

# CREA Discussion Paper 2012-15

Center for Research in Economic Analysis  
University of Luxembourg

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December, 2012

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# Commodity taxation and regulatory competition

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September 27, 2012

## Abstract

This paper studies competition in regulation and commodity taxation between trading countries. We present a general equilibrium model in which destination based consumption taxes finance public goods, while regulation of entry determines the number of firms in the markets. We find *(i)* no strategic interaction in commodity taxes; *(ii)* regulation leads to lower commodity tax rates if demand for public goods is more sensitive to income than demand for private goods and *(iii)* regulation policy is a strategically complement instrument if consumers do not over value product diversity. In the empirical part of the paper, we test our predictions using panel data for 21 OECD countries over the period 1990-2008.

**Keywords:** Regulation, commodity tax, strategic interactions, fiscal federalism

**JEL:** F0, H1, H7, H87, L5

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<sup>§</sup>We thank Gautham Tripathi for his suggestions. This project has been supported by the grant F2R-CRE-PUL-10EGQH at the University of Luxembourg.

# 1 Introduction

This paper studies competition in regulation and commodity taxation between trading countries. A large literature in public economics investigates the existence and the impact of tax interactions between countries.<sup>1</sup> Much less attention is devoted to the dependence between regulation and taxes and their interactions in an international context. This is puzzling because as Oates (2004, p. 377) writes, the "economic competition among governments makes use of a wide class of policy instruments *including both fiscal and regulatory policies* [...]". In particular, market regulation imposes costs on the production of goods and services and impedes the creation of new product varieties. It affects prices, product diversity and, consequently, consumer surpluses both at home and in foreign markets. As a result, we can expect interdependencies between the regulatory decisions of trading partners. This paper aims to fill this gap in the literature.

Importantly, the discussion of product market regulation cannot be disentangled from the issue of taxation, for two reasons. On the one hand, from an economic viewpoint, each country's choice of commodity taxes depends on product market competitiveness, which is significantly influenced by market regulation. On the other hand, commodity taxation accounts for 18.9 percent of total government revenues in the OECD countries in 2003 (OECD 2005) and is, therefore, a policy instrument that should not be neglected in economic analysis. An extensive literature studies the strategic interactions among governments' taxes and suggests that competition in commodity taxes is mitigated by the adoption of the destination principle (Mintz and Tulkens, [25]; Haufler et al, [18], Behrens et al. [5]; see Lockwood, [23] for a survey). However, the existence of strategic interactions between fiscal policies and market regulation has not been analyzed.

The contribution of this paper is three-fold. First, we investigate the existence and the nature of strategic interactions in commodity taxation under the destination principle, this regime being the one most widely used in developed countries. Second, we analyze the existence and nature of the strategic interactions in regulatory settings: does a country's decision to weaken its regulatory setting entice trading partners to weaken or strengthen theirs? Third, we analyze how regulation policies affect commodity tax rates in an international context.

To this end, we build a general equilibrium model with endogenous commodity taxes under the destination principle and with endogenous regulatory restrictions in a product market subject to monopolistic competition. More specifically, we build a two-country trade model with immobile individuals who consume private and public goods and work in firms, and with immobile firms that produce private goods, set prices and freely enter product markets. Public goods or services are supplied by public agencies. Regulation imposes

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<sup>1</sup>For instance, see Wildasin [30] for a survey of the fiscal competition literature.

additional costs on firms' physical fixed costs. Benevolent governments set consumption taxes while regulators choose the regulation level. We combine two common views on regulation by assuming that regulators care for both consumers' welfare and the rents from regulatory activities. Regulatory requirements are decided before commodity taxation in order to reflect governments' greater flexibility in setting tax rates than in restructuring regulatory processes and standards. While a reform on tax rates often requires specifying a single tax figure on which parliament votes, regulatory reform involves a long and cumbersome analysis of a nexus of laws and decrees and raises many industry specific contentions before any vote can be called.

The model generates three theoretical predictions. First, we show that commodity taxes are independent instruments under the destination principle. This result is in line with the literature on commodity tax competition, which finds strategic independence in commodity tax policies under the destination principle, in both perfect and imperfect competitive settings (see Lockwood, [23] for a survey). Second, regulation has a negative impact on commodity tax rates if demand for public goods is more sensitive to income than demand for private goods. In this case, government lowers its commodity tax when regulation becomes stricter. Although this action leads to lower public good provision, it benefits consumers because it 'neutralizes' the negative impact of stricter regulation on private consumption. Finally, we show that regulation polices are strategic complement instruments as long as consumers do not excessively value product diversity. Under this condition, stronger foreign regulatory constraints oblige foreign firms to increase their production scale and lead to a deterioration in the foreign terms of trade. Since this improves domestic terms of trade and the competitive position of domestic firms, domestic regulators have incentives to strengthen domestic regulation in order to extract more rents.

In the empirical part of the paper, we investigate our three theoretical predictions using a unique dataset that combines information on product market regulation, consumption taxation, institutional characteristics and social preferences, for 21 OECD countries over the period 1990-2008. We estimate the model under a number of alternative specifications, accounting for potential endogeneity issues related to simultaneity, reverse causality, and spatial dependence, which are typical in empirical analyses of policy interactions (Brueckner, [7]). Our baseline measure of product market regulation is the widely used 'low level' index which aggregates quantitative and qualitative information on entry barriers (Conway and Nicoletti [11]). We proxy consumption tax rates by average effective tax rates on consumption, following the methodology proposed by Carey and Rabesona [9]. That is, consumption tax rates are given by each country's fiscal revenue from consumption taxes divided by the country's total consumption. Since we focus on the destination principle, we exclude tax items that are likely to be affected by application of the origin principle (e.g. excise taxes) and we choose a weighting matrix that minimizes cross-border shopping between

countries. The empirical results confirm the absence of commodity tax competition under the destination principle: domestic VAT policies have no significant effects on foreign ones. Our empirical results show also that, on average, stronger domestic regulations are associated with lower local consumption taxes, supporting the view that national governments use commodity taxes to ‘neutralize’ the negative welfare impact of long-lasting regulation. Finally, our results also show that, on average, OECD countries reduce domestic regulation in response to foreign deregulation, i.e., regulation policies are strategic complements. Our estimates suggest that medium term decisions regarding local deregulation have an important impact on a country’s ability to raise consumption taxes.

This paper contributes to the existing literature in the following ways. First, it revisits the theoretical foundation and empirical relevance of international competition in commodity taxation. The literature offers an extensive theoretical discussion of the welfare impact of commodity taxation under the destination and origin principles (see Lockwood, [23] for a survey). It also presents empirical evidence of strategic interactions under the origin principle. Egger et al. [15] find evidence of strategic complementarity of average effective tax rates on consumption using OECD panel data. Lockwood and Migali [24] show that the introduction of the EU Single Market in 1993 triggered strategic interactions among excise taxes in EU countries. Devereux et al. [12], using US panel data, find evidence of strategic complementarity of excise taxes on cigarettes. By contrast, the present paper presents empirical evidence of the absence of strategic interactions in destination-based taxation. Second, our paper investigates the impact of regulation policy on commodity taxation from both a theoretical and an empirical perspective. To our knowledge, there are no contribution in the public economics literature on this issue. There are some studies in environmental economics such as Oates and Schwab’s [28] discussion of impact of environmental regulations on taxes and welfare. Third, our paper contributes to the literature analyzing the regulation of entry and strategic interactions in regulation policy. Djankov et al [14] and Aghion et al. [1] analyze the social and cultural factors that affect entry regulation. However, these papers do not look at strategic interactions in regulation policy, which however are investigated in related fields, e.g. labor economics (e.g. Haaland and Wooton, [16]). A final contribution of our paper is that it addresses the endogeneity of product market regulation, exploiting exogenous variation in social norms and values. Recent papers in cultural economics find strong correlation between measures of ‘civicness’ and distrust and product market regulation (Aghion et al. [1]). To our knowledge, our paper is the first to exploit time variations of social preferences to identify the impact of product market regulation on economic outcomes.

The paper is structured as follows. Section 2 presents the theoretical model, Section 3 studies the strategic interactions in regulation and commodity taxation. Section 4 presents and discusses our empirical analysis. Section 5 concludes.

## 2 The model

We describe a general equilibrium economy with (i) commodity taxation with destination-principle and (ii) regulatory competition. We therefore assume two countries, home and foreign, with immobile unit populations. Variables pertaining to the foreign country are indexed by the superscript \*. We describe the model for the domestic country, symmetric expressions holding for the foreign one.

**Private good demand** In the domestic country, consumers' preferences are given by an increasing, separable, and concave utility function  $U(C, G)$  where  $C$  is the bundle of private commodities and  $G$  the public good consumption, respectively. The bundle of private commodities is defined over the varieties  $\omega \in [0, N]$  such that:

$$C = N^\xi \left[ \int_0^N c(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}, \quad (1)$$

where  $c(\omega)$  is the private consumption of variety  $\omega$  and  $\sigma$ ,  $\sigma > 1$ , is the elasticity of substitution among varieties. The world number of varieties,  $N$ , is given by the sum of the endogenous numbers of domestic and foreign varieties,  $n$  and  $n^*$ . That is,  $N = n + n^*$ . As in Benassy (1996), the parameter  $\xi \in [-1/(\sigma - 1), 0]$  measures the love for variety.<sup>2</sup> Each consumer chooses her private consumption  $c(\cdot)$  subject to her budget constraint

$$\int_0^N p(\omega)c(\omega)d\omega = W,$$

where  $p(\omega)$  is the domestic (tax-inclusive) consumer price for variety  $\omega$  and  $W$  is the consumer's income. Hence, her demand for each variety is given by

$$c(\omega) = \left( \frac{p(\omega)}{P} \right)^{-\sigma} \frac{W}{P}, \quad (2)$$

where  $P = \left[ \int_0^N p(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}$  is the domestic consumer price index.

**Public good supply and demand** The public good  $G$  is supplied by a unit mass of symmetric public agencies. Without loss of generality, we assume that each public agency transforms the existing private varieties  $\omega \in [0, N]$  into the public good  $G$ . All public agencies produce the same amounts of  $G$  with a production function given by:

$$G = N^\xi \left[ \int_0^N q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}},$$

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<sup>2</sup>There is no love for variety if  $\xi = -1/(\sigma - 1)$  while love for variety is the same as the elasticity of substitution if  $\xi = 0$ . With  $\xi = 0$ , one recovers the well-known Dixit and Stiglitz (1977) framework.

where  $q(\omega)$  is the public agency's input demand for variety  $\omega$ .<sup>3</sup> Each public agency chooses its input mix that maximizes the level of its public good given its budget constraint,  $\int_0^N p(\omega)q(\omega)d\omega = B$ , where  $B$  is the government's budget. Public agencies take prices, taxes and regulation as given. It naturally comes that the input demand is given by

$$q(\omega) = \left( \frac{p(\omega)}{P} \right)^{-\sigma} \frac{B}{P}. \quad (3)$$

Public and private consumptions are proportionate. Indeed, one can check that

$$q(\omega)/c(\omega) = B/w \quad G/C=B/w. \quad (4)$$

**Private production** Each private firm has a production plant in a country and sell its products in the two countries under monopolistic competition. To be profitable, each variety must be produced by one and only one firm. Thus, firms can be indexed by  $\omega \in [0, N]$ . A domestic firm  $\omega$  has a profit given by

$$\pi(\omega) = \left[ \frac{p(\omega)}{\tau} - W \right] [c(\omega) + q(\omega)] + \left[ \frac{p^*(\omega)}{\tau^*} - W \right] [c^*(\omega) + q^*(\omega)] - fW,$$

where  $p(\omega)$  and  $p^*(\omega)$  are its domestic and foreign prices,  $c(\omega)$  and  $q(\omega)$  are the demands from domestic private consumers and public agencies while  $c^*(\omega)$  and  $q^*(\omega)$  are the demand by foreign consumers and public agencies. To produce a unit of the good a firm must hire a unit of labor paying a wage equal to  $W$ . She must as well incur a set up cost  $fW$  where  $f$  is the fixed labor input that is induced by the regulatory policies. For the sake of exposition, we measure domestic and foreign commodity taxes by the ratio between (tax-inclusive) consumer and (tax-exclusive) factory prices:  $\tau > 1$  and  $\tau^* > 1$ . Commodity tax rates are simply equal to  $\tau - 1$  and  $\tau^* - 1$ . Taxes follow the destination principle and are set by governments.

