of 18countries for 1980-2005 that the tax-GDP ratio is significant and exerts a non-linear effect on export performance, showing that there indeed exists an optimal size of government, which we estimate at around 40%. Product market rigidities are also shown to affect negatively export performance via a negative effect on R&D. Among traditional variables, relative unit labour cost and R&D shares in GDP show up significantly and with the expected signs.

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1. Introduction

What determines export performance? In a landmark paper, Carlin, Glyn and Van Reenen (2001) investigated the role of unit labour costs on relative exports among 14 countries OECD. They concluded that while relative unit labour costs and indices of technological advancement are important, they cannot by themselves explain entirely the development in export shares. Among the factors that are suggested as missing include 'deep structural characteristics' of these economies. Our overall objective in this paper is to investigate the role in shaping export performance played by two sets of such 'deep characteristics', namely the size of the government sector, and labour and product market 'institutions'.

The paper is related to various strands of existing literature. Firstly, it touches on the relation between competitiveness and export performance. While international competitiveness is not always straightforward (see, e.g., Krugman, 1993), unit labour costs are widely considered as the source of comparative advantage. Unit labour costs have been found to be significant determinants in empirical export regressions (Fagerberg, 1988; Carlin *et al.*, 2001; Leon-Ledesma, 2005; Cavallaro and Mulino, 2008). Additionally, new trade theory emphasises the role of monopolistic competition and R&D-supported product differentiation as key export drivers(see Helpman and Krugman, 1985; empirical validation of these models can be found in Hummels and Levinsohn, 1993; Leon-Ledesma, 2005; and Cavallaro and Mulino, 2009). The specialisation via R&D has been set as the major target for many OECD economies that cannot compete in cost compression with newly industrialised countries. The remarkable decline in export shares of OECD countries (see Figure 1 below) is likely to reflect the failure of many advanced economies to transform their production towards more knowledge-intensive activities thus leading to losses in international market shares. A natural question is what has caused delays in this transformation process, leading to a worsening export performance. A possible answer may lie in the institutional, regulatory, or labour market rigidities of those countries. For instance, Nicoletti and Scarpetta(2003) find that a high degree of rigidity in the labour market raises substantially the cost of production preventing resources from moving quickly and causelessly towards more productive activities. This leads on to a second branch of literature on 'institutions', particularly the role of labour market and product market institutions. The role of the former in affecting unemployment has been widely investigated and debated (see e.g., Nickell, 1997; Blanchard and Wolfers, 2000). Among the latter, product market competition has been argued to affect wages and

unemployment (Griffith, Harrison and Macartney, 2007); entry regulation for new firms is seen as detrimental to firm entry and growth (Djankov, La Porta, Lopez-DeSilanes and Shleifer, 2002; Koeniger and Prat, 2007). The current paper contributes to the literature by analysing whether various institutional features such as aspects of labour market rigidity or entrepreneurship have impacted on export performance via R&D investment. As this set of institutional features has been added to the relative unit labour costs as basic determinants of export performance, we are able to at least partially meet the challenge set by Carlin *et al.* (2001), namely to uncover some of the deep institutional determinants of export performance.

Equally importantly, a third branch of literature to which the paper is related concerns the macroeconomic effects of government size, which continues to be a focus of contention in the literature. Critics (see for instance a National Heritage Foundation webpage, Mitchell, 2005) argue that government displaces or crowds out utility-enhancing private consumption by essentially inefficient, often totally wasteful, public consumption. A purely redistributive type of taxation, moreover, may breed distortion, corruption and dependence or moral hazard (Sinn, 1995). Proponents of government spending and the welfare state (e.g., Atkinson, 1995a, 1995b) question the specifics of many of these arguments, view the international evidence on the government spending-growth relation as mixed, and conclude that the debate is still open. La Porta et al. (1999) caution that "larger governments tend to be the better performing ones" (p. 222), and "identifying big government with bad government can be highly misleading" (p. 266). In their discussion of this paper, Gordon and Wang (2004) concur with this circumspect view. In his review of the endogenous growth evidence, Temple (1999, p. 145) concludes that "…it would be wrong to argue that a correlation between small government and fast growth leaps out from the data." Thus, one is left to conclude that despite the often politically charged nature of the debate, the evidence is not strong either way, and that the role of government in providing a spurt (or otherwise) to production, growth, or other measures of macroeconomic performance is a fruitful, indeed urgent, area for future research. This paper should be seen as a contribution in this line of investigation.

Starting at least with Aschauer (1989) and Barro (1990), there is a formidable tradition in the theoretical literature that emphasises the beneficial effects of productive public services such as administration, maintenance of the rule of law, investment in infrastructure, promotion of human capital via education and health, and delineation of property rights and contract enforcement. Further contributions in this tradition include Futagami, Morita and Shibata,

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(1993), Fisher and Turnovsky (1995), Turnovsky (1996, 2000), Tsoukis and Miller (2003), Ghosh and Roy (2004); Irmen and Kuehnel (2009) provide a survey of this literature. On the empirical side, there is fairly clear-cut evidence that public investment on infrastructure has a beneficial effect on growth (Easterly and Rebelo, 1993; Demetriades and Mamuneas, 2000; Canning and Pedroni, 2008). On the expenditures on services or non-infrastructural public goods, the evidence is less clear-cut; Levine and Renelt (1992) finds that the evidence is not robust in this respect; but nor are of course the vast majority of explanatory variables in growth regressions. Non-robustness is the picture that one also gets from the information on 'Government'-related variables shown in the Table in Appendix 2 of the follow-up survey on new growth empirics (Durlauf, Johnson and Temple, 2005). Thus, the state of the empirical literature also seems to call for further research.

A more nuanced view would therefore combine both aspects of public services, the productivity-enhancing one and the disincentives induced by higher taxation, and would proceed broadly along the lines of reasoning proposed by Barro (1990): The growth-government size relation may be summarised by a hump-shaped curve; this is due to the fact that some essential public services foster growth, as they complement private capital in the production function. This effect is however subject to diminishing returns; beyond a certain point, the cost of these services (taxation) begins to dominate, so that further expansion of government decreases growth. There is thus a conceptually clear, but harder to pin down empirically, optimal size of government.[1] Our paper continues on this front by investigating the contribution of government size to relative exports, another measure of macroeconomic performance, both theoretically and empirically.

Alesina (1999) interprets the international evidence as showing countries with low incomes tend to have inefficient, insufficient and corrupt government, while at high incomes, government is too much and generates some kind of addiction from public services, with concomitant too high taxation. This view parallels the reasoning of Barro (1990), if arguably with the reverse order of causality (in Barro, causality goes from public services to growth, whereas in Alesina's reasoning, it is the opposite direction). In any case, we do find a hump-shaped curve of export performance versus the size of the welfare state in both the theoretical and empirical part of our investigation along the lines of Barro (1990).

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[1] Karras (1996) provides one of the precious few attempts to empirically implement this idea and determine whether public services are optimally provided or not.

Another precursor to this paper is Alesina and Perotti (1997) which studies theoretically and empirically the effects on competitiveness of redistribution financed by distortionary taxation. Their empirical part confirms the theoretical predictions: For instance, a rise in labour tax by 1% of GDP increases unit labour costs by as much as 3%. They also find that a key institutional feature of the labour market, notably the degree of centralisation of the wage bargaining, has an important effect, with the above effect being highest in countries with an intermediate level of centralisation. Though related, our line of investigation has a different focus from this paper, namely we enquire about the determinants of export performance; thus, competitiveness is an explanatory, rather than a dependent, variable. Our contribution over the Carlin *et al.* (2001) findings has been noted, which is that we are able to highlight some of the 'institutions' and government size that determine export performance in addition to the relative unit labour costs. Data availability implies that our data sample consists of 18 countries for the period 1980-2005, a more recent and extensive panel than both studies mentioned above (compared to 14 countries for 1960-1990 in Alesina-Perotti and 14 countries for 1970-92 for Carlin *et* al., 2001).

The nature of our investigation is dual, both theoretical and empirical: In a theoretical model, we analyse relative export performance in a setup that draws on the vintage model of Dorfman, Dornbusch and Samuelson (1977). This model determines market capture (share of a unit-mass of goods produced by each of two countries) based on unit labour costs in a monopolistically competitive product market. On this basic setup the role of the state sector and institutions in promoting export performance are investigated: Labour market institutions are captured by the introduction of unions and their attributes in shaping unit labour costs. Furthermore, using a model in which productive public services complement private capital in the production function but require taxes in order to be funded, we show that 'government', as a purveyor of public services, indeed exerts a non-linear role along the lines of Barro (1990).

In the empirical part, we investigate the relation between export performance, labour and product market institutions, and the size of government as measured by the total tax revenue-GDP ratio. Our estimates consistently and robustly reveal a significant, non-linear role for the state, and verify the existence of a Barro-type curve of export performance versus our measure of state size. The estimates imply an export-maximising tax-GDP ratio of around

40%. We also look at various institutional aspects related to labour (intensity of trade unionism, employment protection) and product (barriers to entrepreneurship, competition, and FDI; and overall product market regulation)markets. The product market-related institutional features that we consider do play a negative and significant role in affecting international export shares, via a negative effect on the effectiveness of R&D expenditures; but we could not uncover any significant role for labour market-related rigidities. Among more traditional determinants of export performance, relative unit labour costs and the R&D share in GDP turn up as expected, while the share of purely social (i.e., non-productive) expenditures in GDP turn up negatively and significantly, in a way reminiscent of Alesina and Perotti (1997). The paper is organised as follows: Section 2 develops an analytical model that informs the subsequent empirical analysis, Section 3 contains the baseline regressions, Section 4 implements some robustness and sensitivity analyses, while Section 5 concludes. Appendices A and B have more information about the construction of the relative unit labour cost variable and descriptive information about the series used in this study.

2. A Model of the state sector and export performance

As mentioned, the model seeks to uncover the channels of influence of the size of the state sector on export performance. While the tax rate reduces competitiveness (Alesina and Perotti, 1997), it may also increase productivity via its support of productive public services (Barro, 1990). Such services include basic administration, support of the rule of law, health and education services, a clear delineation of property rights and contract enforcement. To bring these arguments to bear on export performance, we follow the dynamic Ricardian model of Dornbusch, Fischer and Samuelson (1977;see also Obstfeld and Rogoff, 1996, Chapter 4) coupled with monopolistic competition in the product and labour markets (something missing from the original model). We also combine this with productive public services in the manner of Barro (1990) so as to analyse the role of government and the welfare state in terms of export performance. In contrast to the supply-side model of Barro (19990), here we have a model in which demand is determined first, and then labour demand is determined residually. More technically, we shall also use a CES production function, which introduces the possibility of unemployment in the labour market, and hence a meaningful role for trade unionism. This links up with a rich literature on the effects of union

behaviour. While these should be valuable extensions of DFS (1977) in their own right, the main focus here is to highlight the link between state size and taxation on the one hand and competitiveness and export performance on the other.

Accordingly, there is a continuum of goods, $i \in [0,1]$ that are internationally tradable. A fraction $0 < z < 1$ of them is produced by the Home economy (H), and the rest by the Foreign economy (F - the latter will be indicated by starred variables). We indicate by α_i and α_i^* the unit labour requirements (inverse productivity) for each good i in each of the two countries. Thus, the ratio $A(i) \equiv \alpha_i^*/\alpha_i$ indicates the relative productivity of H concerning good i. Later on, we shall consider also broader interpretations of productivity and A(i) that bear on institutions. We index the goods such that A(i) falls as i rises; in other words, H has a relative productivity advantage for goods with a low i and F in those with a high i.

The utility of the representative domestic agent has the following structure:

$$U = \left(\int_0^1 C_i^{\frac{\theta-1}{\theta}} di \right)^{\frac{\theta}{\theta-1}} + (1-\delta)uR \tag{1}$$

Utility is made up of two components, firstly a consumption aggregate and secondly a term reflecting the utility of leisure. The consumption sub-utility is a Dixit and Stiglitz (1977) aggregate of all globally produced, and consumed, individual goods; it is assumed that, globally, there exists a unit mass of differentiated goods, each subscripted by and characterised by elasticity of substitution $\theta > 1$, produced by monopolistically competitive firms (see Blanchard and Kiyotaki, 1987). All quantities refer to the representative agent, and because of symmetry, they are identical to aggregate bundles.

We follow Alesina and Perotti (1997) in the treatment of leisure in utility: It is weighted by δ and it is valued at the exogenous utility of leisure R, if the individual is unemployed; if they work, there is no utility of leisure. There is no proper leisure-labour choice here; the unemployment rate ($0 < u < 1$) will be decided by the conditions in the labour market, and a fraction u of each individual's time is involuntarily spent out of work.

Given the monopolistic structure, the associated price level is:

$$P = \left(\int_0^1 (P_i)^{1-\theta} di \right)^{1/(1-\theta)} = 1 \tag{2}$$

This is normalised to unity; in other words, the numeraire is the global basket of goods, but we shall keep it for completeness.

One innovation in relation to Alesina and Perotti (1997) concerns productivity, A. It has been recognised since at least Barro (1990) that productivity may be at least partly supported by public services such as administration and the maintenance of the rule of law, education, health, and infrastructure development; so, public capital augments labour in production. Public services are supported by levying a flat tax rate τ across all incomes; a balanced budget is assumed, so this rate also equals the public services-to-GDP ratio. The public services are assumed non-rival, so all producers enjoy the same level without congestion effects. Accordingly, individual good production is characterised by:

$$Y_i = \frac{BL_i}{\alpha_i} \tag{3}$$

Where B is productivity, supported by public services, and therefore specified as:

$$B = (\tau Y)^{\beta} \tag{4}$$

Taxation supports public services in the form of purchased goods; for tractability, the government is assumed to buy all goods (worldwide) in the same proportion as individual consumers. In this way, the price index of the government-consumed goods bundle is the same as the global price level P and no other changes need to be made to the way the global price level is calculated. The parameter $0<\beta<1$ captures the production effectiveness of a given level of public services, and may therefore be interpreted as a measure of institutionally-determined efficiency in the model.

Due to the monopolistic structure of the goods market, producers in all sectors enjoy a monopolistic mark-up of price over marginal cost, as is standard; so, the generic producer j sets their price according to:

$$P_i = \frac{(1+\mu)\alpha_i W}{B} \tag{5}$$

Where W is the nominal wage producer i faces, common across the domestic economy, as will be specified below. In analyses of monopolistic markets, it is customary to define the mark-up as $\mu \equiv \frac{\theta}{\theta-1} - 1$, i.e. tightly linked to product market structure and the elasticity of substitution in utility (θ). Strictly speaking, the mark-up is closely connected to the elasticity of demand θ which is the same across all goods, so it should be assumed symmetric across the two economies. However, the elasticity of substitutions will be common across economies and goods, whereas a lot of interesting, real world-related possibilities arise if we let the mark-up differ across the two economies. Therefore, we shall let the mark-up be disconnected from the monopolistic structure, and assume that mark-ups across the two

economies can differ because of idiosyncratic factors across the two economies which we do not need to model. Allowing for a different mark-up and nominal wage, symmetry applies to pricing in the foreign market.

All goods for which $P_i < (>)P_i^*$ will be produced by the Home (Foreign) economy. In view of the pricing rule, therefore, good i will be produced by H if:

$$(1 + \mu)\alpha_i W/B < (1 + \mu^*)\alpha_i^* W^*/B^*$$

The marginal good z is defined such that costs are the same across the two economies; it is hence defined implicitly from:

$$(1 + \mu)\alpha_z W/B = (1 + \mu^*)\alpha_z^* W^*/B^* \tag{6}$$

Any good i<z will be produced by H and j>z will be produced by F. We may therefore interpret z (0<z<1)as the (endogenous) extent of 'market capture' by the Home economy.

Given the structure of utility, demand for good is given by:

$$C_i = (P_i/P)^{-\theta}C \tag{7^{H}}$$

where C is total domestic consumption in real terms (in units of the numeraire good), and symmetrically

$$C_i^* = (P_i/P)^{-\theta}C^* \tag{7^{F}}$$

Total aggregate demand comprises global consumption plus global government spending; the latter is assumed to be equal to $\tau Y + \tau^* Y^*$ under the assumption of balanced budget. Since the two governments buy goods in the same proportion to their relative prices as individual consumers, individual goods demand and production is:

$$Y_i = \left(\frac{P_i}{P}\right)^{-\theta}(C + C^* + \tau Y + \tau^* Y^*)$$

The model here features no investment or capital accumulation, therefore on a global scale, the sums of consumer and government spending should equal global output, $C + C^* + \tau Y + \tau^* Y^* = Y + Y^*$. Therefore, and in view of the pricing rule:

$$Y_i = \left(\frac{(1+\mu)\alpha_i W}{BP}\right)^{-\theta}(Y + Y^*) \tag{8}$$

Given this output, total employment in the i-th sector is:

$$L_i = \alpha_i Y_i = \alpha_i^{1-\theta}\left(\frac{(1+\mu)W}{BP}\right)^{-\theta}(Y + Y^*)$$

It is noteworthy that the effect of a rise in the unit labour requirement α_i on employment in sector is twofold: positive since more labour is required per unit of good, and negative as demand will fall in the sector because of the higher price. Because of the assumption of $\theta>1$, the latter effect dominates; it is worth contrasting that with the original DFS (1977) of Cobb-

Douglas utility in which case the two effects exactly cancel out, so that employment is constant across sectors. As a result, total employment in the domestic economy is:

$$1 - u = L = \int_0^z \alpha_i^{1-\theta} di \left(\frac{(1+\mu)W}{BP}\right)^{-\theta} (Y + Y^*) \tag{9}$$

Where C+C* is total consumption expenditure across the two economies in real terms. This is to be taken as exogenous by the union, whose behaviour will be described shortly.

The next step in the analysis concerns the labour market and the determination of the real wage. As mentioned, our model is able to incorporate unemployment, in contrast to the essentially supply-side models of both DFS (1977) and Barro (1990). Before turning to the union's behaviour, we analyse Walrasian equilibrium; this will be a useful benchmark in what follows. In Walrasian equilibrium, when no union behaviour is involved, the nominal wage is set at such a level that unemployment is eliminated. (Strictly speaking, this is not entirely accurate. Since at least Blanchard (1986), we know that imperfect competition even on one side of the labour market suffices to generate structural unemployment, and this should be the case here even without union presence, just by the monopolistic power of the firms. Since we are interested however on what effects the union behaviour will have, we may more accurately say that we normalise unemployment to zero when there are no unions, even though there are monopolistic firms; we then measure the effects of unions on the deviations of unemployment from this benchmark – zero – level.)Accordingly, the Walrasian equilibrium real wage would be determined by:

$$\frac{W^{WE}}{P} = \frac{B}{1+\mu}\left((Y + Y^*) \int_0^{z^{WE}} \alpha_i^{1-\theta} di\right)^{1/\theta} \tag{10}$$

Both demand (global demand) and supply (productivity, firm mark-up and international competitiveness) factors play a role here.

We next turn to union behaviour (see e.g. Nickell, 1990). If there is a single 'monopoly union' in the Home economy, its welfare is assumed to be:

$$\bar{U} \equiv \frac{(1-u)W}{P}(1 - \tau) + uR \tag{11}$$

where τ is the tax rate. The union has the specific aim of raising the mean take-home pay over the entire workforce; the only alternative to employment for an economy-wide union is only unemployment, which is valued above as leisure. Maximising (11) with respect to the real wage ($w \equiv W/P$), we have:

$$(1 - u)(1 - \tau) = \frac{du}{dw}\left(\frac{W}{P}(1 - \tau) - R\right) \tag{12}$$

The economy-wide union factors in the effect of the real wage on aggregate employment. We note that for any work to be offered at all, the take-home wage should be greater than the disutility of leisure, $\frac{W}{P}(1-\tau) - R > 0$. The union takes the tax rate and the level of global demand as given. Therefore, from equation (9) of unemployment, we get:

$$\frac{du}{dw} = (1-u)\left[\theta\frac{P}{W} + \varphi\right] \tag{13a}$$

whereφ

$$\varphi \equiv -\frac{\alpha_z^{1-\theta}}{\int_0^z \alpha_i^{1-\theta}di}\frac{dz}{dw} > 0 \tag{13b}$$

is the effect of the union's actions on the amount of goods z that the domestic economy produces. The positive sign follows from $\frac{dz}{dw} < 0$, the fact that a rising real wage makes the economy less competitive. In other words, the economy-wide union takes into account the fact that its policies will have significant side-effects on total production and indirectly therefore on unemployment. The internalisation of these externalities by a centralised union is some of the key findings of Calmfors and Driffill (1988). Here, we shall treat φ as parametric and interpret it as the degree of centralisation of the trade union and its concomitant extent of internalising the externalities it causes on the economy's productive structure. Inserting (13a) into (12), we can solve for the real wage that the union settles for:

$$\frac{W^{Union}}{P} = \frac{\theta R}{(\theta-1)(1-\tau) + \varphi\left(\frac{W^{Union}}{P}(1-\tau) - R\right)} \tag{14}$$

This implicitly defines the real wage set by the monopoly union. Since the tax rate is of interest, we may totally-differentiate and re-arrange to get:

$$\frac{d\frac{W^{Union}}{P}}{d\tau} = \frac{W^{Union}}{P}\frac{\theta-1+\varphi\frac{W^{Union}}{P}}{(\theta-1)(1-\tau)+\varphi\left(2\frac{W^{Union}}{P}(1-\tau)-R\right)} \approx \frac{W^{Union}}{P}\frac{1}{1-\tau}[1-\phi] > 0; \tag{15}$$

where

$$1 > \phi \equiv \frac{\varphi\left(\frac{W^{Union}}{P} - \frac{R}{(1-\tau)}\right)}{(\theta-1) + \varphi\left(2\frac{W^{Union}}{P} - \frac{R}{(1-\tau)}\right)} > 0$$

with$\phi'(\varphi)>0$, inherits from φ its properties and the interpretation of degree of centralisation of the union. The tax rate unambiguously increases the real wage set by the union. A greater centralisation and restraint of the union will lower the real wage – an effect discussed by Alesina and Perotti (1997). The conditions in the product market also feature in the union-set wage – a more inelastic market (lower θ) will feature a higher real wage, quite independently of the mark-up that the firm sets.