Under monopolistic competition, each firm  $\omega$  sets the domestic and foreign prices,  $p(\omega)$  and  $p^*(\omega)$  that maximize its profit taking all other variables as given. The optimal prices are given by

$$p(\omega) = \frac{\sigma}{\sigma - 1} \tau W \quad \text{and} \quad p^*(\omega) = \frac{\sigma}{\sigma - 1} \tau^* W. \quad (5)$$

Under monopolistic competition, firms also enter until profits fall to zero. In the domestic country, the above prices imply that each firm's production scale  $x$  is equal to

$$x = (\sigma - 1) f, \quad (6)$$

which increases with setup costs. Similar expressions hold for the foreign country.

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<sup>3</sup>In this model, public agencies basically use outsourcing and procurement to supply the public good. A large share of public infrastructures and services are supplied in this way. Furthermore, this approach yields analytical tractability. Similar results can be obtained using a public good provision produced with public labor and under constant returns to scale.

Plugging optimal prices into the price indices we get the following property:

$$\frac{P}{\tau} = \frac{P^*}{\tau^*} = \frac{\sigma}{\sigma - 1} [nW^{1-\sigma} + n^*W^{*1-\sigma}]^{\frac{1}{1-\sigma}}. \quad (7)$$

The cost of living is the same across countries once they are deflated by local commodity tax rates.

**Labor and product market equilibrium** In the domestic country, each firm demands  $x + f = f\sigma$  units of labor and the labor market clears when the total labor demand  $nf\sigma$  equalizes its unit supply. Applying the same argument for the foreign country we get the following number of firms

$$n = \frac{1}{\sigma f} \quad \text{and} \quad n^* = \frac{1}{\sigma f^*}. \quad (8)$$

In each country, the number of firms is proportional to the labor force because they operate at the same production scale. Because of (6), setting the domestic regulatory entry cost  $f$  is equivalent to setting the domestic production scale and, ultimately, the number of domestic firms,  $n$ . For this reason, in the rest of the paper the choice of regulation is treated as the choice of the number of firms in country.

For each domestic firm  $\omega$ , the product supply  $x$  must satisfy the product demand:  $x = c(\omega) + q(\omega) + c^*(\omega) + q^*(\omega)$ . Using (2) and (3), this equality can be written as

$$x = \left(\frac{p(\omega)}{P}\right)^{-\sigma} \frac{W + B}{P} + \left(\frac{p^*(\omega)}{P^*}\right)^{-\sigma} \frac{W^* + B^*}{P^*}.$$

Then, using (5) and (7), we obtain

$$x = W^{-\sigma} \frac{\sigma - 1}{\sigma} \frac{(W + B)\tau^{-1} + (W^* + B^*)\tau^{*-1}}{nW^{1-\sigma} + n^*W^{*1-\sigma}},$$

where the ratios on the right hand side are the same in both countries. As a result, given the production scale (6), wages satisfy

$$\frac{W}{W^*} = \left(\frac{x}{x^*}\right)^{-\frac{1}{\sigma}} = \left(\frac{f}{f^*}\right)^{-\frac{1}{\sigma}}. \quad (9)$$

The relative wage falls with larger domestic production scales and therefore with larger domestic setup costs and stronger regulation. Indeed, when setup costs rise, domestic firms need to sell more to break even and therefore set a lower relative price. Since firms set constant markups over marginal costs and therefore wages, domestic firms can achieve a profit balance only when their relative wages fall. *Ceteris paribus*, a too strong regulation diminishes domestic prices and thus workers' real wages and consumption. This is the effect of product market regulation on the domestic purchasing power, or equivalently, on the domestic terms of trade,  $W/W^*$ .

**Government balance and consumer utility** The government balances its tax revenues against its expenditures on public inputs. The value of the sales to domestic agents is equal to the domestic consumers' and government's expenditures,  $W + B$ . Thus, the value of those sales before tax is given by  $(W + B)/\tau$  and the domestic tax revenue is equal to  $(\tau - 1)(W + B)/\tau$ . Equating the latter to the government's budget  $B$  yields

$$B = W(\tau - 1). \quad (10)$$

The equalities (6), (8) and (10) characterize the equilibrium in the product and labor markets and for a balanced budget. We can now compute the private and public consumption. The private consumption bundle is given by (1) and simplifies to

$$C = \frac{W}{P} N^\xi, \quad (11)$$

and from (4) the public good consumption is equal to

$$G = (B/W)C = (\tau - 1)C. \quad (12)$$

The consumption of private and public goods increase with real wages  $W/P$ . Using (7) and (9) real wages are given by

$$\frac{W}{P} = \frac{\sigma - 1}{\sigma} \frac{1}{\tau} \left[ n + \left( \frac{n}{n^*} \right)^{1 - \frac{1}{\sigma}} n^* \right]^{\frac{1}{\sigma - 1}}, \quad (13)$$

where  $n$ ,  $n^*$  and  $N = n + n^*$  are given by (8). It is easy to check that taxes affect negatively the level of private consumption because they negatively affect real wages (see (11) and (13)). By contrast, a tax increase leads to a larger supply of public goods. Indeed, substituting (11) and (13) in (12) one readily finds that  $\partial G / \partial \tau > 0$ .

To check how private and public good consumption change with the number of goods produced domestically we substitute (13) in (11) and find

$$C = \frac{1}{\tau} C_0(n, n^*) \quad (14)$$

where

$$C_0(n, n^*) \equiv \frac{\sigma - 1}{\sigma} \left[ n + \left( \frac{n}{n^*} \right)^{1 - \frac{1}{\sigma}} n^* \right]^{\frac{1}{\sigma - 1}} (n + n^*)^\xi$$

is the consumption level in the absence of tax, which is a function of  $n$  and  $n^*$  only. It follows that  $G = C_0(\tau - 1)/\tau$ .

A stronger domestic regulation diminishes the level of domestic diversity  $n$  and therefore changes the utility from private consumption through two channels. On the one hand, it reduces the terms of trade  $W/W^*$ , which reduces the term  $(n/n^*)^{1-1/\sigma}$  in the above expression and therefore domestic consumers' utility. On the other hand, it reduces product diversity

and diminishes the utility from private consumption to the extent of the consumers' taste for variety,  $\xi$ . When consumers express the same love variety as under Stiglitz-Dixit preferences ( $\xi = 0$ ), stronger regulation makes consumers worse off both because of a lower product diversity and worse terms of trade. However, things may slightly differ when consumers express no taste for variety ( $\xi = -1/(\sigma - 1)$ ). To show this, we compute the elasticity of private consumption with respect to  $n$  as follows:

$$\frac{\partial \ln C_0}{\partial \ln n} \equiv \Phi\left(\frac{n}{n^*}\right) = \frac{1}{(\sigma - 1)} \left[ 1 - \frac{1}{\sigma} \frac{1}{1 + (n/n^*)^{\frac{1}{\sigma}}} \right] + \xi \frac{1}{1 + (n/n^*)^{-1}}. \quad (15)$$

When consumers have love for variety ( $\xi = 0$ ), this elasticity is obviously positive so that a rise in product diversity raises the domestic utility from private consumption. Instead, when  $\xi = -1/(\sigma - 1)$ , the sign of this elasticity depends on the balance between the effects of terms of trade and product diversity. Its sign is positive if  $n/n^*$  does not lie too high above 1.<sup>4</sup> In this case, the terms of trade dominate the effect of product diversity. In the present model, this will be the most relevant case. By contrast, the sign of this elasticity can be negative if the ratio  $n/n^*$  becomes large enough. In this case, a rise in domestic product diversity diminishes the utility from domestic private consumption.

We are now equipped to discuss the strategic interactions between governments and regulators.

### 3 Strategic interactions between governments and regulators

In this paper, we consider government and regulatory agencies as independent entities. Moreover, we take the view that regulatory processes and standards are less easy to restructure than commodity tax rates. Whereas a reform on the tax rate requires to specify a single tax figure on which parliament must vote, a regulation reform requires a long and cumbersome analysis of a nexus of laws and decrees and raises many industry specific contentions before any vote can be called for. We therefore model the interaction between government and regulators as a sequential game in which regulators firstly set the firms' entry requirements and then governments set their commodity tax rates. The game is solved by backward induction.

We assume that each government is benevolent and maximizes its residents' utility whereas each regulator has two facets: he cares for consumers' welfare but also for his own rents. This provides a partial reconciliation of the two extreme views on bureaucracy.

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<sup>4</sup>The elasticity  $\partial \ln C_0 / \partial \ln n$  is non-negative if  $\sigma (n/n^*)^{\frac{1}{\sigma}} - (n/n^*) \geq 1 - \sigma$ . This condition holds for  $n/n^* = 1$  when countries have symmetric population sizes as in this model. The condition will not hold for very asymmetric population sizes so that  $n/n^*$  is very large.

On the one hand, as in standard public economics, the regulator is benevolent in that it cares about the level of utility of the citizen. On the other hand, the bureaucrat has a Leviathan side aiming at increasing its own rents. More specifically, we assume that regulators weights their own rent and the residents' welfare when deciding the level of regulations.

We begin with the analysis of the governments' competition in commodity taxes.

### 3.1 Commodity tax competition

Each government sets the commodity tax rate that maximizes its residents' utility, holding a balanced budget and taking the other tax and the regulatory setting as given. In particular the domestic government maximizes  $U(C, G)$  or equivalently  $U [C_0/\tau, C_0(\tau - 1)/\tau]$ . Because  $C_0$  is a function of only  $n$  and  $n^*$ , the optimal domestic commodity tax  $\tau$  is independent of the foreign tax. We can then state then the following proposition:

**Proposition 1** *Under the destination tax principle, there exists no strategic interaction in commodity tax rates.*

This is a known result in optimum taxation theory under the destination tax principle.<sup>5</sup> Indeed, in their seminal paper, Mintz and Tulkens [25] show the absence of commodity tax competition under the destination principle in perfectly competitive markets. Haufler et al., [18] obtain the same result in imperfectly competitive markets where firms are perfectly mobile and sell their goods under monopolistic competition. The present paper confirms such a result in a similar monopolistic competition model. In contrast to Haufler et al. [18], it gives a role to taxation as the provision of public goods, considers the taxation of all goods and does not use firms' mobility as a factor that cancels fiscal externalities.

The choice of commodity taxes can readily be obtained and understood by reformulating the government's problem in the following way. Since  $C = C_0/\tau$  and  $G = C_0(\tau - 1)/\tau$ , we get  $C + G = C_0$ . So, the government's problem is simply to find the private and public consumption bundles that maximize each individual's utility  $U(C, G)$  subject to the resource constraint  $C + G = C_0$ . This yields the standard Samuelson condition

$$U'_C/U'_G = 1 \tag{16}$$

according to which the sum (over the unit mass consumers) of the marginal rate of substitution between public and private goods,  $U'_C/U'_G$ , equates the unit marginal rate of transformation between public and private goods. The optimal tax rate is given by  $\tau - 1 = G/C$ . A maximum is guaranteed under our standard concavity assumptions.

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<sup>5</sup>For a synthesis of the literature see Lockwood [23].

What is the impact of domestic regulation on domestic tax rates? It depends on income effects associated to public and private goods. Stronger regulation indeed decreases the number of domestic firms  $n$  and therefore reduces the private consumption bundle  $C_0(n, n^*)$  if and only if  $\partial \ln C_0 / \partial \ln n > 0$ . Suppose it is the case. Then, stronger regulation yields a contraction of the resource constraint  $C + G = C_0(n, n^*)$ . In consumer theory, this corresponds to a fall in the income of a representative consumer whose income is given by  $C_0(n, n^*)$  and who faces the identical prices for private and public consumption bundles. Then, suppose that the income effect on the demand of public goods is stronger than that on private goods. That is, the income expansion path or Engel function is biased toward public goods. Then a fall in resource or income must diminish the optimal consumption of public goods more than that of private goods. To achieve this, the government simply has to reduce the commodity tax rate. If the income effects go in opposite directions, the converse result obtains.