In practice, no union unilaterally sets the wage, as the 'monopoly union' model postulates. The 'right to manage' model (Oswald, 1986; Nickell, 1990) is instead a lot more realistic, assuming as it does that the union and firm negotiate the wage and then the firm sets employment according to its labour demand curve or its profit-maximising objective more generally. To solve for that would be too complicated, though; instead, we resort to the convenient shortcut that the actual wage is a geometric average of the Walrasian and the Union wages as a way of approximating the real wage set in a 'right-to-manage' setup (see Manning, 1987):

$$\frac{W}{P} = \left(\frac{W^{Union}}{P}\right)^{\gamma} \left(\frac{W^{WE}}{P}\right)^{1-\gamma}$$

Where $0<\gamma<1$ is the normalised strength (organisational, political, or other) of the union. Therefore, using (15), the semi-elasticity of the real wage with respect to the tax rate becomes:

$$\frac{d\frac{W}{P}}{d\tau} / \frac{W}{P} = \frac{\gamma(1-\phi)}{1-\tau} \tag{16}$$

Since the global price level is normalised to unity by (2), the union cannot affect it; (16) then also equals the effect of the tax on the nominal wage:

$$\frac{dW/W}{d\tau} = \frac{\gamma(1-\phi)}{1-\tau} \tag{16'}$$

Having fixed the wage, and symmetrically for the Foreign economy, we can now pin down the extent of domestic production(and domestic capture of world markets), z. Given our definition of relative productivity, $A(i) \equiv \alpha_i^*/\alpha_i$, $A'(i)<0$, and the condition for the marginal good, z, (6), we have:

$$A_z = \frac{(1+\mu)W/B}{(1+\mu^*)W^*/B^*} \tag{17}$$

Since A is an inverse function of i, the extent of H production (z) rises with the foreign product mark-up and nominal wage and falls with the domestic ones. These results are intuitive, as the product mark-up and wage costs directly affect product prices and therefore the relative competitiveness of the two economies. The exogenously given curvature of the A(i) function also plays a role: Apart from reflecting productivity in a narrow sense, this may also be interpreted as a country's institutional features that have a bearing on productivity, as alluded to above. Since 1/A(i) is the cumulative distribution function of relative productivity, a rise in relative productivity by the domestic economy (a shift in 1/A(i) such that the new distribution is first-order stochastically dominated by the old), implies that the domestic economy is more productive across the board. This may be interpreted as a technological

improvement but it may also be a business-friendly institutional change. This type of change will induce a rise in A^{-1}(.)for each level of cost competitiveness $\frac{(1+\mu)W/B}{(1+\mu^*)W^*/B^*}$; therefore, *ceteris paribus*, the extent of H production (z) rises.

In view of our specification for productive public services (4), (17) becomes:

$$A_z = \frac{(1+\mu)W/(\tau Y)^\beta}{(1+\mu^*)W^*/B^*} \qquad (18)$$

Totally-differentiating, we find that the tax rate will affect the degree of H production (z) as follows:

$$\frac{\partial z}{\partial \tau} = \frac{\frac{\gamma(1-\phi)}{1-\tau} - \frac{\beta}{\tau}}{A'(z)} \qquad (19)$$

where $A'(.) \equiv dA(i)/di < 0$. Therefore, we have the following sign:

$$sgn\left\{\frac{\partial z}{\partial \tau}\right\} = -sgn\{\tau - \bar{\tau}\}, \qquad \bar{\tau} \equiv \frac{\beta}{\beta + \gamma(1-\phi)} \qquad (20)$$

(20) defines a threshold tax rate, $\bar{\tau}$, around which the balance of effects of the tax rate on the degree of specialisation changes sign: The two effects are a positive one via public services and a negative one via the effect on the union-bargained wage. We thus get a hump-shaped graph of z(τ), which parallels the graph of growth on the tax rate in Barro (1990), but does not seem to have been derived in the literature in its own right. We therefore get an optimal tax rate, and government size (because of the balanced budget), from the point of view of maximising z, the extent of Home production and its 'capture' of world markets. A rise in the level of productivity, technical or institutional, as captured by A(i), raises the absolute value of dz/dτ (whatever its sign) in two mutually-reinforcing ways: firstly by reducing A'(.) for all i, and second, by increasing z, and therefore further decreasing A'(z).

We thus arrive at the following proposition:

Proposition 1: On the determinants of Home production (z):

  a) *The tax rate exerts a dual effect on the degree of external specialisation (z): positively, via the productivity-enhancing public services, and negatively via the effect on the bargained real wage derived from union behaviour. The balance of the two effects gives the tax threshold in (20), $\bar{\tau}$; this is also the optimal government size with respect to the maximisation of the share by H of world production (z).*

  b) *The strength of the union (greater γ) exacerbates the negative effect of the tax on the wage, as the union is better able to compensate for the loss of net pay in negotiations, and therefore reduces the threshold tax rate, $\bar{\tau}$.*

c) *A more centralised union (higher φ, ϕ) mitigates the negative effects in (b), as the union internalises the negative externalities caused by its actions; hence it increases the threshold tax rate, $\bar{\tau}$.*

d) *Institutionally-determined efficiency (β) increases z and the threshold tax rate.*

e) *Ceteris paribus, a greater degree of technological or institutional productivity, manifested in the productivity term A'(z), increases the effect that the tax rate has on the extent of Home production, z.*

Proof: All parts of the proposition readily follow from (20) and the associated discussion. From (8), noting the definition of productivity as based on public services (4), domestic output is:

$$Y = \int_0^z P_i Y_i \, di = \left(\int_0^z \left(\frac{(1+\mu)\alpha_i W}{(\tau Y)^\beta P} \right)^{1-\theta} di \right)(Y + Y^*) \tag{21}$$

The effect of the tax rate is:

$$\frac{dY}{d\tau} = \frac{-(\theta-1) + \frac{Y_z}{A'(z)}}{1 - \beta(\theta-1) - y} \left\{ \frac{\gamma(1-\phi)}{1-\tau} - \frac{\beta}{\tau} \right\} \tag{22}$$

Where

$$0 < y \equiv \frac{Y}{Y + Y^*} < 1$$

is the relative size of H in the global economy, and will be assumed parametric and exogenous; correspondingly, the size of F is given (although there are two economies in the world).

Competitiveness manifests itself via the relative price of the domestically produced goods. If we consider the effect of a tax change on real output, we have five channels: Firstly, the negative effect of the real wage on domestic demand via higher prices (the θ in the numerator of the first ratio times β/τon the RHS in 22); secondly, the effect of the tax rate on public services and productivity (the $\theta\gamma(1-\phi)/(1-\tau)$ term). Thirdly, the effect of the tax rate on the degree of domestic capture of markets (the rest of the same numerator); this involves in turn a dual effect, the effect of the tax rate on public services and productivity, and the effect of the tax rate on the real wage bargained for by the union (that is, noting 19). Fourthly, the tax rate reduces net disposable income and consumption; fifth, government spending will rise with the tax rate; in fact, the last two channels exactly cancel out under our assumptions (note that global consumer demand equals $(1-\tau)Y+(1-\tau^*)Y^*$, while government spending is $\tau Y+\tau^*Y^*$). We assume that $1-\beta\theta-y>0$, i.e. that the effect of public services on productivity is not too

strong and that the domestic economic is not too large. Under this maintained assumption,

$\frac{-(\theta-1)+\frac{Y_z}{A'(z)}}{1-\beta(\theta-1)-y} < 0$, and

$$sgn\left\{\frac{dY}{d\tau}\right\} = -sgn\left\{\frac{\gamma(1-\phi)}{1-\tau} - \frac{\beta}{\tau}\right\}$$

Maximising output entails setting $dY/d\tau=0$. The tax rate that brings that about is found to be the same threshold, $\bar{\tau}$, as the one that maximises the extent of Home production in (20). Thus, the properties of the optimal tax rate with respect to Home output maximisation, are as described in Proposition 1. As with the extent of Home production (z), the tax rate exerts a hump-shaped effect on output, with output rising with tax below the threshold and falling beyond it. Again, these effects parallel Barro's (1990) effects of the tax rate on growth; but here, the variety of effects considered is richer. The main difference with Barro (1990) is that the negative effect is not due to the disincentive of taxation but to the effect of the tax on the real wage. Furthermore, the hump-shaped effect of tax on output mirrors its effect on Home production (z) except that it is exacerbated, comprising the effect of tax on both product capture plus the other channels discussed above.

Turning now to the external balance, it is useful to consider the 'export ratio', the ratio of domestic to foreign exports:

$$Exp \equiv \frac{\left(\int_0^z \left(\frac{(1+\mu)\alpha_i W/B}{(\tau Y)^\beta P}\right)^{1-\theta} di\right)(C^* + \tau^* Y^*)}{\left(\int_z^1 \left(\frac{(1+\mu^*)\alpha_i^* W^*}{(\tau^* Y^*)^\beta P}\right)^{1-\theta} di\right)(C + \tau Y)}$$

Exports of H in the numerator are generated by demand from F and is proportional to (7^F); symmetrically for the F exports (denominator).

Now, while global consumption equals global output (there is no saving or investment in this model), this need not be the case for each individual economy: GNP and GDP need not be equal. If one economy has accumulated claims on the other, then its GNP>GDP by the amount of interest payments on those assets; for the other economy, correspondingly, the opposite will be true. To model how these possibilities may arise is beyond the scope of this (it generally requires an intertemporal model of consumption spending). Here, we may take the relative GNP and therefore consumption that depends on it as parametric, and let $0 < c \equiv \frac{C}{C+C^*} < 1$ be the share of the domestic economy in global consumption, and correspondingly 1-c that of the foreign economy. In turn, global consumption is given by:

$$C + C^* = (1 - \tau)Y + (1 - \tau*)Y*$$

We thus have:

$$Exp = \frac{\left(\int_0^z \left(\frac{(1+\mu)\alpha_i W/B}{(\tau Y)^\beta P}\right)^{-\theta} di\right)}{\left(\int_z^1 \left(\frac{(1+\mu^*)\alpha_i^* W^*}{(\tau^* Y^*)^\beta P}\right)^{-\theta} di\right)} \bar{y} \qquad (24)$$

where

$$\bar{y} \equiv \frac{(1-c)[(1-\tau)y + (1-\tau*)(1-y)] + \tau^*(1-y)}{c[(1-\tau)y + (1-\tau*)(1-y)] + \tau y} \qquad (25)$$

is relative aggregate demand (F relative to H), and:

$$\frac{d\bar{y}}{d\tau} = -\frac{1-c}{\{c[(1-\tau)y + (1-\tau*)(1-y)] + \tau y\}^2} \qquad (26)$$

In deriving the effect of the domestic tax rate on relative aggregate demand, we assume that this rate can affect global consumption – both Home and Foreign in proportion to relative country size. Note that the sign is unambiguously negative.

The effect of the tax rate on *Exp* is:

$$\frac{dExp}{d\tau} = Exp\left\{-(\theta-1)\frac{dW}{d\tau}\frac{1}{W} + (\theta-1)\beta\left[\frac{dY}{d\tau}\frac{1}{Y} + \frac{1}{\tau}\right] + \frac{(P_z/P)^{1-\theta}}{\int_0^z (P_i/P)^{1-\theta}di}\frac{dz}{d\tau} + \frac{d\bar{y}}{d\tau}\frac{1}{\bar{y}}\right\}$$

Using (16'), (19), (22) and (26), we get:

$$\frac{dExp}{d\tau} = Exp\left\{\begin{bmatrix}-(\theta-1)\frac{1-\frac{Y_z}{A'(z)}}{1-\beta(\theta-1)-y} + \frac{\left(\frac{P_z}{P}\right)^{-\theta}}{y}\frac{1}{A'(z)}\end{bmatrix} \\ \begin{bmatrix}\frac{\gamma(1-\phi)}{1-\tau} - \frac{\beta}{\tau}\end{bmatrix} + \frac{d\bar{y}}{d\tau}\frac{1}{\bar{y}}\end{bmatrix}\right\} \qquad (27)$$

All terms in the curly brackets are proportional to $\frac{\gamma(1-\phi)}{1-\tau} - \frac{\beta}{\tau}$ except the final, positive, term. That term captures the effect of the domestic tax rate on relative demand in the two countries. If we were to ignore this effect, the same hum-shaped curve of *Exp* versus the tax rate would arise as the ones that characterise the extent of Home production and domestic output (cf.19 and 22). The new consideration here is the last term inside the curly brackets, which reflects the effect of the domestic tax rate on the relative global demand (negative, to show that Foreign demand falls and Home rises). This term causes a deviation in the *Exp*-tax rate graph from the other graphs, in the sense that the threshold tax rate at which d*Exp*/dτ changes sign is different than the one in the earlier graphs ($\bar{\tau}$).

The threshold tax rate in this case is:

$$\bar{\bar{\tau}} = \frac{\beta + \frac{\frac{d\bar{y}}{d\tau}\frac{1}{\bar{y}}}{(\theta-1)\frac{1-\frac{Y_z}{A'(z)}}{1-\beta(\theta-1)-y} - \frac{\left(\frac{P_z}{P}\right)^{-\theta}}{y}\frac{1}{A'(z)}}}{\beta + \gamma(1-\phi)} < \bar{\tau} \qquad (28)$$

Hence, the threshold tax rate is lower than the ones that maximise Home production or output, essentially because of the added effect of domestic taxation on domestic demand and therefore imports. We thus have:

Proposition 2: Determinants of relative export performance:

a) *For a sufficiently low tax rate (below the threshold specified in (b) below), relative export performance falls with trade union strength (γ), rises with trade union internalisation of the effects of its actions (φ, ϕ), and rises with productivity ($A'(z)$).*

b) *Institutionally-determined efficiency (β) increases the export ratio at least for a sufficiently low tax rate; but its effect on the threshold tax rate is not clear-cut.*

c) *The threshold tax here is lower than the threshold tax rate that maximises or Home production or output. This is because of the effects of taxation on Home and Foreign demand.*

3. Empirical results

Building upon the implications of the theoretical framework of Section 2, this Section's aim is to provide empirical estimates of the relationship between measures of the state sector, institutions and export performance. We begin by discussing the data, before proceeding to empirical specifications.

3.1 Basic data

The empirical analysis combines information from various data sources. Our panel covers 18 OECD countries for the period 1980-2005.[2] Export performance is measured as the share of country's exports to total world exports using data from UNCTAD. Our strategy is to augment a standard export regression (as e.g. in Carlin *et al.*, 2001) with variables that capture state size, institutions and other variables. The proxy for cost competitiveness is an index of Relative Unit Labour Costs (RULC). We use data from EUKLEMS Growth and Productivity Accounts, 2009 edition (www.euklems.net) on value added, labour compensation and number of employees to construct Unit Labour Costs relative to our sample (of 18 OECD countries), following Bournakis (2013); the rationale and methodology of this construction are briefly described in Appendix A. We control for technological complexity and product

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[2] We rely on different sources for the various data series; merging these data sources results in the 1980-2005 data period.

differentiation of exports using a measure of industry-funded R&D as a percentage of GDP taken from Science and Technology Indicators, OECD (2010 edition).

The government size variables are taken from the OECD. As a first proxy of government size, we use the total tax revenue as a share of GDP; we shall use both the variable itself and its quadratic to uncover any possible Barro (1990)-style hump curve of the type highlighted above. As social expenditure by the state does not only support productivity-enhancing public services but also transfer payments and other social types of expenditure, which may induce only the negative effects of taxation without any impact on productivity, any estimated positive effect of government size on exports may be interpreted as understating the true effect, and therefore being a low bound.   (It has been argued that purely social spending may improve competitiveness, see De Grauwe and Polan, 2005; and that a positive welfare state is optimal even in the face of globalisation, Molana and Montagna (2006); but in what follows we shall treat the pure social expenditures as non-productive.) But in order to investigate further the possibility that some government spending is not productive (but does entail taxation), we proceed in a dual way: Firstly, we also include separately the purely social spending from total spending (as a percentage of GDP) in order to have a measure of the (potentially) purely productive government spending. Secondly, we also consider other measures of state size, namely government spending, and government spending net of the purely social spending (all as percentages over GDP).

A number of other variables will be described as go along. Appendix B provides descriptive statistics for all the empirical variables, and graphs for competitiveness, export performance, taxation, and R&D.

3.2 *A benchmark specification*

We begin by specifying a benchmark econometric model that includes four key determinants of export performance as follows:

$$Exp_{c,t} = \alpha_0 + \alpha_1 RULC_{c,t} + \alpha_2 R\&D_{c,t} + \alpha_3 Tax_{c,t} + \alpha_4 (Tax)^2_{c,t} + \alpha_5 Soc_{c,t} + u_{c,t} \qquad (29)$$

Where, for each country c in our sample and at time t: $Exp_{c,t}$ stands for the export share relative to total exports of OECD countries; this closely corresponds to the theoretical variable of Section 2. $RULC_{c,t}$ indicates unit labour costs relative to OECD, one of the main determinants of export performance (see Section 1). $Tax_{c,t}$ is the share of total tax revenue

relative to GDP, a key variable from the perspective of the analysis of Section 2, and $SOC_{c,t}$ is the share of social expenditures to GDP, which are non-productivity-enhancing state expenditures. $R\&D_{c,t}$ stands for the share of private R&D in GDP.

The optimal (export performance maximising) tax share implied by the estimates is shown as $\hat{\tau}$ in Tables 1-4,wherever relevant; this is the empirical counterpart to $\bar{\bar{\tau}}$ in (28).In other words, the $\hat{\tau}$ shown in the Tables is the government size that maximises export performance implied by our estimates. It is related to the estimated coefficients as follows, taking the coefficients of (29) as an example; as the empirical variable Tax$\equiv$100*τ, the tax-GDP ratio that maximises export performance is seen by differentiation of (29) to be:

$$\hat{\tau} \equiv -\alpha_3 / (200 * \alpha_4)$$

Similarly, for the coefficients of the other equations and the estimates in the other Tables.

The estimates of (29) by pooled OLS are shown in the first column of Table 1. Then we control for heterogeneity across countries by augmenting (29) with fixed effects (country dummies) as well as controlling for common global macroeconomic shocks using year dummies (Table 1, column 2). The F-tests in the last rows of Table 1test for the joint statistical significance of the country and year dummies. The coefficients of common macroeconomic shocks show insignificant shifts over time. Column 3 presents a variant by dropping Soc. On the whole, the results from columns 1-3 of Table 1present a successful basic model of export performance along the lines of neoclassical and new trade theory, without the quadratic tax term. The estimated coefficient of RULC is negative confirming the reverse effect of cost performance on exporting activity. Private R&D as a share to GDP maintains consistently a positive and robust coefficient indicating that the ability of OECD countries to innovate and provide a differentiated product in international markets constitutes a crucial source of competitive edge. The significantly negative coefficient of social expenditure (SOC) is in line with the findings of Alesina and Perotti (1997). Finally, the level term of the tax share is positive and significant in column 2, something confirmed in the variant in column 3 where social expenditures are dropped.

Columns 4 to 5 then essentially replicate the above results with the introduction of the quadratic term of the tax share. While little changes in the other coefficients, the quadratic of the tax share is negative and significant, suggesting that the export-state size relationship can be more accurately described by a hump-shaped curve, along the lines explored in Section 2

and echoing Barro (1990). The tax share that maximises export performance implied by our estimates ($\hat{\tau}$) is of the order of 0.40, something that recurs rather consistently across all Tables and specifications. Interestingly, the size of the coefficients reveal that without controlling for the non-linear effect of taxation, RULC and R&D have almost an identical effect on export shares while when the quadratic term of tax share is included, the results suggest that OECD countries compete more on cost reduction rather than on innovation and R&D.

Column 6 adds a proxy related to trade unions, about which more in the next sub-Section. Furthermore, we check the robustness of the previous results using instead of tax share, a measure of productive government spending (G_{pr}) that excludes expenses on social security from Government final consumption. In other words, we replace (29) by:

$$Exp_{c,t} = \alpha_0 + \alpha_1 RULC_{c,t} + \alpha_2 R\&D_{c,t} + \alpha_3 (G^{pr})_{c,t} + \alpha_4 (G^{pr})^2_{c,t} + \alpha_5 Soc_{c,t} + u_{c,t} \tag{29'}$$

Where $G^{pr} \equiv G\text{-Tax}$, with G being total government spending (consumption) – all variables as shares of GDP. Results from the linear and the quadratic term of this variable are shown in column 7, while column8 presents a variant with linear terms from productive spending and social spending only. The new estimates are now somewhat less significant from previous estimates but the main message prevails, government spending has a non-linear impact on export performance; the implied optimal government size is now considerably less, around 015. But as the estimates are insignificant, we do not pursue this line of inquiry further.

[TABLE 1 ABOUT HERE]

3.3 *Export performance and institutional rigidities*

This part of the econometric specification seeks to investigate how 'institutions' affect export performance and through what channels. This is he empirical counterpart to the parameter β of Section 2, which controls for the effectiveness of the public services in the aggregate production function, and which was found in general to increase the home economy's production, capture of export markets and relative export performance (subject to some caveats summarised in Proposition 2). The first institutional feature to be considered is the share of trade union membership to total labour force (Union), for which continuous data exists (source: OECD). It is included in the column 4 of Table 1. The labour market and unemployment literature has long emphasised this variable for unemployment (see e.g.,

Nickell, 1997), but its relevance for export performance has not been highlighted. According to Section 2, and Proposition 2, this variable should have a negative effect on relative export performance; the date however does not confirm this, giving this variable a positive but insignificant coefficient.