More formally, the domestic commodity tax falls with a smaller number of domestic firms if  $d\tau/dn = - (d\mathcal{F}/dn) / (d\mathcal{F}/d\tau) \geq 0$  where  $\mathcal{F} \equiv (d/d\tau) U [C_0/\tau, C_0(\tau - 1)/\tau]$  is the first order condition with respect to  $\tau$  and where  $d\mathcal{F}/d\tau < 0$  is the respective second order condition. Then,  $d\tau/dn > 0 \iff d\mathcal{F}/dn \geq 0$ . Some lines of computation show that this condition is equivalent to

$$[U''_{GG}(\tau - 1) - U''_{CC}] \frac{\partial \ln C_0}{\partial \ln n} \geq 0,$$

where  $U''_{CC}$  and  $U''_{GG}$  are negative. The last expression clearly depends on the response of domestic private consumption bundle  $C_0$  to  $n$  and on the concavity of the utility function with respect to private and public goods ( $C$  and  $G$ ) and therefore on the degree of consumers' satiety for those two kinds of goods. The above condition can be expressed in terms of the marginal rates of substitution,  $MRS \equiv U'_C/U'_G$ , as

$$\left( \frac{d \ln MRS}{d \ln C} + \frac{d \ln MRS}{d \ln G} \right) \frac{\partial \ln C_0}{\partial \ln n} \geq 0$$

The term in parenthesis expresses the income effects on marginal rates of substitution. Indeed, take any ray,  $G/C = \text{cst}$ , on which private and public consumptions are proportionate ( $d \ln C = d \ln G$ ). When income effects on public and private goods are the same, the marginal rate of substitution remains constant on the ray. Changes in regulation and thus in number of domestic firms have no impact on commodity tax rates. When income effects are stronger on the demand of public goods, marginal rates of substitution increase on this ray when consumptions rise proportionally so that the term in parenthesis becomes positive. As a result, a stronger regulation reduces the number of domestic firms and thus increases commodity taxes. This is what have informally explained in the previous paragraph.

We summarize our findings in the following proposition:

**Proposition 2** *Suppose that private consumption increases with the number of domestic varieties ( $\partial C_0 / \partial n > 0$ ). Then, a stronger product market regulation lowers commodity tax*

rates if and only if income has a stronger effect on the demand of public goods than on that of private goods.

Empirically, the concavity of preferences, the marginal rates of substitution for private and public goods and the income effect on demand depend on the nature of each good. To our knowledge, the public economic literature has not identified clear and distinct patterns about those properties on private and public goods. The direction of commodity tax changes with respect to the number of firms and market deregulation is therefore an empirical issue that we will discuss in Section 4.

### 3.2 Regulatory competition

In this section, we discuss the governments' interactions through their regulatory policies. From the previous section, we know that optimal commodity tax rates are independent instruments. Therefore, any change of domestic regulation implies a change of the foreign tax only from its impact on the number of local and foreign firms. For the sake of simplicity, we sterilize the effect of local regulation on local tax by assuming that the utility function of agents is log-linear, i.e.,  $U(C, G) = \alpha \ln C + (1 - \alpha) \ln G$ , where  $\alpha$  is the specific domestic preference for private consumption. This utility function allows us to discuss the regulatory competition stage. Under this assumption, the optimal commodity tax rate is equal to  $\tau_0 = 1/\alpha$ . The utility becomes  $V(C) = \ln C_0 + \ln [\alpha^\alpha (1 - \alpha)^{1-\alpha}]$ . Similarly, the foreign country sets a tax  $\tau_0^* = 1/\alpha^*$ .

We assume that domestic regulators follow an objective that mixes the consumers' utility and their own rents. That is, their objective function is given by  $V(C) + Z(R)$  where  $Z$  is an increasing and concave function and  $R$  is the real rent they grab from their activities. For simplicity, we consider that regulators get a rent by extracting and adding an extra input  $z$  on the fixed input cost  $f_0$  of a subset of firms that has a constant mass equal to  $m$ . The idea is that although the regulation applies to all firms in the country, regulators are able to grab a rent only in a limited number of firms with which they interact more often. Regulators therefore collect an income  $wz$  per controlled firm times the number of controlled firms  $m$ . They get a nominal rent of  $mzw$  which gives to them a consumption equal to  $R = mzC$ . The input required for entry becomes  $f = f_0 + z$  so that, by (8),  $z = 1/(\sigma n) - f_0$ . In this setup, rents should be positive and the number of firm no smaller than the number of firms under control  $m$ . That is, we assume that the condition,  $1/(f_0\sigma) \geq n \geq m$ , holds.

Domestic regulators therefore choose the regulatory setup that maximizes  $V(C) + Z(R)$  where  $R = mzC$  and  $C = C_0(n, n^*)/\tau_0$ . This amounts to choose the number of domestic firms  $n$ . The first order condition with respect to  $n$  can be written as

$$[CV' + RZ'] \frac{\partial \ln C_0}{\partial \ln n} = -RZ' \frac{\partial \ln z}{\partial \ln n}. \quad (17)$$

Regulators balance their cost that this regulation imposes to society and to themselves (the left hand side) with the benefit from their rent from a stronger regulation (the right hand side). This cost increases with the elasticity of domestic consumption to domestic variety,  $\partial \ln C_0 / \partial \ln n$ . An increase in domestic variety indeed increases the utility of both domestic consumers and regulators.

For analytical tractability, we set now  $Z(R) \equiv \rho \ln R$  where  $\rho$  is the weight regulators put on their own benefit. Domestic regulators therefore choose the regulatory setup that satisfies (17), which becomes

$$\frac{1 + \rho}{\rho} (1 - f_0 \sigma n) \frac{\partial \ln C_0}{\partial \ln n} = 1. \quad (18)$$

Differentiating totally the first order condition (18) and using (15) we obtain

$$\frac{d \ln n}{d \ln n^*} = \frac{n}{n^*} \left( 1 - \frac{f_0 \sigma}{1 - n f_0 \sigma} \frac{\Phi}{\Phi'} \right)^{-1}, \quad (19)$$

where  $\Phi$  is defined in (15) and  $\Phi'$  is as follows:

$$\Phi'(n/n^*) = \frac{1}{\sigma^2 (\sigma - 1)} (n/n^*)^{\frac{1}{\sigma} - 1} \left[ \frac{1}{1 + (n/n^*)^{\frac{1}{\sigma}}} \right]^2 + \xi \left( \frac{1}{1 + n/n^*} \right)^2.$$

When (19) is positive, domestic regulators increase  $n$  by reducing domestic regulation when foreign competitors do the same. At any symmetric equilibrium with  $\rho = \rho^*$  and  $f_0 = f_0^*$  and  $n/n^* = 1$ , using (18), we get:

$$\frac{d \ln n}{d \ln n^*} > 0 \iff \frac{\rho}{f_0 \sigma (1 + \rho)} \geq \frac{\Phi^2(1)}{\Phi'(1)} = \frac{(2\sigma - 1 + \xi \sigma (\sigma - 1))^2}{(\sigma - 1) (1 + \xi \sigma^2 (\sigma - 1))}. \quad (20)$$

Let  $\hat{\rho}$  be the solution of the last inequality when it binds. Then, the following proposition can be stated:

**Proposition 3** *Suppose two symmetric countries and log linear utility functions. (i) For low enough love for product diversity ( $\xi < -1/\sigma^2(\sigma - 1)$ ) regulation policies are strategic complement instruments for any regulator's preference for rent  $\rho$ . (ii) For large enough love for variety ( $\xi > -1/\sigma^2(\sigma - 1)$ ) and low  $f_0$  ( $f_0 < (\sigma - 1)/(\sigma(2\sigma - 1)^2)$ ), regulations are strategic complement instruments if regulators have sufficiently strong preferences for rents ( $\rho > \hat{\rho}$ ). Otherwise, regulation policies are strategic substitutes.*

**Proof.** To prove (i) in Proposition 3, we sign the denominator  $(\sigma - 1)(1 + \xi \sigma^2 (\sigma - 1))$ , which is always negative when  $\xi < -1/\sigma^2(\sigma - 1)$ . Hence, if  $\xi < -1/\sigma^2(\sigma - 1)$ , then  $d \ln n / d \ln n^* > 0$ . When instead  $\xi > -1/\sigma^2(\sigma - 1)$  (the case in (ii)) and moreover  $f_0 < (\sigma - 1)/(\sigma(2\sigma - 1)^2)$ , then  $d \ln n / d \ln n^* > 0$  if  $\rho > \hat{\rho}$ . Otherwise (namely either if  $\xi > 1/\sigma^2(\sigma - 1)$  and  $f_0 < (\sigma - 1)/(\sigma(2\sigma - 1)^2)$  and  $\rho < \hat{\rho}$  or if  $\xi > 1/\sigma^2(\sigma - 1)$  and  $f_0 > (\sigma - 1)/(\sigma(2\sigma - 1)^2)$ )  $d \ln n / d \ln n^* < 0$ . ■

The intuition of Proposition 3 is as follows. When regulators and consumers do not value product diversity, local regulation increases local fixed input and obliges local firms to expand their production, which negatively affects local wages and the local terms of trade. As a consequence, when foreign regulators relax regulatory pressure, the terms of trade becomes unfavorable to domestic regulators, which have incentives to relax domestic regulation to restore their purchasing power. Regulatory decisions are strategic complements. By contrast, when regulators and consumers value product diversity, domestic regulators are harmed by their own regulation as the latter reduces domestic and therefore global diversity. An increase in the foreign product diversity however reduces the impact of domestic regulation on the utility derived from domestic consumption. As a result, the relaxation of foreign regulation entices the domestic regulators to enhance regulatory constraints and their rents. Regulatory decisions then become strategic substitutes. To sum up, when consumers have low taste for variety, regulation policies are strategic complements because regulations affect mainly the terms of trade. Conversely, when consumers have high taste for variety, regulation policies are strategic substitutes because they affect product diversity in a country.

Before testing empirically the nature of regulatory competition, it is worth to note that existing empirical studies have already shown that consumer’s “love of variety” is significantly lower than what it is assumed in the Dixit-Stiglitz framework (see Hummels and Klenow [21] and Ardelan [4]).

## 4 Empirical evidence

### 4.1 Empirical strategy

In this section, we estimate the direction of the forces described in the theoretical setup. We build an empirical model in which tax and regulation decisions are taken sequentially in two stages by several countries over some time periods. The best reply functions obtained in the tax stage determine the link between taxation and regulation. The empirical specification is a generalization (in a linearized form) of the optimal tax rates that solve equation (16) when the origin or destination taxation principle is not specified:

$$\tau_{it} = \sum_{j \neq i} a_{ij} \tau_{jt} + bz_{it-2} + c' X_{it} + d_i + e_t + u_{it}, \quad (21)$$

where  $i = 1, \dots, I$  denotes the country,  $t = 1, \dots, T$  the time-period,  $d_i$  and  $e_t$  are country and time dummies,  $X_{it}$  is the vector of relevant characteristics of country  $i$  at time  $t$ , including factors describing national consumption patterns, and finally  $u_{it}$  is the error term. Coefficients  $a_{ij}$  measure how the consumption tax in country  $i$  responds to the consumption tax in each country  $j \neq i$  at time  $t$ . According to Proposition 1 strategic interactions in commodity taxation are absent. A significant  $a_{ij} = 0$  would provide no evidence of strategic interactions

and confirm our theoretical analysis as well as previous studies on the destination principle of commodity taxation (see Lockwood [23] for a synthesis). Coefficient  $b$  describes how government's tax policy reacts to product market regulation  $z_{jt-2}$ , where  $j = 1, \dots, I$ . The use of a lag reflects our theoretical priors: the implementation of the regulation policy is time consuming, due to the difficulties encountered in restructuring regulatory processes. Thus current taxes are determined by past regulation.<sup>6</sup> According to our theoretical model, a significant  $b < 0$  would indicate that the government uses commodity taxes to mitigate the negative impact of regulation on consumers' welfare.

In the first stage of the model, entry regulation is selected anticipating and internalizing its effect on consumptions taxes. Hence, from condition (17), regulator  $i$ 's best reply to the regulation set by partner countries  $j = 1, \dots, I$  is a function  $z_i = F(z_{-i}, Y_i)$ , where  $z_{-i} = [z_1, \dots, z_{i-1}, z_{i+1}, \dots, z_I]$  is a vector of regulations in each partner country  $j \neq i$  and  $Y_i$  is a vector of relevant country characteristics. These include country specific factors that determine the national patterns in public and private consumption as well as regulator's preferences. We can make a linear approximation of  $F(z_{-i}, Y_i)$  and generalize it for  $T$  time periods as follows:

$$z_{it} = \sum_{j \neq i} \alpha_{ij} z_{jt} + \beta' Y_{it} + \gamma_i + \delta_t + \mu_{it}. \quad (22)$$

where  $\gamma_i$  and  $\delta_t$  are country and time dummies and  $\mu_{it}$  is the error term. The coefficients  $\alpha_{ij}$  measure how  $z_i$  responds to  $z_j$ :  $\alpha_{ij} > 0$  ( $< 0$ ) indicates that country  $i$ 's regulation policy is a strategic complement (substitute) of country  $j$ 's regulation.