We next turn attention to a number of other institutional features that capture market rigidity. The inefficiencies caused by rigidity are likely to be economy-wide but they affect disproportionally those sectors that are more exposed to international competition. Furthermore, such rigidities can affect decisions associated with R&D investment. R&D activity is the crucial element for the transformation to a knowledge-based economy whose competitive edge is not any more in cost reduction, but in innovation and product differentiation. This reasoning leads to the suggestion that the effect of such institutional rigidities on export performance may be felt via their effects on R&D. Thus, the institutional features that are described next will all be entered in a multiplicative way with R&D.[3]

A labour market-related institutional feature is Employment Protection Legislation, also highlighted in the unemployment literature. This is an index ranging from 0 (a fully liberal labour market without any protection) to 6 (full protection); it is denoted as *EPL*. It is a standard argument that economies with heavily protected labour markets are less mobile hindering the allocation of resources towards more dynamic and efficient units (Nickell, 1997). The key argument here is that resources wasted by heavy employment protection could have been used alternatively to fund R&D activity. However, the interaction term EPL×R&D in column 1 of Table 2 turns out to be positive and insignificant.

Recent studies in the literature of applied industrial organisation (Arnold *et al.*, 2008; Nicoletti and Scarpeta, 2003) have pointed out that rigid markets increase the cost of adjustment towards a long run steady state hurting in particular those industries that have the potential to excel in international markets. The second measure to be considered therefore is' barriers to entrepreneurship', essentially capturing administrative regulation that impacts negatively on economic performance; to be denoted as *Bar.Enter*.[4]Such regulation includes

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[3]These institutional indices are only reported for three years (1988, 2003, 2008); furthermore they change slowly over time, so that they are almost time invariant. As a result, we entered them only as country means; this means that they could only be entered multiplicatively (i.e., in order to avoid perfect multicollinearity with country dummies).

[4] All the institutional indices used in the empirics come from the OECD. They all range between 0 and 6, with values close to 6 indicating a very stringent market while values close to 0 mean a very market-friendly environment.

the existence of cartel practices in the market, the extent of bureaucratic procedures for setting up a new business or start-up costs, and poor legislation rules.[5]High barriers to entrepreneurship are associated with weak product market competition that lead once again to efficiency losses. The third index of institutional rigidities used is 'barriers to competition' (*Bar.Comp*). In theory, the nexus between monopolistic power and performance is not always straightforward. Monopolies usually experience economies of scale that allow reductions in the cost of production per unit, which benefits export involvement; nevertheless, monopolistic markets can always be a crucial source of slackness where dynamic efficiency and investment in R&D are not favoured. The institutional index used reflects distortions that exist in the market and prevent fair competition. According to this definition, barriers to competition capture the effect of non-contestable markets and the associated losses from the lack of competition. The last specification presented in Table 2 refers to 'barriers to FDI', denoted as *Bar.FDI*; this type of institutional rigidity represents impediments and obstacles that restrain inward FDI investment. Barriers to FDI can also be harmful to export performance mainly for two reasons. First, there is a long tradition in the FDI literature (De Mello, 1997, among many others) that highlights the role of foreign capital stock on technological expertise and knowledge spillovers. Therefore the presence of FDI is a conduit that enhances positive knowledge spillovers improving the recipient's economy overall productivity. Second, multinational enterprises can contribute to current account as they usually develop substantial export activity. In general, impediments to FDI can also harm national export activity.

With the institutional variables entering as interactive terms with R&D, the empirical specification takes the following form:

$$XS_{c,t} = \beta_0 + \beta_1 RULC_{c,t} + (\beta_2 + \theta Ins_c^h)R\&D_{c,t} + \beta_3 Tax_{c,t} + \beta_4 (Tax)^2_{c,t} + \beta_5 Soc_{c,t} + u_{c,t} \qquad (30)$$

Where Ins^h stands for the *h*-th institutional index: Ins^h, h=*EPL, Bar.Enter, Bar.Comp, Bar.FDI*. The interaction terms between each of these rigidities and R&D, shown in columns 2-4 of Table 2, are negative and significant, confirming the theoretical priors, and showing a strong role for these institutional features in shaping export performance. The higher is the degree of market rigidity (higher values for any of Ins^h), the lower is the private R&D share to GDP. Such a finding supports the view that chronic market distortions have a considerable adverse effect on dynamic efficiency, the effectiveness of R&D, and export performance.

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[5] We refer the reader to Nicoletti*et al.*(1999) for the exact definitions of these indices as well as their empirical construction. Table A1 displays mean values for the countries of our sample.

Throughout Table 2, on the other hand, the estimates of the other variables (RULC, Tax, Tax^2, Soc) are quite similar to the estimates in Table 1 and significant. In terms of the tax share, in particular, the non-linear role of government size is confirmed, as is the implied optimal government size (on the high side of the 0.40 benchmark uncovered earlier).

[TABLE 2 ABOUT HERE]

3.4 *Robustness checks – Endogeneity Bias*

The results presented in Tables 1 and 2 are estimates from OLS with the inclusion of country fixed effects. OLS can provide consistent and unbiased estimates only if the exogeneity assumption holds: $\mathrm{E}\left(u_{c,t} \mid \mathrm{X}_{c,t}\right) = 0$, where E is the expectations operator and X is a vector of independent regressors. Admittedly, the above assumption is strong and not always admissible with empirical data, as the causality of the exports-RULC nexus is not always very clear. For example, export expansion is likely to increase profitability, making workers to request higher wages leading thus to higher labour compensation and RULC.[6]Hence, the contemporaneous specification might be subject to feedback effects and thus one needs to disentangle the causality issues between exports shares and RULC. We follow two strategies for controlling endogeneity bias between export shares and RULC. The first approach is to consider all right-hand-side variables in (29) as predetermined, satisfying the assumption of weak exogeneity. This refinement is represented by lagging all regressors by one year. In such a case, the OLS can still provide consistent results. Nonetheless, this modification does not preclude the possibility that current export shares might cause feedback effects to future values of RULC, $\mathrm{E}\left(u_{c,t} \mid RULC_{c,t+1}\right) \neq 0$. The most compelling way to ensure strict exogeneity is to use an Instrumental Variable (IV) estimator. This is our second and most preferable approach for addressing the possible endogeneity bias. The most crucial issue in IV estimation is the identification of valid instruments. In our context, RULC is a variable that measures cost performances taking into account only labour, while there are many other factors that drive costs. We argue that capital assets and energy materials are only indirectly related to export shares while they clearly impact on labour costs. For example, the degree of substitutability between labour, capital and energy services is strongly associated with the cost per unit of labour. Therefore, we use the contemporaneous and the one-year lagged

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[6]If so, the relation would be positive, not the negative one shown by the estimated parameters. But the key thing is, there is potentially reverse causality between the two variables.

values of Gross Fixed Capital Formation (GFCF) and energy resources as instruments for RULC;[7]these should correlated with the endogenous variable while being uncorrelated with the error term, making them valid instruments.

Table 3reports results with IV of the benchmark specification as well as the specifications with the indices of institutional rigidities. We also show results from predetermined regressors lagging right-hand side covariates by one year. The statistics reported at the bottom of the Table are for exogeneity(Davidson-MacKinnon) and instrument identification (Sargan-Hansen), respectively. As per the null hypothesis of the Davidson-MacKinnon test, endogeneity bias among the regressors is not deleterious and thus OLS can provide consistent estimates. The probability values in all specifications indicate a clear rejection of the null except one. Overall, the Davidson-MacKinnon test provides enough evidence for the use of an IV estimator. The Sargan-Hansen statistic is a test of over-identifying restrictions referring essentially to the validity of instruments. The test follows the Chi-squared distribution with L-K degree of freedom, where L is the number of excluded instruments in the original equation and K is the number of regressors. The null hypothesis of the Sargan-Hansen test specifies that the instruments used should be uncorrelated with the error term and thus valid. On the whole, our instruments pass the identification test. The estimates in Table 3 show only minor changes in comparison with the OLS estimates of Table 2. Assuming weak exogeneity between RULC and export shares affects only the significance of the R&D coefficient. In the IV estimation, there are two changes compared to the OLS results, RULC and R&D are both insignificant. The pattern of the remaining variables is unchanged. In particular, the estimations with the interacted institutional variables are consistent with the results of Table 2. The tax share estimates (of the linear and quadratic terms) are of the same signs and significant, and imply once again an optimal tax share of 0.40 (perhaps somewhat higher, and with more variability across specifications). Taken as a whole, the existence of endogeneity seems to affect only the statistical significance of RULC and R&D, while the effects of institutional rigidities and state size on export shares remain robust.

[TABLE 3 ABOUT HERE]

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[7] Both GFCF and energy are expressed as shares to GDP, energy resources are calculated as kilotonnes of oil-equivalent. Data are taken by the World Bank Development Indicators database.

3.5 *Robustness checks- Dynamic specifications*

Specifications (29), (29') and (30) represent a static long-run equilibrium relation between export share and the various export determinants. The dependent variable in all cases is export share which is by definition bounded between 0 and 1 and thus it is considered as an I(0) variable. Nevertheless, estimates from the static specification in Table 1 have shown that coefficients of country dummies are statistically significant raising implicitly an issue of econometric specification. The significance of country fixed effects suggests that country differences do exist and are persistent. Countries may also differ in the speed of adjustment towards the long-run equilibrium, something not allowed by the static models described so far. A dynamic model is called for in order to capture thedynamic adjustment towards the steady state and to investigate country differences in this respect.

To this end, (29) is augmented to:

$$Exp_{c,t} = \gamma_0 Exp_{c,t-1} + \gamma_1 RULC_{c,t} + \gamma_2 R\&D_{c,t} + \gamma_3 Tax_{c,t} + \gamma_4 (Tax)^2_{c,t} + \gamma_5 Soc_{c,t} + u_{c,t} \qquad (31)$$

The parameter $(1-\gamma_0)$ represents the speed of adjustment. An equivalent Error Correction Model (ECM) is represented as follows:

$$\Delta Exp_{c,t} = \gamma_0 (Exp^*_{c,t-1} - Exp_{c,t-1}) + \gamma_j \Delta Z^j_{c,t} + u_{c,t} \qquad (32)$$

Where the superscripted * indicates the equilibrium value of the export share from (31). For the ease of exposition in (31), we aggregate all export shares determinants in the vector Z. This structure also allows us to identify those factors driving the speed of long run adjustment. Given the negative impact of institutional rigidities found in Tables 2 and 3, we examine specifically whether labour market rigidities can affect the speed of adjustment. The degree of flexibility in the labour market is the most crucial determinant of how quickly the labour force can move from declining to expanding sectors contributing to a fast and efficient reallocation of the resources. The level of productive efficiency in the aggregate economy is also correlated with its export capacity. A similar logic applies to other institutional indices and their associated effect on the speed of long run adjustment. Exporting is burdened with additional sunk costs and various foreign market uncertainties requiring from suppliers substantial financial adequacy. To the extent that rigidities increase costs unnecessarily, export activity is likely to be constrained due to lack of financial viability. We capture how the presence of institutional rigidities affect export shares in a dynamic context by interacting lagged export shares with the institutional indices. The empirical counterpart of the ECM is now written as:

$$Exp_{c,t} = \tilde{\gamma}_0 Exp_{c,t-1} + \gamma_1 RULC_{c,t} + \gamma_2 R\&D_{c,t} + \gamma_3 Tax_{c,t} + \gamma_4 (Tax)_{c,t}^2 + \gamma_5 Soc_{c,t} + u_{c,t} \qquad (33)$$

The coefficient of adjustment $\tilde{\gamma}_0$ now represents the lagged dependent variable plus the lag dependent variable interacted with an institutional index h:

$$\tilde{\gamma}_0 = \gamma_0 Exp_{c,t-1} + \delta Exp_{c,t-1} \times Ins_c^h$$

Where the institutional features now are a slightly different set: Ins^h, h=*EPL, Bar.Enter, PMR*, where PMR is an index of product market regulation (measured in a similar fashion as the others, from 0 – least regulated - to 6 – most restrictively regulated; source: OECD). A positive estimate of parameter δ would be evidence that countries with high degree of institutional inflexibility in a particular aspect of economic activity adjust more slowly to long run equilibrium. As before, the institutional indices are calculated at their mean values for each country.[8]The presence of a lagged dependent variable in the right hand-side of (32) implies that a fixed effects estimator will be biased. According to Nickell (1981), the size of the bias depends on panel dimensionality. More precisely, the degree of bias is decreasing in the number of years, so for a sufficient number of years the potential bias converges to zero. In such a case, a fixed effects estimator can provide consistent and unbiased results. In our data set the number of years is approximately 25 and greater than the number of countries (18) (i.e. T>N) and thus model (32) can be estimated using a standard fixed effects routine.

Results from the dynamic specification (33) are shown in Table 4. The long-run version of the estimated coefficients is obtained by the transformation $\gamma_j/(1-\gamma_0)$. These long-run coefficients are shown in Table 5. Comparing these coefficients with the static ones reported in Table 1, there are only minor differences. Coefficients of RULC, R&D share and Soc are very close; the only substantial difference is in the coefficients of the tax share terms are now insignificant. However, the non-linear structure is still present; the implied optimal (export share maximising) tax shares are now lower, a little higher than 030.

[TABLES 4 AND 5 ABOUT HERE]

Another interesting remark from the dynamic estimates is that not all institutional variables play the same role in the convergence process towards the long-run equilibrium. In the first column of Table 4, the interacted term of lagged export share with employment protection

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[8]Due to the fact that these variables change very slowly over time, we prefer taking the sample mean.

(EPL) is insignificant while chronic rigidities in entrepreneurship(Bar.Enter) and product market regulation (PMR) are shown to significantly decelerate the speed of adjustment. These results reveal a new message which is not highlighted in the literature so far. Nickell *et al*. (2008) have found that strong protectionism in the labour market slows down the speed of dynamic adjustment preventing a fast reallocation of resources. According to the findings of the present study (see Tables 2 and 4) the story is slightly different. A high degree of protection in the labour market is not very costly and its negative impact on the reallocation of resources is only minor. From the present analysis, it becomes apparent that there are other institutional rigidities more damaging for a country's international competitiveness. This finding has a critical policy implication: Countries that seek to increase export market shares should implement reforms that eliminate barriers to competition and other chronic bureaucratic procedures rather than attempting labour market liberalising policies.

5. Conclusions

This paper investigates the role of government size and labour and product market 'institutions' in determining export performance of OECD economies. We read the current state of the literature on empirical export performance as suggesting that unit labour costs, as a measure of competitiveness, is quite important but do leave room for improvement in the explanation of export shares, a view exemplified by Carlin *et al.* (2001). In addition to the 'deep' structural/institutional characteristics suggested in that paper as further determinants, we argue that there are good grounds to argue that government size may also play an important explanatory role. Following the reasoning of Barro (1990), the role of this variable is likely to be non-linear. Thus, our main contribution is to investigate the (possibly non-linear) role of government size and various institutional features in shaping export performance, in addition to the (maintained) role of unit labour costs and competitiveness. To this end, we first present a theoretical model of export performance, whose role is to formalise and sharpen these insights. The model, a variant of Dornbusch, Fischer and Samuelson (1997) with monopolistic competition, also includes a role for government, trade unions, and other labour market institutional features. Indeed, both sets of variables, government size and institutions, are shown to be relevant, the former in a Barro (1990)-type non-linear way.

We then proceed to estimation. Our results may be summarised as follows. Among the variables traditionally emphasised as determinants of international export shares, relative unit labour costs (RULC above) and the share of R&D expenditures in GDP (R&D) continue to play a significant role in the expected way. Our contribution is that we uncover a significant role for government in shaping export performance: The empirical estimates of the coefficients of the share of taxes in GDP, as a measure of the size of government and public services (Tax) and its quadratic term verify the pattern suggested by the previous theoretical arguments in a consistent fashion. The tax share is almost everywhere significant, revealing a non-linear effect on export shares that implies an export-maximising tax share of the order of 40%. The institutional features we consider include measures of labour market rigidity (strength of trade unionism and employment protection) and product market rigidity (barriers to entrepreneurship, competition, FDI and a measure of product market regulation). The labour market rigidities are on the insignificant, but the first three of three of the four product market rigidities mentioned above play a significantly negative role in shaping exports, mainly via a negative effect on the effectiveness of R&D (as revealed by a significant multiplicative term between these institutional indices and R&D). Quite independently of the tax share, social expenditure, which is entirely non-productive in nature, maintains a robust negative sign clearly establishing a negative role of the welfare state regarding export performance. This result parallels those of Alesina and Perotti (1997): The obvious interpretation is that the funds for implementing a welfare policy are derived from taxation, causing a loss of efficiency and harming competitiveness. A policy corollary is that social policies should rely as much as possible on the provision of incentives rather than on direct financial aid.

To sum up, the paper contributes to the current applied international trade literature by examining export performance within a framework that considers factors other than those found in standard trade theory, namely government size and institutions. Our results show that a public sector of a substantial size, around the 40% benchmark, is necessary to guarantee that economic activity occurs within a well functioning institutional environment. Nevertheless, as the public sector exceeds a certain optimal size then the state obtains a distortionary character affecting negatively the economy's international competitiveness. This is mainly due to the need for a higher taxation. Additionally, various institutional features are important, but not always those that the literature or public discourse suggests: Labour market rigidities did not show up significantly; only product market rigidities appear

to be significant. In all, these results recommend that countries should pursue export-promotion based on the dual strategy of productive public services and a dynamic product market.

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Dependent variable: $Exp_{c,t}$

VARIABLES	1	2	3	4	5	6	7	8
RULC	-0.058***	-0.039***	-0.048***	-0.039***	-0.044***	-0.039***	-0.052***	-0.048***
	[4.25]	[6.13]	[8.05]	[6.09]	[7.46]	[6.16]	[6.52]	[5.40]
R&D	0.039***	0.002	0.001	0.004***	0.004***	0.004***	0.001***	0.002
	[10.67]	[1.37]	[1.16]	[2.41]	[2.73]	[2.25]	[2.64]	[1.22]
Tax	-0.003***	0.001***	0.0004***	0.0029***	0.0035***	0.003***		
	[5.98]	[3.78]	[2.35]	[5.17]	[6.28]	[5.15]		
$(Tax)^2$				-337×10^{-5}***	-449×10^{-5}***	-338×10^{-5}***		
				[4.56]	[6.18]	[4.55]		
G^{pr}							0.001*	0.0011
							[1.83]	[0.31]
$(G^{pr})^2$								-383×10^{-5}
								[0.25]
Implied $\hat{\tau}$	N/A	N/A	N/A	0.43	0.39	0.43	N/A	0.15
Soc	0.002***	-0.001***		-0.0004***		-0.0004***	-0.001***	
	[3.27]	[5.57]		[3.86]		[3.75]	[6.05]	
Union						0.00001		
						[0.28]		
Country Dummies	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	438	438	438	438	438	438	438	438
R-squared	0.37	0.99	0.99	0.99	0.99	0.98	0.99	0.99
F(24, 392)		1.10	1.0.8	1.32	1.22	0.72	0.34	1.06
Prob>F		(0.33)	(0.33)	(0.14)	(0.14)	(0.83)	(0.99)	(0.39)
F(17, 392)		1916.03***	918.20***	1498.10***	1090.31***		648.97***	912.03***
Prob>F		(0.00)	(0.00)	(0.00)	(0.00)		(0.00)	(0.00)

Notes: Numbers in brackets below coefficients refer to absolute t-statistics. Asterisks denote significance as follows, *** at 1%, ** at 5%. In all specifications, the dependent variable is the share of exports of country *i* to total OECD exports. The estimator used in all specifications is OLS with country and year dummies where specified. The first F-statistic refers to the joint significance of year dummies and the second refers to the joint significance of country dummies. All estimates are consistent for cluster robust standard errors at the country level. $\hat{\tau}$ is the optimal (export performance maximising) tax share implied by the estimated coefficients.

Table 2: Export performance among OECD countries: institutional rigidities and R&D.
Dependent variable: $Exp_{c,t}$

VARIABLES	1	2	3	4
RULC	-0.040***	-0.043***	-0.038***	-0.048***
	[5.981]	[6.417]	[6.071]	[7.215]
R&D	-0.01	0.043***	0.028***	0.031***
	[1.253]	[5.197]	[3.501]	[5.372]
R&D ×EPL	0.005			
	[1.235]			
R&D ×Bar.Enter		-0.020***		
		[5.101]		
R&D ×Bar.Comp			-0.014**	
			[3.286]	
R&D ×Bar.FDI				-0.022***
				[5.700]
Tax	0.00159***	0.00192***	0.00184***	0.00212***
	[3.474]	[4.311]	[4.279]	[4.808]
$(Tax)^2$	-188×10^{-5}**	-225×10^{-5}***	-212×10^{-5}***	-254×10^{-5}***
	[3.120]	[3.685]	[3.464]	[4.124]
Implied $\hat{\tau}$	0.42	0.43	0.43	0.41
Soc	-0.001***	-0.001***	-0.000***	-0.000***
	[5.398]	[5.616]	[4.840]	[4.490]
Country Dummies	No	Yes	Yes	Yes
Year Dummies	No	No	No	No
Observations	438	438	438	438
R-squared	0.99	0.99	0.99	0.99
F(23, 114)	1180.73	1534.47	1391.41	1724.22
Prob>F	0.00	0.00	0.00	0.00

Notes: Numbers in brackets below coefficients refer to absolute t-statistics. Asterisks denote significance as follows, *** at 1%, ** at 5%. In all specifications the dependent variable is the share of exports of country *i* to total OECD exports. The estimator used in all specifications is OLS with country dummies. The reported estimates represent semi-elasticities calculated at the sample mean of each variable. The F-statistic refers to the joint significance of country dummies. All estimates presents are consistent for robust heteroscedastic standard errors.$\hat{\tau}$is the optimal (export performance maximising) tax share implied by the estimated coefficients.