**Degrees of freedom** Equations (21) and (22) cannot be estimated as there are too many parameters. The usual approach is to modify them as follows:

$$\tau_{it} = a\tau_{-it} + bz_{it-2} + c' X_{it} + d_i + e_t + u_{it}, \quad (23)$$

$$z_{it} = \alpha z_{-it} + \beta' Y_{it} + \gamma_i + \delta_t + \mu_{it}; \quad (24)$$

where  $\tau_{-it} = \sum_{j \neq i} \omega_{ij} \tau_{jt}$  and  $z_{-it} = \sum_{j \neq i} \omega_{ij} z_{jt}$  are indices of trade partners' tax and regulation policies. Those indices are constructed with the nonnegative exogenous weights  $\omega_{ij}$ , normalized so that  $\sum_{j \neq i} \omega_{ij} = 1$ . There is considerable discussion on the appropriate weights in the literature, as their choice affects the magnitude of the coefficients of interest (see Brueckner, [7]). The idea is to construct  $z_{-i}$  and  $\tau_{-i}$  by aggregating the foreign variables according to the relevance of each country  $j$ 's interaction with country  $i$ . Based on our

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<sup>6</sup>By taking a two year lag we make the implicit assumption that it takes two years to actually implement a product market reform. This is consistent with descriptive evidence for OECD countries (see Conway et al. [11] and World Bank's Doing Business reports [31]-[34]).

theoretical model, we need to focus on the destination principle and exclude strategic interactions that stem from cross-border shopping. Thus, we construct weights that describe the exogenous country  $i$ 's propensity to import from country  $j$ , as predicted by the structural characteristics of countries such as size, distance, culture, legal origin and historical relationship (see Appendix A for details). This approach contrasts with existing papers that choose contiguity weights to highlight strategic interaction between governments in origin based commodity taxation (e.g. Lockwood and Migali [24], Devereux, Lockwood and Redoano [12]).

**Endogeneity** As regulation and taxation levels in equations (23) and (24) are the outcome of spatially correlated policy decisions, OLS estimates of  $a$ ,  $b$  and  $\alpha$  are subject to endogeneity issues. There is a first problem of simultaneity that stems from strategic interactions between countries. There is a second issue of reverse causality in equation (23) in so far as the regulators might rather set regulation as a function of prevailing taxes instead of setting their taxes as a function of their regulatory environments as assumed in our study. There is a third problem of omitted variable bias as  $\tau_{it}$ ,  $z_{it}$ ,  $\tau_{-it}$  and  $z_{-it}$  may be affected by common unobserved shocks. In our context for instance, we have ‘spatial error dependence’ as the error terms in (23) and (24) may include omitted country characteristics that are spatially correlated. As Brueckner [7] notes, ignoring spatial dependence implies that the estimated coefficients may provide false evidence of strategic interactions.

We solve endogeneity issues by means of an instrumental variables (IV) estimator. We use regulator’s preferences as an instrument for regulation. In fact regulator’s preferences determine the local regulation while we do not expect any correlation with either local commodity tax policy nor foreign regulation. Let  $r_i$  be the proxy of regulator’s preferences in country  $i$ , then  $E[r_i z_i] \neq 0$  while  $E[r_i \tau_i] = 0$  and  $E[r_{-i} z_i] = 0$ . These conditions for instance hold in our model with log-linear utility functions. To instrument for foreign taxation in equation (23), we exploit the exogenous variation associated with each country’s trading partners that have implemented at least one of two structural commodity tax reform that occurred over the sample period. These are the switch from a consumption-based to a VAT-based system of commodity taxation, and the implementation of the 1993 VAT reform by countries belonging to the EU.<sup>7</sup> The 1993 VAT reform originated from a common agreement among EU countries that kept the destination principle for firms’ transactions and applied the origin principle to cross-border shopping. As shown by Lockwood and Migali [24], cross-border shopping represents a direct effect of the reform in a country on com-

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<sup>7</sup>The switch to the VAT entails the adoption of a relatively more efficient system of consumption taxation, which ensures higher tax compliance and avoids double marginalization (OECD Consumption Tax Trends [26]). Conversely the 1993 VAT reform introduces a different VAT treatment of domestic and cross-border supplies that creates incentives to smuggling and tax avoidance practices (see Lockwood and Migali [24]).

modity tax revenue of the neighboring countries. As the presence of cross-border shopping could invalidate our identification strategy, we firstly use *a* definition of the consumption tax variable that minimizes the set of transactions subject to the application of the origin principle (see more below) and we secondly choose *a* weighting matrix  $\omega$  that minimizes cross-border shopping effects. These two empirical strategies allow us to isolate the goods sold under the destination principle. Under the destination principle, both reforms are associated with an exogenous change in local commodity tax revenues but not on the commodity tax revenues of the partner countries. To sum up, we can then estimate equations (23) and (24) by instrumental variables and use the set of instruments described above to predict the endogenous regressors in the first stage. The predicted values  $\widehat{z}_{it-2}$ ,  $\widehat{\tau}_{-it}$  and  $\widehat{z}_{-it}$  are then used in the second stage equations (23) and (24) to obtain consistent estimates  $\widehat{a}^{IV}$ ,  $\widehat{b}^{IV}$  and  $\widehat{\alpha}^{IV}$ , respectively.

## 4.2 Data and main variables

We construct a unique dataset that combines information on product market regulation, consumption taxation, institutional characteristics and social preferences for 21 OECD countries over the period 1990-2008.<sup>8</sup> Our primary measure of product market regulation is the Energy, Transport and Communication Regulation indicator (*ETCR*) drawn from the *OECD International Regulation Database* (IRD; see Conway and Nicoletti [11]). We focus on the low-level *ETCR* index that aggregates over a 0 to 6 scale qualitative and quantitative information on entry barriers (fixed costs) in seven non-manufacturing industries: electricity, gas, air passenger transport, rail transport, road freight, and postal services.<sup>9</sup> We proxy the consumption tax rate by the (implicit) average effective tax rate on consumption (*CTAX*), which measures consumption tax revenues as a percentage of total consumption. We construct *CTAX* using Carey and Rabesona [9]’s methodology on data from the *OECD National Accounts* and *Revenue Statistics*. As we want to focus on destination based commodity taxation, the *CTAX* definition includes only sales and value added taxes. In other words, we exclude excise taxes, customs and import duties, profits from fiscal monopolies and taxes in specific services, whose revenues may partly reflect the application of the origin principle to consumers’ transactions.<sup>10</sup> We finally construct the average measure of product market

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<sup>8</sup>The countries we consider are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States.

<sup>9</sup>Conway and Nicoletti [11] distinguish the low-level *ETCR* index disaggregated by type of regulation (entry barriers, public ownership, vertical integration) from the aggregate *ETCR* index which is a weighted average of the low level indicators.

<sup>10</sup>In contrast, existing studies adopt definitions of commodity taxes that (at least partly) reflect the application of the origin principle. For instance, Egger et al. [15] computes the implicit average effective

regulation of each country’s trade partners,  $ETCR_{TP}$ , and the average effective consumption tax rate of each country’s trade partners  $CTAX_{TP}$ . These are computed as averages of  $ETCR$  and  $CTAX$  of each country’s trade partners, weighted by the propensity to import from that specific country,  $\omega$ .

To proxy regulator’s preferences, we use data from two international social surveys, the *World Value Survey* (WVS) and the *European Value Study* (EVS). The first indicator (*OrderNation*) is the percentage of individuals who responded ‘*maintaining order in nation*’ to the question: ‘*There is a lot of talk these days about what the aims of this country should be for the next ten years, ..., If you had to choose, which of the things on this card would you say is most important?*’. As suggested by Inglehart [22], *OrderNation* captures the perception that regulators behave in the interest of their citizens, describing the extent to which the society is inspired by social values, emphasizing the importance of economic and physical security, relative to economic freedom and autonomy. The second indicator (*DisTrust*) is the percentage of respondents who answered ‘*Can’t be too careful*’ to the question: ‘*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?*’. Aghion et al. [1] propose *DisTrust* as a basic measure to capture the perception about regulator’s propensity to adopt a rent seeking behavior. Again, we construct the proxies for average preferences of trade partners’ regulators ( $DisTrust_{TP}$ ,  $OrderNation_{TP}$ ) weighting *DisTrust* and *OrderNation* by  $\omega$ .

In contrast to previous works on the impact of trust and social norms on institutions that exploit only cross-country variation (see Algan and Cahuc [3] for a notable exception), we are able to construct consistent time-varying measures of preferences for regulation, since WVS and EVS data consist of fully comparable survey waves. In fact, we use the last four waves of the WVS and three waves of the EVS and take country averages of the two indicators over the periods 1990-94, 1995-99, 2000-04 and 2005-08. Under the assumption that social values and preferences have a persistent component that makes their evolution over time very slow, each wave provides the description of individual tastes, preferences and ideologies in each country over the covered period. In other words, it can be assumed that social preferences for regulation change between two periods while remain constant within each period.

We construct a dummy variable  $VAT$  that equals one if a country adopts a VAT-based system and a dummy variable  $EUVAT93$  that equals 1 if a country is exposed to the EU VAT reform in 1993. These two dummies are used to construct our two instruments for consumption taxes,  $VAT_{TP}$  and  $EUVAT93_{TP}$ . They measure the share of each country’s trade partners that implemented each reform, weighted by  $\omega$ .  $VAT$  and  $EUVAT93$  exhibit

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tax rate on consumption that accounts also for excise taxes, customs and import duties, profits from fiscal monopolies and taxes in specific services. Devereux et al [12] and Lockwood and Migali [24] focus on excise taxation.

a sufficient variation in our sample to ensure identification.<sup>11</sup> An even higher variation is shown by  $EUVAT93_{TP}$  and  $VAT_{TP}$  since each country has a different number of trading partners that implemented each reform.

In Appendix A we provide more details over the construction of our variables of interest and describe the additional variables used as controls and in the robustness checks. These variables come from multiple sources: the OECD Economic Outlook; the World Bank’s ‘Database on Political Institutions’ (DPI), ‘World Development Indicators’ (WDI) and Doing Business (DOBUS); the International Monetary Fund’s ‘Direction of Trade Statistics’ (DOTS); the CEPII Gravity Dataset (CEPII).

### 4.3 Descriptive statistics

In Figure 1, we plot the effective tax rate on consumption in each country against entry barriers, taken in differences between the final period’s level (i.e., 2004/08) and the initial period’s level (i.e., 1990/94). All countries in the sample present an overall negative variation in the  $ETCR$  indicator during the period 1990-2008. More specifically, when we compare the product market deregulation efforts of each country, a distinction emerges between low, intermediate and high reformers. The low reformers’ group includes countries that experienced a reduction of  $ETCR$  by less than 2 points. These are USA, UK, and Canada that implemented deregulation waves before the 1990s, thus entering the sample already with a low overall level of product market regulation.<sup>12</sup> The intermediate reformers’ group include countries that present a deregulation pace very close to the OECD median. These are countries whose reform efforts started generally in the mid-eighties (as in Sweden, Finland, Norway and Australia) plus some countries from Continental Europe whose reforms concentrated after 1995 (Austria, Belgium, Switzerland). The high reformers’ group includes countries that cut  $ETCR$  by more than 3.5 points. These are mostly EU countries that were heavily regulated until the 1995, boosting the pace of their reforms afterwards due to the incentives provided by the EU deregulation directives (Conway and Nicoletti, [11]). The figure displays a negative correlation between changes in taxes and changes in product market regulation: high reformers experienced an increase in average effective tax rates during the period 1990-2008, with the only exception of France. Conversely, none of the low reformers increased average effective tax rates. In Spain, Portugal, Japan, and more

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<sup>11</sup>Identification of  $EUVAT93_{TP}$  is guaranteed by cross-country and over time variation among countries exposed and not exposed to the 1993 VAT reform. This is basically cross-country variation among countries that in 1993 were EU and non-EU as well as over time variation for EU countries before and after 1993. Identification of VAT is guaranteed by the four countries switching to VAT during the sample period (Australia, Canada, Switzerland and Finland).

<sup>12</sup>The USA started its reform process early in the mid-seventies and carried most of its reforms in the period 1975-1985. Canada, and UK instead concentrated their reforms in the period 1985-1995.

recently, Switzerland and Australia, the rise of the average effective tax rates also reflects the introduction and consolidation of a VAT system (see OECD [26]).

In Figure 2, we show the correlation between each country's average regulation and the trading partners' weighted average regulation. The weights are chosen according the procedure described in the previous section. Also in this case we take differences between the 2004/08 level and the 1990/94 level. All countries are close to the top-right and the bottom-left quadrants of Figure 2. This indicates that the trading partners of high reformers are high reformers themselves on average, and similarly trading partners of low reformers are low reformers themselves. While being purely descriptive, this evidence is consistent with the view that trade partners deregulate in response to each others' deregulation waves, i.e., that regulation policies among trading partners are strategic complements.