Table 3: Exports in OECD: IV Estimation. Dependent variable: $Exp_{c,t}$

VARIABLES	1	2	3	4	5	6	7
	OLS	IV	IV	IV	IV	IV	IV
RULC(t-1)	-0.035***						
	[5.349]						
R&D(t-1)	0.001						
	[0.681]						
Tax(t-1)	0.00202***						
	[4.615]						
$(Tax)^2$(t-1)	-0.0000253***						
	[4.204]						
Soc. Expend(t-1)	-0.001***						
	[5.328]						
RULC		0.003	0.002	-0.014	-0.031*	0.001	-0.022
		[0.173]	[0.125]	[0.776]	[1.84]	[0.053]	[1.125]
R&D		-0.001	-0.006	0.046***	0.048***	0.030***	0.029***
		[0.428]	[1.168]	[5.265]	[5.590]	[3.891]	[4.705]
R&D ×EPL			0.003				
			[1.090]				
R&D ×Bar.Enter				-0.021***	-0.022***		
				[5.422]	[5.840]		
R&D ×Bar.Comp						-0.014***	
						[4.073]	
R&D ×Bar.FDI							-0.020***
							[4.934]
Tax		0.00207**	0.00202**	0.00218***	0.00277***	0.00225**	0.00233***
		[2.795]	[2.726]	[3.142]	[3.870]	[3.098]	[3.394]
$(Tax)^2$		-0.0000211*	-0.0000208*	-0.0000237*	-0.0000372**	-0.0000234*	-0.0000262**
		[2.031]	[2.008]	[2.424]	[3.820]	[2.307]	[2.704]
Implied $\hat{\tau}$	0.40	0.49	0.49	0.46	0.37	0.48	0.45
Soc		-0.001***	-0.001***	-0.001***		-0.001***	-0.001***
		[5.113]	[5.110]	[4.586]		[4.277]	[3.621]
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	No	No	No	No	No	No	No
Observations	421	421	421	421	421	421	421
R-squared	0.986	0.11	0.12	0.23	0.20	0.16	0.23
Wald Test		27264 (0.00)	27379.46 (0.00)	30989.90 (0.00)	30242.36 (0.00)	28672.20 (0.00)	31525.55 (0.00)
Davidson-MacKinnon		6.23 (0.01)	5.99 (0.01)	2.65 (0.10)	1.07 (0.30)	5.10 (0.02)	1.78 (0.18)
Sargan-Hansen		3.806 (0.28)	4.170 (0.24)	2.145 (0.54)	11.480 (0.01)	7.52 (0.05)	3.82 (0.28)

Notes: In all specifications the dependent variable is the share of exports of country*i* to total OECD

exports. Numbers in brackets below coefficients refer to absolute t-statistics. Asterisks denote significance as follows, *** at 1%, ** at 5%. The endogenous variable in IV estimations is RULC and the instruments used are $GFCF_t$, $GFCF_{t-1}$, ENE_t and ENE_{t-1} where GFCF is the share of gross fixed capital formation to GDP and ENE is the energy of oil equivalent per capita. Wald test refers to whether the regressors included are jointly statically significant. Davidson-MacKinnon statistic tests the exogeneity assumption and under the null hypothesis it is distributed with F(m, N-K), where m is the number of potentially endogenous variables. The Sargan-Hansen statistic tests the orthogonality condition for a panel and under the null hypothesis the test follows the Chi-squared distribution, see the text for more details. Numbers in parentheses refer to p-values of diagnostic tests. All estimates presented are calculated for robust heteroscedastic standard errors. $\hat{\tau}$ is the optimal (export performance maximising) tax share implied by the estimated coefficients.

Table 4: Export performance among OECD countries: dynamics and institutions.
Dependent variable: $Exp_{c,t}$

VARIABLES	1	2	3
Exp_{t-1}	0.783***	0.537***	0.624***
	[12.61]	[4.54]	[8.30]
$Exp_{t-1} \times EPL$	0.019		
	[0.70]		
$Exp_{t-1} \times$ Bar.Enter		0.114*	
		[2.35]	
$Exp_{t-1} \times PMR$			0.101
			[2.08]
RULC	-0.007**	-0.008**	-0.007**
	[3.31]	[3.04]	[3.31]
R&D	0.001	0.001	0.001
	[0.61]	[0.79]	[0.61]
Tax	0.00060	0.00055	0.00052
	[1.09]	[1.13]	[1.09]
$(Tax)^2$	-937×10^{-6}	-861×10^{-6}	-816×10^{-6}
	[1.23]	[1.33]	[1.23]
Implied $\hat{\tau}$	0.32	0.32	0.32
Soc	-0.0001	-0.0001	-0.0001
	[1.11]	[1.08]	[1.11]
Year Fixed Effects	No	No	No
Country Fixed Effects	Yes	Yes	Yes
Observations	420	420	420
R-squared	0.716	0.718	0.717

Notes: Numbers in brackets below coefficients refer to absolute t-statistics. Asterisks denote significance as follows, *** 1%, **5%. The estimation technique is a within fixed effects estimators. All estimates presented are calculated for robust heteroscedastic standarderrors.$\hat{\tau}$is the optimal (export performance maximising) tax share implied by the estimated coefficients.

Table 5: Implied long-run estimates for export share determinants (source: Table 4)

RULC, $\left(\dfrac{\gamma_1}{1-\gamma_0}\right)$	0.043	0.020	0.025
R&D, $\left(\dfrac{\gamma_2}{1-\gamma_0}\right)$	0.017	0.008	0.010
Tax, $\left(\dfrac{\gamma_3}{1-\gamma_0}\right)$	0.0087	0.0041	0.0050
Soc, $\left(\dfrac{\gamma_4}{1-\gamma_0}\right)$	0.039	0.018	0.023

Note: The three columns of this Table draw on the estimated coefficients shown in the corresponding three columns of Table 4.

Appendices

Appendix A: Methodology of construction of RULC

RULC has been constructed as in Bournakis (2013), as follows: Unit Labour Cost(ULC)combines information on (a) cost per unit of labour input and (b) an index of labour productivity. For country c at time t, we define *ULC* as follows (without subscripts):

$$ULC = \frac{W}{Y/N} \qquad \text{(A1)}$$

W represents wages per worker measured as labour compensation per working hour while the lower ratio (Y/N) indicates labour productivity defined as value added per hour worked.[9]RULCaim to reflect cost competiveness in country *c* relative to cost in other countries of the sample. For that purpose, we weight ULC by the arithmetic mean of *ULC* in all countries of the sample (denoted by an overbar):

$$RULC_{c,t} = \frac{ULC_{c,t}}{\overline{ULC_t}} \qquad \text{(A2)}$$

For comparisons to be meaningful across countries, values in (A2) must be expressed in a common currency. We use Purchasing Power Parity (ppp)-exchange rate to express all values in constant 2000 USD; additionally, the mean unit labour cost is computed as:

$$\overline{ULC_t} = \frac{\dfrac{1}{c-1}\sum_{c=18} W}{\dfrac{1}{c-1}\sum_{c=18}(Y/N)} \qquad \text{(A3)}$$

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[9] The difference between *H* and *N* is that the former refers to total number of hours including self-employed while *N* refers only to total hours worked by employees.

Appendix B: Summary statistics and graphs

Table B1: Summary Statistics

| Variable	Obs	Mean	Std. Dev.	Min	Max
Export share	438	5.71	5.61	0.27	21.99
RULC	450	1.00	0.18	0.74	1.69
Tax share	450	35.70	8.40	15.65	52.26
Social Expenditure share	450	20.98	6.28	3.00	36.20
Private R&D share	450	1.01	0.63	0.03	2.96
EPL	450	2.14	0.91	0.21	3.63
Barriers to Entrepreneurship	450	2.25	0.45	1.45	3.05
Barriers to Competition	450	2.41	0.52	1.72	3.22
Barriers to FDI	450	1.59	0.74	0.09	2.92

TableB2: Indices of Institutional Rigidities, Mean Values (1985-2008) (OECD)

Country	EPL	Barriers to Entrepreneurship	Barriers to Competition	Barriers to FDI
Australia	1.11	1.56	2.20	1.72
Austria	2.12	2.19	3.22	2.14
Belgium	2.53	2.33	2.31	1.20
Denmark	1.74	1.82	2.77	1.23
Spain	3.16	2.39	2.03	1.61
Finland	2.09	2.41	1.94	1.70
France	3.01	3.05	3.06	2.83
Germany	2.55	2.31	1.91	0.09
Greece	3.26	2.68	3.16	2.34
Ireland	0.99	1.60	1.72	1.20
Italy	2.69	2.74	2.95	2.92
Japan	1.59	2.97	3.01	1.85
Korea	2.32	2.73	2.24	2.35
Netherlands	2.40	2.05	1.92	1.06
Portugal	3.63	2.15	2.36	1.43
Sweden	2.47	2.11	1.89	1.45
UK	0.66	1.45	1.73	0.24
USA	0.21	2.02	2.94	1.18
Total	2.14	2.25	2.41	1.59

Notes: EPL refers to Employment Protection Legislation. All these indices are from the OECD; their values range from 0 to 6. Values close to zero indicate a market that is less stringent while values closer to the upper bound indicate a restrictive market.