In Figure 3, we look in detail at the correlation between *OrderNation* and *DisTrust*. Also in this case we take the two variables in differences between the final period's level (i.e., 2004/08) and the initial period's level (i.e., 1990/94). The two variables display a considerable variation over time. Trust and preference for order in nation in fact evolve over time as a consequence of exogenous shocks or feedback effects from past policies/reforms (Aghion et al. [1]; Algan and Cahuc [2]; Inglehart [22]). The time interval covered in our sample (1990-2008) is long enough to describe such an evolution in a period with several political, social and economic changes. With these respect, we clearly distinguish four groups of countries. The first group includes Finland, Belgium and Sweden that in 1990-2008 experienced increasing distrust (particularly Belgium and Finland) and demanded more security due to social, political and economic unrest.<sup>13</sup> The second group includes Anglo-Saxon countries (USA, UK, Canada, Ireland, New Zealand and Australia) and Japan. These countries did not see a relevant rise in the demand for order in nation, probably due to their traditionally liberal views. However they experienced a significant rise of social distrust, probably created by the rising inequalities and the fears of terrorism. Two relevant exceptions in the group of Anglo-Saxon countries are New Zealand and Australia, which in the last two decades experienced increasing levels of trust mostly related to the successful political turnover and structural reforms implemented during the 1990s.<sup>14</sup> The third group includes Continental

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<sup>13</sup>In Finland the rise of social equality movements and the contrast with the Swedish minorities by the end of 1980s increased social unrest. Furthermore, the collapse of the Soviet Union and the ensuing great economic depression of the first half of the 1990s increased the demand for social, political and economic stabilization. Similarly, in Belgium the gradual concentration of the political power around the need to represent the main cultural communities increased political and social polarization and the needs for political stabilization.

<sup>14</sup>At the beginning of the 1990s, Australia started from very low levels of trust mostly driven by political inertia and economic depression. The increase in trust is probably related to the election of a new liberal government which launched successful waves of liberalizations and structural reforms. A somehow similar path was experienced by New Zealand where up to the early 1990s national governments carried out reforms

and Southern-EU countries (France, Austria, Germany, Italy, Spain, Greece, and Portugal). In the last twenty years these countries experienced a resurgence of distrust and nationalism, while their mediocre economic performance boosted public support for freedom and autonomy in the private sector.<sup>15</sup> The fourth group includes Denmark, Netherlands and Norway that during the period 1990-2008 experienced both decreasing preference for order in nation and increasing trust. These countries in the last two decades were characterized by an increasing perception of the need to reform, and the success of the welfare and workfare reforms inspired to flexicurity principles (Algan and Cahuc [2]). Finally *DisTrust* and *OrderNation* have been relatively stable in Switzerland over the sample period.

Finally, it is important to notice that *ETCR* is strongly correlated, at the 1% significance level with our proxies for regulator’s preferences *DisTrust* and *OrderNation*. This correlation is explained by Aghion et al. [1], and Djankov et al. [14]: high-trusting and ‘order-free’ nations tend to prefer very few controls on opening a business, whereas low-trusting and secured countries, present higher preferences for regulations and tend to impose heavy barriers to entry.<sup>16</sup>

## 4.4 Results

Table 1 reports estimates for the commodity tax response function in (23). OLS estimates in column [1] indicate a negative impact of  $CTAX_{TP}$  on  $CTAX$ , significant at the 5% level and a significant negative impact of  $ETCR$  on  $CTAX_{TP}$ . The former result is counterintuitive as it suggests that commodity taxes are strategic substitutes under the destination principle. However, as explained before, these OLS estimates are biased and inconsistent due to endogeneity. More specifically, spatial error dependence is a concern for  $CTAX_{TP}$  as spatially correlated unobserved factors may exist that may provide a false evidence of strategic interaction in commodity taxation (Brueckner [7]).

In columns [2] and [3] we deal with these problems and perform two stage least squares (2SLS) and Hansen’s Generalized Method of Moment (GMM), using *OrderNation*, *DisTrust* (in five year lag),  $VAT_{TP}$  and  $EUVAT93_{TP}$  as instruments for  $ETCR$  and  $CTAX$ .<sup>17</sup> The

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that seemed to fail to reflect the mood of the electorate. The rising trust in the 2000s seems to reflect the success of the referendum to change the electoral system to mixed proportional representation, which led to an effective change in political representation in the country.

<sup>15</sup>It is generally acknowledged that the ‘shock’ that triggered the resurgence of distrust in these countries during the 90s has been the fall of the communist regime in Russia and East European countries. Furthermore, the fall of communism and the war in ex-Yugoslavia did produce a feeling of fear against rise of immigration. These have been often perceived as ‘dangerous’ to national communities and led to the election of governments supported by extreme right and nationalist parties (see European Commission [8]).

<sup>16</sup>Aghion et al. [1] notice that the relationship goes both directions, i.e. distrust and social disorder create regulation, which in turn, feeds further distrust and social disorder.

<sup>17</sup>Since there are  $l = 4$  instruments for  $k = 2$  endogenous regressors, the equation is overidentified. In

tests confirm that instruments are correlated with the endogenous regressors, they explain a relevant portion of their variance in the first stage regression and they provide valid exclusion restrictions in the second stage.<sup>18</sup> The Pagan-Hall and Wooldridge tests reject at the 1% level the null hypotheses of homoskedasticity and absence of serial correlation in the idiosyncratic errors. Consequently, we compute Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors in columns [2] and [3]. Finally, the RESET test confirms that there are no problems of omitted variables or misspecified functional form. Compared to OLS estimates, the negative significant coefficient of  $CTAX_{TP}$  turns to a (positive) non-significant one. This indicates that, once we correct for endogeneity, strategic interactions in commodity taxation are not significantly different from zero. Up to our knowledge, this is the first paper that shows the absence of commodity tax interactions under the destination principle. As mentioned earlier, this result stems from the construction of the tax indicator, which includes only goods subject to sales and consumption taxes, and the choice of the weighting matrix that minimizes cross-border shopping.

The effects of regulation is also important to notice. The negative coefficient of  $ETCR$  in 2SLS and GMM estimates becomes bigger in size and significant at the 1% level suggesting that *a one point increase in ETCR produces about a 0.5 percentage points decrease in the effective tax rate CTAX*. Finally, the positive significant coefficient of  $VAT$  indicates that the adoption of a value-added based system of commodity taxation entails an increase of the effective tax rate up to 0.8 percentage points while the negative significant coefficient of  $EUVAT93$  suggests that the EU VAT reform reduces the average effective consumption tax rate by 0.5 percentage points. The former finding is consistent with the view that the

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this case 2SLS and GMM yield different results. In fact, 2SLS collapses the information contained in the  $l$  instruments to derive only  $k$  moment conditions. The GMM estimator solves a different optimization problem, by deriving  $l$  moment conditions and using them to derive the optimal weighting matrix. As a result, the GMM estimator is more efficient than the 2SLS estimator. However, the highest efficiency of GMM comes at a price in terms of estimates' precision in the presence of small sample size. For this reason it is useful to report both estimates, to have an overview of results that keeps into account the possible bias arising under each estimator. Note finally that 2SLS and GMM assign all instruments to all first stage regressions, leaving each instrument free to 'bind' in the relative first-stage equation. In the sensitivity analysis we assign each instrument directly to the 'a priori' relevant endogenous regressor (i.e.  $VAT_{TP}$  and  $EUVAT93_{TP}$  to  $CTAX_{TP}$  and  $OrderNation$ ,  $DisTrust$  to  $ETCR$ ), by estimating the entire system of equations by three stages-least-squares (3SLS).

<sup>18</sup>The low Kleibergen-Paap rk Wald F-statistics seems to suggest instruments are weak. However this is driven by the fact that we take five lags of  $OrderNation$  and  $DisTrust$ . Five years lags minimize endogeneity issues, but also impose a cost in terms of instruments' explanatory power in the first stage. Overall, we decide to keep this specification for two reasons. First, the Kleibergen-Paap rk LM statistic rejects at the 1% level the null hypothesis that the system is underidentified in the first stage; second the Anderson-Rubin statistic, which is robust to the presence of weak instruments, confirms that endogenous regressors are jointly significant in the second stage.

switch from a sales-based to a value added based system of commodity taxation increases tax collection, and therefore the effective tax rate. The latter suggests that the 1993 reform reduced VAT efficiency in the EU e.g. favouring tax avoidance practices (see OECD [26] for a review).

Table 2 reports the estimates of the regulation policy responses (24). In column [1] we present OLS estimates, which assume that  $ETCR_{TP}$  is exogenous. However, as explained above, there are sound theoretical reasons to think that  $ETCR_{TP}$  is endogenous. Thus, in columns [2] and [3] we also perform 2SLS and GMM, using five years lags of  $OrderNation_{TP}$ , and  $DisTrust_{TP}$  as instruments for  $ETCR_{TP}$ . Econometric tests confirm that instruments are strongly correlated with the endogenous regressors, explain a large share of their variance in the first stage and provide valid exclusion restrictions in the second stage, thus allowing a robust inference. As in the previous case, the Pagan-Hall and Wooldridge tests reject at the 1% level the null hypotheses of homoskedasticity and absence of serial correlation in the idiosyncratic errors. Consequently, in columns [2] and [3] we report HAC standard errors. Also in this case the RESET test confirms that we do not have problems of omitted variables or misspecified functional form. The coefficients in Table 2 indicate that regulation policies are strategic complements: *a one point increase of  $ETCR_{TP}$  entails a rise of about 0.5 points in  $ETCR$* . The coefficient of  $DisTrust$  takes the expected (positive) sign. It indicates that a 10 percentage points increase in the share of people who demands more regulation in the country (either to enhance security or enjoy more rents) produces a 0.3 points increase in  $ETCR$ .

It is important to clarify the economic magnitude of the forces just described because the  $ETCR$  measure of product market regulation is a synthetic index whose measurement is not straightforward. We interpret our results referring to a more intuitive measure of product market regulation, i.e., the number of days that are necessary to start up a new business ( $StartUp$ ). This is one of the measures proposed by Djankov et al. [14], used by the recent literature on determinants and economic impacts of product market regulation (e.g. Aghion et al. [1]). Over the period 2003-2008, for which both indicators are available, the standard deviations of  $ETCR$  and  $StartUp$  are respectively equal to 0.56 (over a scale of 0 to 6) and 20 (days) while the two indicators are strongly correlated. Thus, the number of days corresponding to the standard deviation of  $ETCR$  over the period 1990-2008 (i.e., 1.49) can be approximated by  $1.49 * 20 / 0.56 \approx 53$  (days).<sup>19</sup> This is about one third of the

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<sup>19</sup>The correlation coefficient between the two indicators is 0.49, significant at the 1% level. It should be noted however that the two measures are not fully comparable. In fact the time-to-startup indicator refers to the whole economy while the  $ETCR$  indicator refers only to seven non-manufacturing industries. For this reason, it could be argued that the ‘ $ETCR$ -based’ standard deviation of 53 (days) underpredicts the true variability of product market regulation over the sample. In the next section, we analyze this issue more in detail when checking the robustness of our results against the use of the time-to-start up measure

reduction in time to start up achieved in the EU during the nineties. Taken at their face values, 2SLS estimates suggest that a deregulation wave that reduces the time to start-up by 53 days raises the effective commodity tax rate by  $(-0.53 * -1.49) = 0.79$  percentage points (compare Table 1, column [2]). They also suggest that a country will cut its time to start-up by  $53 * 0.48/1.49 \approx 17$  days in response to a deregulation wave in trade partner countries that cut their time to start-up a firm by 53 days (compare Table 2, column [2]).<sup>20</sup>

To summarize, in this section, we have provided empirical evidence of absence of strategic interaction in commodity taxation, negative impact of regulation on taxes, and finally presence in strategic complementarity of regulation policies. The first result contrasts with previous studies that documented strategic complementarity of taxes in origin-based regimes (Devereux et al. [12] and Lockwood and Migali [24]). The second result provides indirect evidence that demand for public goods is more sensitive to income than that for private goods. The third result suggests a weak love for variety, which is consistent with empirical results by Hummels and Klenow [21] and Ardelean [4].

## 5 Sensitivity analysis

### 5.1 Simultaneous equations models

Our 2SLS and GMM estimates reported in Tables 1 and 2 are methods of limited information that may deliver asymptotically inefficient estimates. In fact, they neglect that the choice of the tax levels can be correlated with the regulation choice. Moreover, they assume symmetric foreign counterparts of response functions (23) and (24), but neglect to estimate them.

We check the robustness of our results to the adoption of full-information methods and estimate a system of four simultaneous equations that allows us to deal with these limitations. In particular, our model suggests that domestic and foreign regulation preferences only affect domestic and foreign levels of regulation, respectively. Furthermore, the occurrence of a commodity tax reform in each country shall only affect local commodity tax rates. Thus, we assign *OrderNation*, *DisTrust* to the *ETCR* equation (by symmetry, *OrderNation<sub>TP</sub>* and *DisTrust<sub>TP</sub>* to the *ETCR<sub>TP</sub>* equation) and *EUVAT93* and *VAT* to the *CTAX* equation (by symmetry, *EUVAT93<sub>TP</sub>*, *VAT<sub>TP</sub>* to the *CTAX<sub>TP</sub>* equation).

In Table 3 we report two sets of estimates. In column [1], we report seemingly unrelated regressions (SUR), which assume exogeneity of all regressors. In column [2], we report three stages least squares (3SLS) estimates that use the specified set of instruments to address

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of regulation.

<sup>20</sup>For these back-of-the-envelope calculations we prefer using 2SLS as they tend to be more precise than GMM estimates with a small sample.

regressors' endogeneity. Under the assumption that these models are correctly specified, SUR and 3SLS estimates are asymptotically more efficient than OLS and 2SLS/GMM.<sup>21</sup>

For expositional simplicity we only report coefficients for the domestic specifications, as these are directly comparable with previous estimates. 3SLS estimates confirm the absence of any form of commodity tax competition once we deal with endogeneity issues. They also point to a broadly similar impact of domestic regulation on domestic taxation as the one predicted by 2SLS/GMM estimates, respectively. Finally they also confirm that regulation policies are strategic complements. Moreover, SUR and 3SLS estimates increase the economic significance of *EUVAT93*, *OrderNation*, and *Distrust*. The estimates for *CTAX<sub>TP</sub>* and *ETCR<sub>TP</sub>* (not reported, but available to the authors upon request) are very similar to those reported in Table 3 for sign and significance, while coefficients are significantly smaller. This probably reflects the fact that each country is small relative to the sum of its trade partners.

## 5.2 Alternative measure of regulation: time to start up

The *ETCR* measure of product market regulation presents the disadvantages of being a synthetic index whose interpretation is not immediate and whose measurement is restricted to a subset of industrial sectors (see Conway and Nicoletti [11] for details about measurement issues related to *ETCR*). Thus, we check the robustness of our results using the measure of product market regulation proposed by Djankov et al. [14], i.e., the number of days which are necessary to start up a new business (*StartUp*).

Table 4 reports the estimates for the tax policy response (panel a) and the regulation policy response (panel b). Caution is needed when looking at these estimates mostly due to the short time spell ( $T = 7$ ), which makes *StartUp* much less suitable than *ETCR* to panel data analysis. The short period has several implications: (i) it does not allow us to exploit the relevant time variation in product market regulation due to the reforms that took place during the nineties; (ii) it renders trivial the addition of time fixed effects and reduces the asymptotical properties of the fixed effect estimator for  $T \rightarrow \infty$ ; (iii) it reduces the correlation of the instruments with the endogenous regressor as it allows us to exploit only the time variation of social preferences between the periods 2000/04 and 2005/08; (iv) it does not allow to identify strategic interactions in commodity taxation as the instruments *VAT<sub>TP</sub>* and *EUVAT93<sub>TP</sub>* do not exhibit enough time variation during 2002-2008.<sup>22</sup>

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<sup>21</sup>The main pitfall of simultaneous equations models is that there is no meaningful way to check that the system of equations is correctly specified, thus the choice of the appropriate model is only based on theoretical considerations. In the case of 3SLS, the choice of an inappropriate model may result in lack of consistency of the estimator (see Wooldridge [35] for details).

<sup>22</sup>The Doing Business data include country level observations for the period 2003-2008 and has been constructed using the exact methodology proposed by Djankov et al. [14]. We exploit this characteristic and

Econometric tests confirm the validity of the set of instruments based on social preferences for regulation. The estimates broadly confirm the negative impact of product market regulation on the level of consumption taxes and the strategic complementarity of regulation policy. It naturally comes to compare these numbers to those obtained when using *ETCR* as a measure of regulation. Estimates in Table 4 suggest that a 53 days reduction of domestic time-to-start up increases the domestic effective tax rate on consumption by  $(0.03 * 53) = 1.5$  percentage points and induces trade partners to reduce their time-to-start up by 74 days, on average. These numbers are bigger than those predicted using the *ETCR* measure. While this may suggest that ETCR, being computed only on seven sectors, tend to underpredict the true economic effects of product market regulation, caution is needed since estimates in Table 4 are asymptotically biased for  $T \rightarrow \infty$ .

### 5.3 Alternative weighting schemes and specifications

So far we have weighted foreign countries' commodity taxes and regulation policies using the import shares predicted by contiguity in culture, legal origins and geographical location. As we explained earlier, this choice allows us to isolate the destination principle and minimize cross-border shopping effects. In Table 5, we carry out a sensitivity analysis against the use of alternative weighting schemes. First we consider that some of the factors that we use to predict a country's import may be more important than others in determining countries' strategic interaction in fiscal and regulation policies. Thus in column [1] we consider weights based only on a country's trading partners sharing the same culture (as measured by language, religion and historical relationships), while in column [2] we adopt weights based on a country's trading partner sharing the same legal origins.<sup>23</sup> In column [3] we consider neighborhood weights, which are typically used in empirical research focusing cross-border shopping effects (Devereux et al. [12] and Lockwood and Migali [24]). This allows us to check the sensitivity of our results to the tax principle. In fact, if the sign and significance of our coefficients do not change with neighborhood weights, that would indicate that our results might be simply generated by some omitted variables bias that is independent on the tax principle adopted. Finally, in column [4] we also check our results against the use of 'placebo' weights, which are randomly chosen disregarding any economic consideration. If we find that sign and significance of our coefficients remain constant even when using placebo weights, that might indicate some correlation generated by omitted variables bias, which would cast further doubts on the economic interpretation of our findings.

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use the 1998 value as a basis to extrapolate the country-level values of StartUp for the 2002, thus extending the time series dimension of the panel.

<sup>23</sup>Cultural weights are constructed considering an exogenous score equal to 1 for each of the cultural controls in the initial gravity equation (see Appendix for details). The legal weight simply considers as trade partners countries that share the same legal origin and the same border, respectively.

The comparison of the estimates in column [1] with the 2SLS/GMM estimates in Tables 1 and 2 shows that cultural closeness does not explain a relevant portion of the correlation between social preferences and regulation. In fact cultural weights considerably reduce the power of instruments in the regulation policy reaction function, resulting in a likely problem of underidentification (panel b). As a result of the weak correlation between social preferences and regulation, the performance of instruments is even poorer in the tax reaction function (panel a). Overall, sign and significance of coefficients do not change. The estimates in column [2] instead suggest that the common legal origins are important determinants of the correlation between social preferences and regulation, as shown by the higher values of weak and underidentification test statistic in panels a and b. Also in this case, the size and significance of the coefficients remain roughly stable. Interestingly, when we opt for neighborhood weights in column [3], the evidence of competition in regulation policy disappears, while some evidence of commodity tax competition appears. This is consistent with the view that neighborhood weights put more emphasis on cross-border shopping effects because of the existence of origin-based consumers' transactions and confirms that results reported in Tables 1 and 2 are specific to the destination principle. In column [4], we finally report estimates when we use weights based on the 'nonsense' procedure by Case et al. [10], which assigns  $\omega_{ij} > 0$  if the name of country  $j$  comes after country  $i$  in the alphabet. Evidence in column [4] indicates that the use of placebo weights cancels any evidence of competition in regulation policy in panel b while induces a negative significant coefficient if  $CTAX_{TP}$  in panel a, which suggest a bias similar to the one arising in OLS estimates (compare Table 1, column [1]).

Finally, in Table 6, we perform a number of robustness checks against alternative specifications. First, we run our model without controls, i.e., just with the country and time fixed effects. This allows us to reduce the number of parameters to be estimated relative to the number of available observations. The sharp increase of the Hansen J-statistics in panel a in column [1] suggests the omission of controls introduces some omitted variable bias in the estimates of the commodity tax policy. In contrast, the omission of controls does not introduce any bias in the estimates of the regulation policy. The more significant coefficient of *OrderNation* and Wald F-statistics indicate that the instruments have a higher explanatory power in the first stage regressions of the regulation policy if we do not include the set of controls.

We also investigate whether our results are driven by unobserved country specific shocks in an open economy. We replace the country fixed effects with country specific time trends in column [2]; we add controls for the output gap and the real exchange rate in column [3]; we add a control for trade openness in column [4]. The estimated coefficients and econometric tests do not significantly differ from our previous estimates. This confirms that unobserved heterogeneity associated with asymmetric shocks is not a concern in our

estimates. Among the cyclical controls (not reported) the output gap displays a negative weakly significant impact on regulation policy. This suggests that, on average, economic expansions (as measured by a rise of the actual output over its expected level) are associated with a lower regulation. The coefficient of the trade-to-GDP ratio (not reported) displays a weak positive impact on  $CTAX$ . This suggests that a country's propensity to import is also associated with a higher ability to tax consumption.

We check whether our results are driven by unobserved country specific differences in individuals' civiness and 'tax morale'. In fact, it is generally argued that trust is an important determinant of tax morale (e.g. Tekeli [29]). If this was the case, previous estimates would simply reflect the fact that low unobserved levels of tax morale induce low effective tax rates on consumption and a high degree of regulation. In Table 6, column [4] we add among the set of controls a measure of social tax morale drawn from the WVS and EVS (see appendix for details). Tax morale indeed displays a significant negative impact on  $CTAX$  and a significant positive impact on  $ETCR$  (coefficients are not reported); still our results do not significantly differ from those reported in Tables 1 and 2.

It can be argued that equation (23) is misspecified as (i) it relies on the hypothesis that foreign and domestic regulation policies have a symmetric impact on consumption taxes (i.e., it assumes that  $ETCR=ETCR_{TP}$ ) and (ii) allows for the presence of commodity tax competition even though there are not clear theoretical reasons for tax competition under the destination principle. In Table 6, column [6], in panel a we deal with these objections by keeping domestic regulation distinct from foreign regulation and neglecting foreign commodity taxation. Results show a positive (still not significant) coefficient of  $ETCR_{TP}$  and a bigger negative coefficient of  $ETCR$ . This evidence may suggest a weak positive spillover effect of foreign regulation on domestic consumption. If neglected, this may underestimate the actual impact of domestic regulation on local commodity taxes. Finally, in column [7] we perform the estimates over the four periods average. Point estimates and econometric tests confirm that our results hold in a medium run perspective despite of the very small number of observations in the sample.

## 6 Conclusions

In this paper, we study competition in product market regulation and commodity tax rates between two trading partner countries using a general equilibrium setup where destination-based consumption taxes finance public good provision and regulation influences the number of firms in the economy. The model generates three theoretical predictions. First, commodity tax rates are strategic, independent instruments. This is in line with the literature on commodity tax competition under the destination principle. Second, regulation policies are

strategic complements as long as consumers do not over value product variety. Third, regulation has a negative impact on commodity tax rates if demand for public goods is more sensitive to income than demand for private goods. In the empirical part of the paper, we specified an empirical model to estimate the direction of the forces described by the theory using data on OECD countries. We found evidence to support the absence of strategic tax interaction, the presence of strategic complementarity in regulation policies, and a negative impact of regulation on commodity taxes. More specifically, taken at face value, our estimates suggest that a domestic deregulation process that reduces the time to firm start-up by 53 days leads to a rise in the effective commodity tax rate of 0.79 percentage points and triggers a deregulation process of about 17 start-up days in trade partner countries. Overall, these magnitudes are non-negligible considering that, on average, EU countries in the 1990s reduced time to start up by about 160 days.

Finally, our results shed light on the relationship between the various policies of trading partner countries. First, (de)regulation policies change significantly the magnitude of tax revenues collected through consumption taxes. This is particularly important as over the early 1990s commodity taxation has become an very important instrument of public finance, particularly in the EU. Our research suggests that deregulation of commodity markets leads to an increase in commodity tax revenues. Put differently, if the aim of the government is to increase tax revenues from consumption, this will be difficult to achieve if government increases entry regulations on commodity markets. Our findings suggest also that the regulation policies of neighboring countries have externalities on other countries, namely they lead to tax revenue shortages due to their effect on domestic regulation and ultimately on domestic commodity tax rates.