Figure 1 illustrates time trends of export shares and tax shares for our sample. A remark that can be made from Figure 1 is that export shares have a high degree of persistence while tax shares are stable indicating mainly the pro-cyclical nature of tax revenue. Interestingly, one can state that tax revenue follows an upward trend in the majority of countries with Scandinavia countries (Sweden, Finland, and Denmark) to have the highest share.
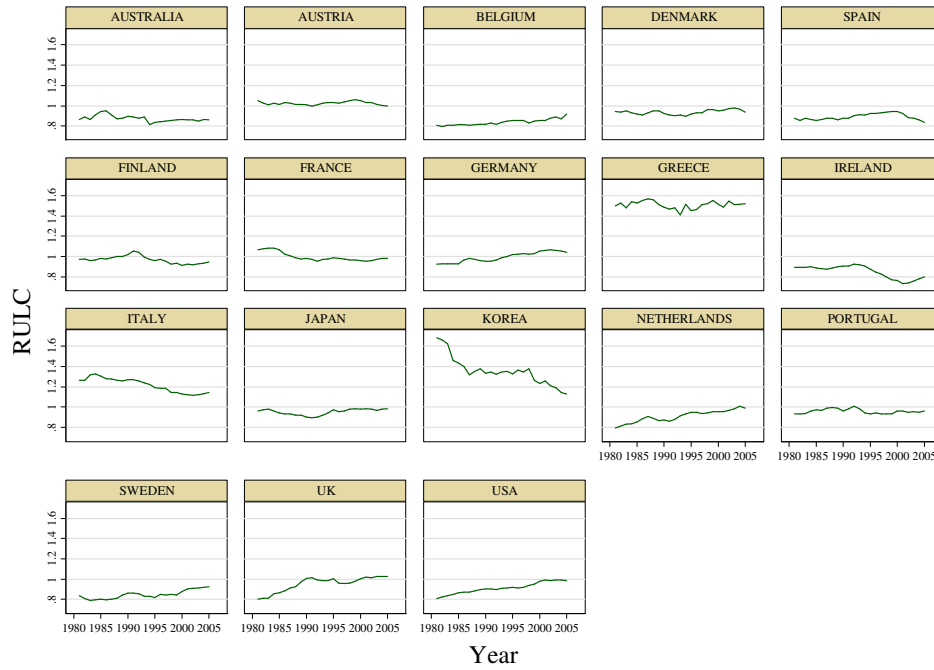
Figure B1: Export share of 18 OECD Countries
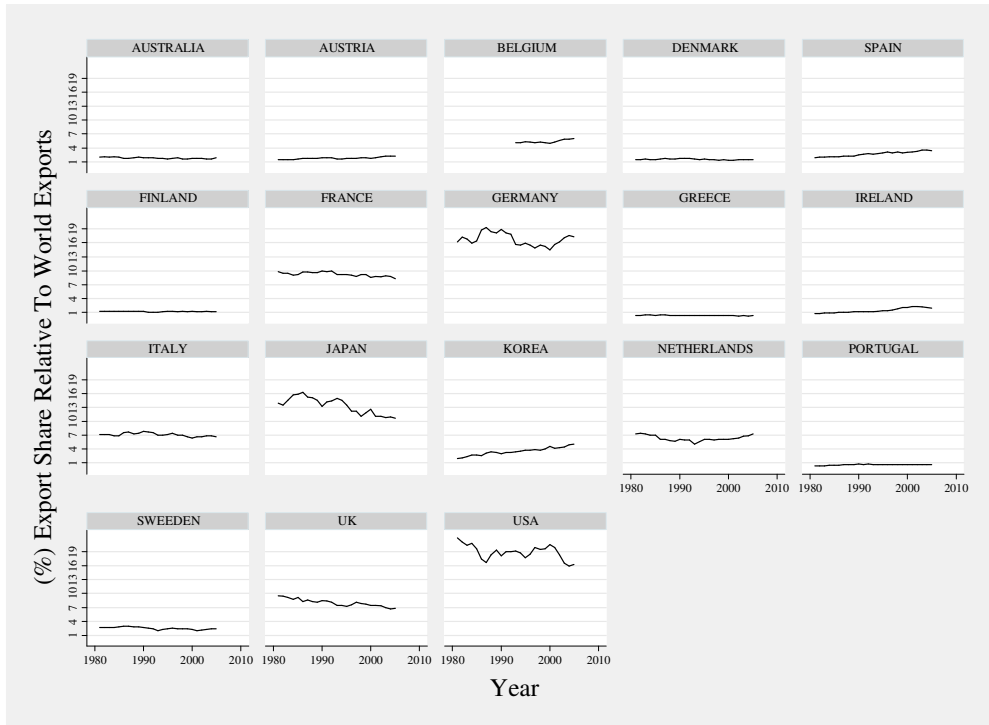
Notes: Country exports as a percentage of world exports
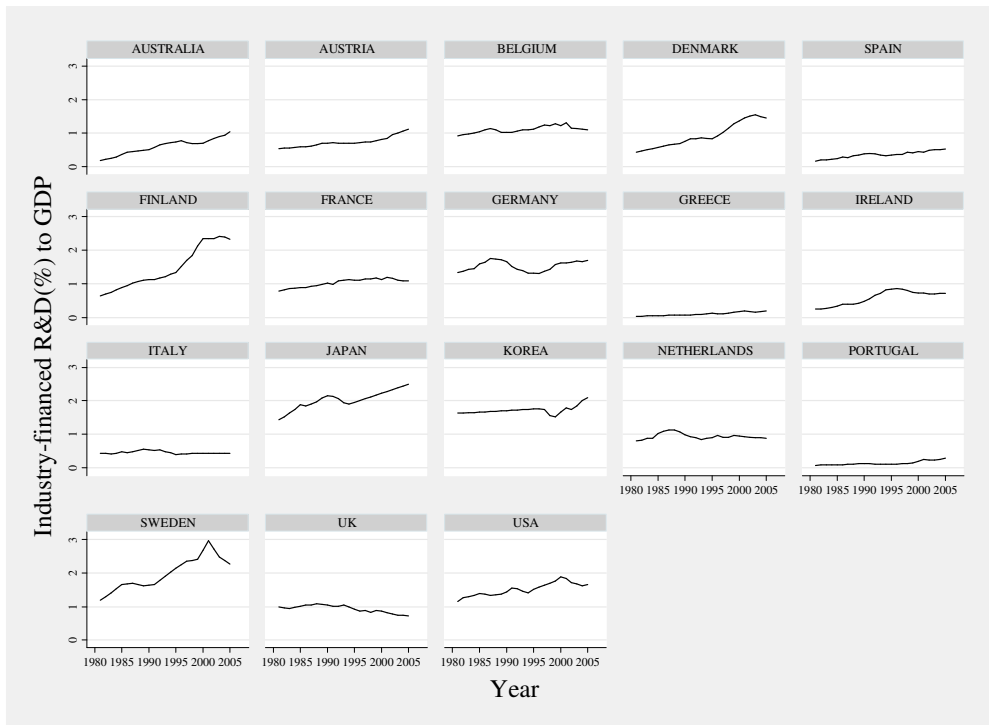
Figure B2: Tax shares of 18 OECD Countries
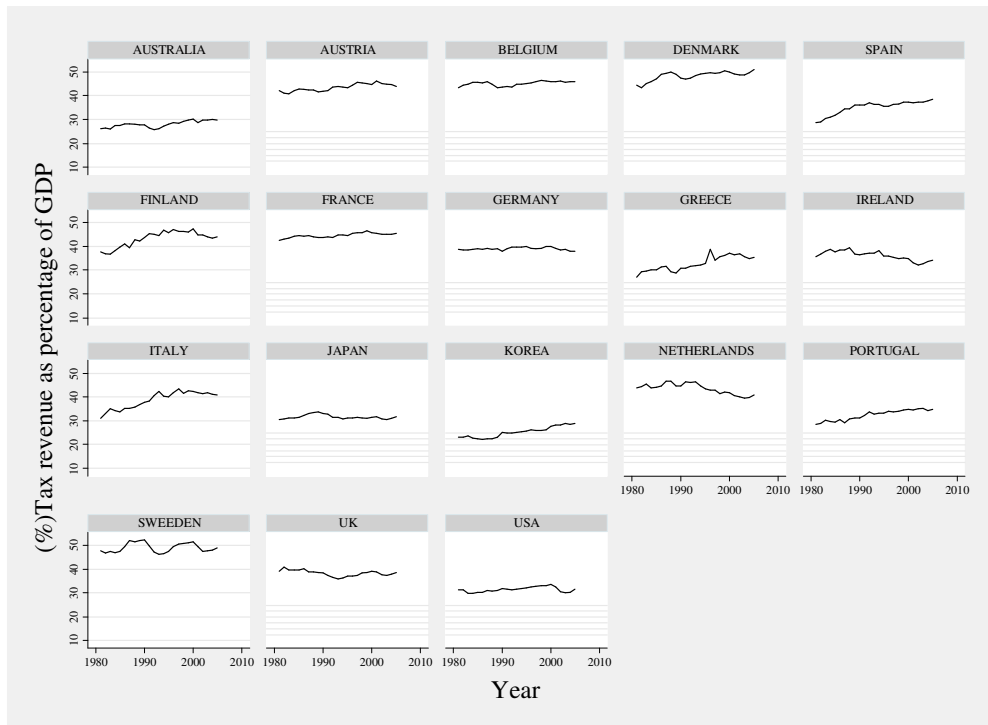
Notes: Total tax receipts as a percentage over GDP

Figure B3: Relative Unit Labour Costs (RULC)

Note: The methodology of construction is reviewed in Appendix A.

Figure B4: R&D Expenditure (%) to GDP in 18 OECD Countries

Appendix C: Notes (NOT for publication):

1. Using the pricing rule above and the definition of the aggregate (global) price level, we have:

$$P = \left(\int_0^z ((1+\mu)\alpha_i W/B)^{1-\theta} di + \int_z^1 ((1+\mu^*)\alpha_i^* W^*/B^*)^{1-\theta} di \right)^{1/(1-\theta)}$$

2. On deriving (14) – inserting (13a) into (12) gives:

$$1 - \tau = \left[\theta \frac{P}{W} + \varphi \right] \left(\frac{W}{P}(1-\tau) - R \right)$$

Or

$$1 - \tau = \theta(1-\tau) - \theta R \frac{P}{W} + \varphi \left(\frac{W}{P}(1-\tau) - R \right)$$

3. On (15): Differentiating (14) with respect to τ:

$$\frac{d \frac{W^{Union}}{P}}{d\tau} \left[1 + \frac{W^{Union}}{P} \frac{\varphi(1-\tau)}{(\theta-1)(1-\tau) + \varphi \left(\frac{W^{Union}}{P}(1-\tau) - R \right)} \right] =$$

$$= \frac{W^{Union}}{P} \frac{\theta - 1 + \varphi \frac{W^{Union}}{P}}{(\theta-1)(1-\tau) + \varphi \left(\frac{W^{Union}}{P}(1-\tau) - R \right)}$$

From this, we get (15) immediately.

4. On the derivation of (22). Differentiating (21) w.r.t. the tax rate, we have:

$$\frac{dY}{d\tau} = \beta\theta \frac{dY}{d\tau} + y \frac{dY}{d\tau} + \frac{\theta dW}{d\tau} + Y_z \frac{dz}{d\tau}$$

Re-arranging, we get:

$$\frac{dY}{d\tau} = \frac{1}{1 - \beta\theta - y} \left\{ \frac{\theta\beta}{\tau} - \frac{\theta\gamma(1-\phi)}{1-\tau} + Y_z \frac{dz}{d\tau} \right\}$$

Inserting (19), we get (22).

5. NOTE: FOR THE definition of $\bar{y}$ in (25): The *ExpRat* is proportional to:

$$\frac{C^* + \tau^* Y^*}{C + \tau Y} = \frac{(1 - c)(C + C^*) + \tau^* Y^*}{c(C + C^*) + \tau Y} = \frac{(1 - c)[(1 - \tau)Y + (1 - \tau *)Y *] + \tau^* Y *}{c[Y + (1 - \tau *)Y *] + \tau Y}$$

From here, the definition follows if we divide both numerator and denominator by Y+Y*.

6. Note for (26): Note an intermediate expression:

$$\frac{d\bar{y}}{d\tau} = -\frac{(1 - c)y[\bar{y} + 1]}{c[(1 - \tau)y + (1 - \tau *)(1 - y)] + \tau y}$$

7. NOTE: INTERMEDIATE EXPRESSION in the derivation of (27):

$$\frac{dExpRat}{d\tau}$$

$$= ExpRat \left\{ \left[-(\theta - 1) - (\theta - 1)\beta \frac{\theta - 1 - \frac{Y_z}{A'(z)}}{1 - \beta(\theta - 1) - y} \right. \right.$$

$$\left. \left. + \frac{(P_z/P)^{-\theta}}{\int_0^z (P_i/P)^{-\theta} di} \frac{1}{A'(z)} \right] \left[\frac{\gamma(1 - \phi)}{1 - \tau} - \frac{\beta}{\tau} \right] + \frac{d\bar{y}}{d\tau} \frac{1}{\bar{y}} \right\}$$

Note that under (19), we have $\int_0^z (P_i/P)^{1-\theta} di = y$.

8. For completeness, the foreign counterpart to output (21) is given by:

$$Y^* = \int_z^1 Y_i di = \left(\int_z^1 \left(\frac{(1 + \mu^*)\alpha_i^* W^*}{(\tau^* Y^*)^\beta P} \right)^{-\theta} di \right) (Y + Y^*)$$