To our knowledge, this contribution is the first theoretical study and empirical verification of international interactions between regulators and their effects on commodity taxes. This paper sets the stage for further research. For instance, it would be interesting to disentangle the possible objectives of regulators in terms of product safety, product quality, bureaucracy and corruption. This should be done theoretically and empirically.

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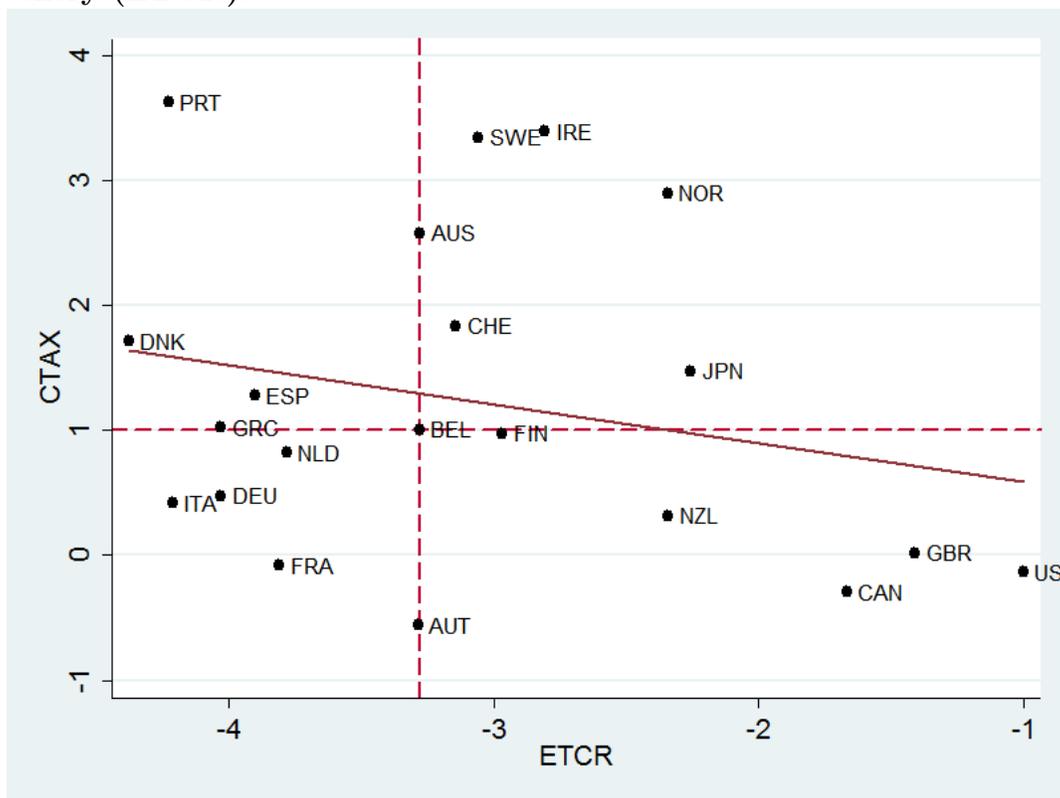
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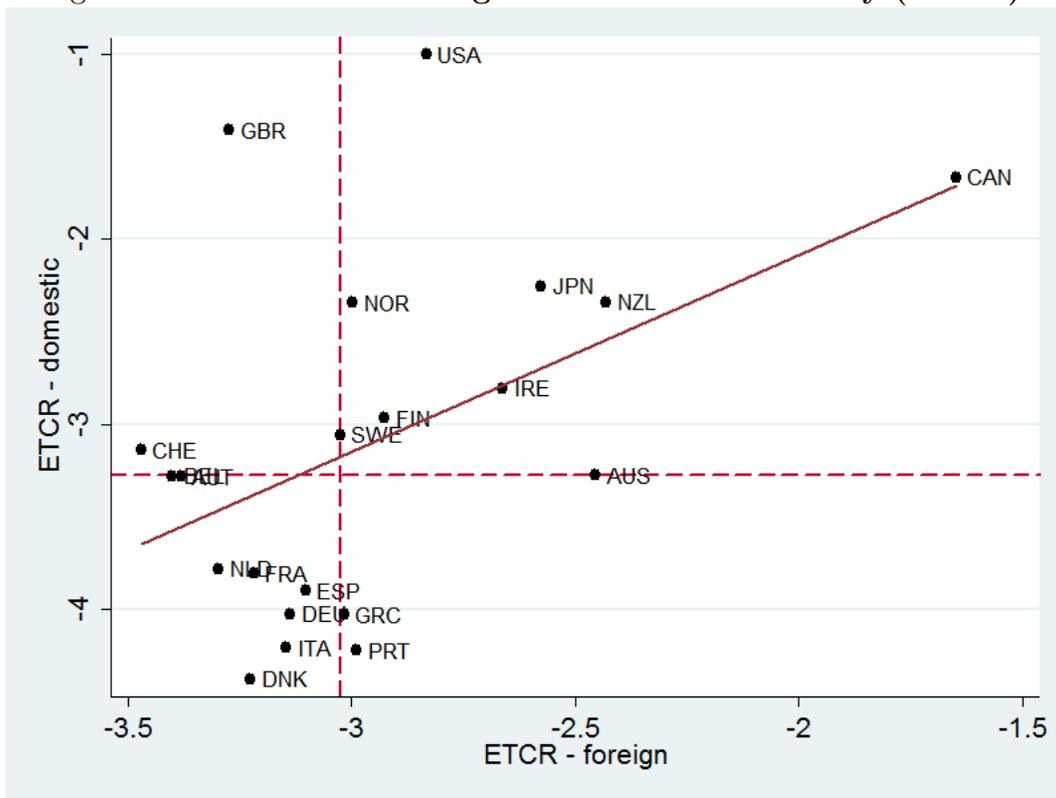
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Figure 1: Average effective tax rate on consumption (CTAX) and barriers to firms' entry (ETCR).



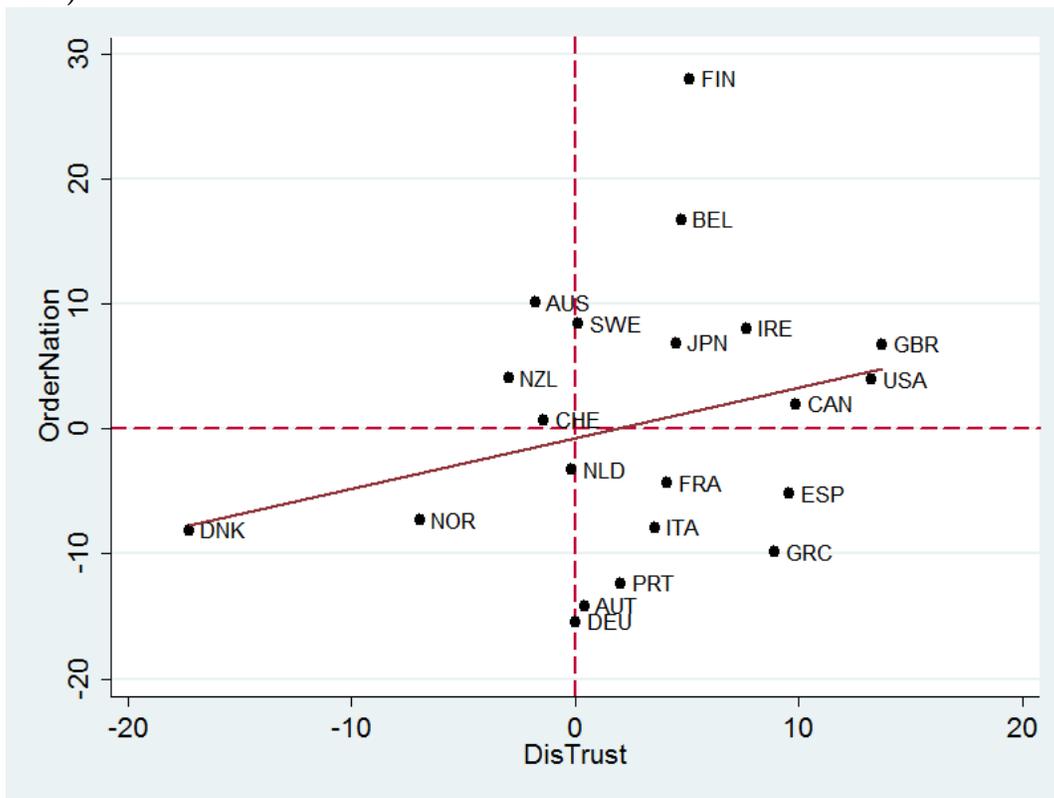
Notes: Differences between country averages over the periods 2004/08 and 1990/94.  
 Authors' calculation on OECD data.

Figure 2: Domestic and foreign barriers to firms' entry (ETCR).



Notes: Differences between country averages over the periods 2005/08 and 1990/93.  
Authors' calculation on OECD data.

Figure 3: Preferences for order in nation (OrderNation) and distrust other people (DisTrust).



Notes: Differences between country averages over the periods 2004/08 and 1990/94.  
Authors' calculation on EVS/WVS data.

Table 1: Commodity tax response

	[1] OLS	[2] 2SLS	[3] GMM
CTAX <sub>TP</sub>	-0.84** (0.33)	0.72 (1.19)	0.73 (1.18)
ETCR	-0.14** (0.06)	-0.53*** (0.20)	-0.52*** (0.20)
VAT	0.78*** (0.20)	0.73*** (0.26)	0.74*** (0.26)
EUVAT93	-0.28 (0.18)	-0.38* (0.22)	-0.39* (0.21)
R sq.	0.99	0.98	0.98
N	389	389	389
Shea Partial R2			
	CTAX <sub>TP</sub>	-	0.07
	ETCR	-	0.11
K-P rk Wald F-stat	-	1.725	1.725
K-P rk LM-stat (p-value)	-	17.89 (0.00)	17.89 (0.00)
Hansen J-stat (p-value)	-	0.154 (0.93)	0.154 (0.93)
A-R Wald test (p-value)	-	13.38 (0.01)	13.38 (0.01)

**Notes:** *ETCR* is lagged by two years. *ETCR* and *CTAX<sub>TP</sub>* are instrumented by *OrderNation* and *DisTrust* in five years lags, *VAT<sub>TP</sub>* and *EUVAT93<sub>TP</sub>*, in columns [2] and [3]. All specifications include one year lagged total population, per capita GDP, government consumption expenditure, real interest rate on government bonds. Specifications also include dummies for rightwing government, country belonging to the EU and the EMU plus country and time fixed effects. We report robust standard errors in parentheses in column [1] and Heteroskedasticity and autocorrelation consistent standard errors in parentheses in columns [2] and [3]. Significance levels: \* : 10% \*\* : 5% \*\*\* : 1%.

Table 2: Regulation response

	[1] OLS	[2] 2SLS	[3] GMM
$ETCR_{TP}$	0.55*** (0.12)	0.48*** (0.18)	0.46*** (0.16)
OrderNation	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
DisTrust	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)
R sq.	0.93	0.93	0.93
N	399	399	399
Partial Rsq	-	0.52	0.52
K-P rk Wald F-stat	-	52.99	52.99
K-P rk LM-stat (p-value)	-	36.29 (0.00)	36.29 (0.00)
Hansen J-stat (p-value)	-	0.090 (0.76)	0.090 (0.76)
A-R Wald test (p-value)	-	7.334 (0.02)	7.334 (0.02)

**Notes:**  $ETCR_{TP}$  is instrumented by five years lag of  $OrderNation_{TP}$  and  $DisTrust_{TP}$  in columns [2] and [3]. All specifications include one year lagged total population and per capita GDP. Specifications also include dummies for rightwing government, country belonging to the EU and the EMU plus country and time fixed effects. Robust standard errors in parentheses in column [1]. Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors in parentheses in columns [2] and [3]. Significance levels: \* : 10% \*\* : 5% \*\*\*: 1%.

Table 3: Alternative estimators: simultaneous equations models

	[1] SUR		[2] 3SLS	
	CTAX	ETCR	CTAX	ETCR
CTAX <sub>TP</sub>	-0.96*** (0.26)		0.48 (0.40)	
ETCR	-0.22*** (0.06)		-0.37*** (0.11)	
EUVAT93	-0.37** (0.17)		-0.42** (0.17)	
VAT	1.02*** (0.16)		1.05*** (0.16)	
ETCR <sub>TP</sub>		0.85*** (0.13)		0.86*** (0.14)
OrderNation		0.01*** (0.00)		0.01*** (0.00)
DisTrust		0.03*** (0.01)		0.03*** (0.00)
R sq.	0.99	0.93	0.98	0.93
N	370	370	370	370

**Notes:** SUR and 3SLS estimates of a four equations' system with four endogenous variables (*CTAX*, *CTAX<sub>TP</sub>*, *ETCR*, *ETCR<sub>TP</sub>*). *CTAX* is instrumented by *EUVAT93* and *VAT*, while *ETCR* is instrumented by *OrderNation* and *DisTrust* in column [2]. Only results for domestic specifications are reported while foreign specifications are perfectly symmetric. Each (domestic and foreign) equation also includes the usual set of controls as in Tables 1 and 2. Robust standard errors in parentheses. Significance levels: \* : 10% \*\* : 5% \*\*\* : 1%.

Table 4: Alternative measure of regulation: number of days to set up a business

	[1] OLS	[2] 2SLS	[3] GMM
<b>Panel a: regulation and tax policy (CTAX)</b>			
StartUp	-0.00 (0.00)	-0.03** (0.01)	-0.03** (0.01)
R sq.	0.99	0.99	0.99
N	146	146	146
Partial Rsq	-	0.14	0.14
K-P rk Wald F-stat	-	4.256	4.256
K-P rk LM-stat (p-value)	-	8.962 (0.01)	8.962 (0.01)
Hansen J-stat (p-value)	-	1.452 (0.23)	1.452 (0.23)
A-R Wald test (p-value)	-	22.59 (0.00)	22.59 (0.00)
<b>Panel b: regulation competition (StartUp)</b>			
StartUp <sub>TP</sub>	1.17*** (0.30)	1.46*** (0.38)	1.32*** (0.36)
R sq.	0.79	0.79	0.79
N	146	146	146
Partial Rsq	-	0.54	0.54
K-P rk Wald F-stat	-	56.48	56.48
K-P rk LM-stat (p-value)	-	29.99 (0.00)	29.99 (0.00)
Hansen J-stat (p-value)	-	1.201 (0.27)	1.201 (0.27)
A-R Wald test (p-value)	-	15.06 (0.00)	15.06 (0.00)

**Notes:** Controls in panel a include *POP*, *GDPxc*, *Right*, *Rexch*, *CG* and *Irate*. Controls in panel b include *POP*, *GDPxc*, *Right*, *Rexch*, five years lags of *OrderNation* and *DisTrust*. All specifications also include country fixed effects. In panel a, columns [2] and [3] *StartUp* is instrumented by five years lags of *OrderNation* and *DisTrust*. In panel b, columns [2] and [3] *StartUp<sub>TP</sub>* is instrumented by five years lags of *OrderNation<sub>TP</sub>* and *DisTrust<sub>TP</sub>*. Robust standard errors in parentheses in column [1]. Heteroskedasticity and Autocorrelation Consistent (HAC) standard errors in parentheses in columns [2] and [3]. Significance levels: \* : 10% \*\* : 5% \*\*\* : 1%.

Table 5: Alternative weighting schemes

	[1] cultural weights	[2] legal weights	[3] neighborhood weights	[4] placebo weights
<b>Panel a: regulation and tax policy (CTAX)</b>				
ETCR	-0.72*** (0.23)	-0.63** (0.25)	-0.23 (0.20)	-0.62*** (0.22)
CTAX <sub>TP</sub>	0.52 (0.46)	-0.00 (0.39)	0.73** (0.31)	-0.40** (0.18)
R sq.	0.98	0.98	0.98	0.98
N	389	389	389	389
K-P rk Wald F-stat	2.303	4.056	2.388	6.206
K-P rk LM-stat (p-value)	6.737 (0.08)	13.28 (0.00)	14.89 (0.00)	19.21 (0.00)
Hansen J-stat (p-value)	2.886 (0.28)	0.32 (0.85)	2.336 (0.31)	0.79 (0.45)
<b>Panel b: regulation competition (ETCR)</b>				
ETCR <sub>TP</sub>	0.88*** (0.33)	0.37** (0.14)	0.08 (0.23)	-0.13 (0.21)
R sq.	0.88	0.93	0.93	0.93
N	399	399	399	399
K-P rk Wald F-stat	3.574	42.25	12.34	17.18
K-P rk LM-stat (p-value)	6.962 (0.03)	35.86 (0.00)	18.36 (0.00)	12.39 (0.00)
Hansen J-stat (p-value)	1.244 (0.26)	0.013 (0.91)	1.251 (0.26)	0.025 (0.97)

**Notes:** GMM estimates with HAC standard errors in parentheses. All specifications in panel a,b include the same set of controls as in Tables 1 and 2, respectively. Significance levels: \* : 10% \*\* : 5% \*\*\*: 1%.

Table 6: Alternative specifications

	[1] only country and time dummies	[2] country spec. time trends	[3] economic cycle	[4] trade openness	[5] tax morale	[6] regulation competition	[7] 5 years averages
<b>Panel a: regulation and commodity tax policy</b>							
CTAX <sub>TP</sub>	-0.59 (1.26)	0.72 (1.21)	0.68 (1.21)	1.38 (1.31)	0.64 (1.18)	- -	1.06 (1.00)
ETCR	-0.43** (0.16)	-0.52*** (0.19)	-0.53*** (0.19)	-0.42** (0.21)	-0.60*** (0.21)	-0.64*** (0.24)	-0.69*** (0.23)
ETCR <sub>TP</sub>	- -	- -	- -	- -	- -	0.30 (0.41)	- -
R sq.	0.97	0.98	0.98	0.98	0.98	0.99	0.98
N	399	389	389	389	389	389	83
K-P rk Wald F-stat	2.648	1.577	1.544	1.319	1.880	15.58	4.425
K-P rk LM-stat (p-value)	15.21 (0.00)	17.88 (0.00)	18.10 (0.00)	16.81 (0.00)	19.34 (0.00)	18.31 (0.00)	10.10 (0.02)
Hansen J-stat (p-value)	4.06 (0.13)	0.14 (0.93)	0.26 (0.88)	0.01 (0.99)	0.22 (0.89)	0.36 (0.83)	0.41 (0.81)
<b>Panel b: regulation policy</b>							
ETCR <sub>TP</sub>	0.98*** (0.16)	0.46*** (0.16)	0.45*** (0.16)	0.47*** (0.17)	0.51*** (0.17)	- -	0.42* (0.22)
OrderNation	0.02*** (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	- -	0.01 (0.01)
DisTrust	0.03*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.02*** (0.01)	0.03*** (0.01)	- -	0.03** (0.01)
R sq.	0.91	0.93	0.93	0.93	0.93	-	0.95
N	399	399	399	378	399	-	84
K-P rk Wald F-stat	60.12	53.33	53.39	50.71	49.62	-	19.86
K-P rk LM-stat (p-value)	33.68 (0.00)	36.40 (0.00)	34.50 (0.00)	35.97 (0.00)	33.86 (0.00)	-	12.96 (0.00)
Hansen J-stat (p-value)	0.06 (0.81)	0.10 (0.74)	0.36 (0.55)	0.19 (0.65)	0.09 (0.76)	-	0.04 (0.85)

**Notes:** GMM estimates with HAC standard errors in parentheses. All specifications in panel a,b include the same set of controls as in Tables 1 and 2, respectively. Exceptions are: column [1] where we use only country and time dummies; column [2] where we use country specific time trends instead of country fixed effects; column [3] where we include the output gap and the real exchange rate; columns [4] and [5] where we add controls for tax morale and trade openness, respectively; column [6], panel a, where we replace  $CTAX_{TP}$  by  $ETCR_{TP}$  and instrument it by the five years lags of  $OrderNation_{TP}$  and  $DisTrust_{TP}$ . Significance levels: \* : 10% \*\* : 5% \*\*\* : 1%.

## Appendix A Data

**ETCR:** we restrict our attention on the ‘low level’ ETCR indicator which measures the barriers to entry of new firms in seven non-manufacturing industries: electricity, gas, air passenger transport, rail transport, road freight, and postal services. In the *energy sector* indicators for entry regulation focus on terms and conditions for third party access (TPA) and the extent of choice of supplier for consumers. Entry regulation in *rail transport services* distinguishes i) free entry (with access fees to the rail network infrastructure), ii) franchising to several firms and iii) franchising to a single firm. Entry regulation in *passenger air transport services* covers, on the domestic side, the liberalization of internal routes and, on the international side, the participation in an agreement liberalizing access to routes within a region. Entry regulation in *road freight* looks at more subtle ways in which entry can be thwarted in this eminently competitive sector: through a restrictive or discretionary licensing system and through the intervention of incumbents in decisions concerning entry or price setting. In the *communication sector*, indicators for entry regulation are based on legal limitations on the number of competitors allowed in each of the post and telecommunications markets covered by the analysis (see Conway and Nicoletti [11] for further details).

**CTAX:** We followed the methodology by Carey and Rabesona [9] which computes the marginal effective tax rates relating the tax revenues to the relative tax base. We thus apply the following formula

$$CTAX = \frac{T5110}{(CP + CG - CGW)} * 100 \quad (A-1)$$

where:

*T5110*: general taxes on good and services (includes VAT, sales taxes and other taxes on goods and services; OECD Revenue Statistics).

*CP*: Private final consumption expenditure (OECD National Accounts).

*CG*: Government final consumption expenditure (OECD National Accounts).

*CGW*: Government final wage consumption expenditure (OECD National Accounts).

Notice that (A-1) is different from the definition provided by Carey and Rabesona [9] in that it excludes those revenues which are most likely to reflect the application of the origin principle to consumers’ transactions (i.e., excise taxes, profits of fiscal monopolies, custom and import duties and taxes on specific services). These tax items are nevertheless included in the denominator as they also provide the tax base to conventional VA/sales taxation.

**OrderNation, DisTrust:** *OrderNation* is constructed as the percentage of respondents which gives answer 1 (i.e., ‘maintaining order in nation’) to questions E003 in WVS1-5, V201 in EVS4, V190 in EVS3, Q532A in EVS2, V460 in EVS1. *DisTrust* is constructed as the percentage of respondents which gives answer 2 (i.e., ‘Can’t be too careful’) to questions A165 in WVS1-5, V62 in EVS4, V66 in EVS3, Q241 in EVS2, V208 in EVS1. We assigned

country observations for the available years to five periods, each period broadly corresponding to the intended coverage of a EVS/WVS wave. Alternative measures of DisTrust are the percentage of respondents which gives answer 4 (i.e., ‘none at all’) to questions *E069\_8* in WVS1-5, *V212* in EVS4, *V207* in EVS3, *q553i* in EVS2, *v546* in EVS1 (how much confidence in civil service) and the percentage of respondents which gives answer 4 (i.e., ‘none at all’) to questions *E069\_13* in WVS1-5, *v219* in EVS4, *027* in EVS3, *q554K* in EVS2, *v547* in EVS1 (how much confidence in major companies). The period is as follows:

*1980-89*: coverage by EVS1/WVS1 but for CHE, CZR and SLK covered by EVS2. Surveys carried in 1981 for AUS, BEL, DEU, DNK, ESP, FIN, FRA, GBR, IRE, JPN, NLD; 1982 for CAN, HUN, NOR, KOR, NOR, SWE, USA; 1984 for ICE and 1989 for CHE, CZR, POL, SLK.<sup>24</sup>

*1990-94*: coverage by EVS2/WVS2. Surveys carried in 1990 for AUT, BEL, CAN, DEU, DNK, ESP, FIN, FRA, GBR, ICE, ITA, JPN, KOR, NLD, NOR, POL, PRT, SWE, USA; 1991 for CZR, SLK, HUN. Notice that we have two observations for ESP (1990 and 1990) corresponding to both WVS2 and EVS2 being carried that year.

*1995-99*: coverage by EVS3/WVS3. Surveys carried in 1995 for AUS, ESP, JPN, USA; 1996 for CHE, FIN, KOR, NOR, SWE; 1997 for DEU and POL; 1998 for CZR, GBR, HUN, BEL, GBR, NZL, SLK; 1999 for AUT, BEL, CZR, DEU, DNK, ESP, FRA, GBR, GRC, HUN, ICE, IRE, ITA, NLD, POL, PRT, SWE, USA. Notice that we have two observations for ESP (1995 and 1999), DEU (1997 and 1999), GBR (1998, 1999), HUN (1998, 1999) and USA (1999), corresponding to both WVS3 and EVS3 being carried in those countries.

*2000-04*: coverage by WVS4 but for FIN and NZL, covered by EVS3 and WVS5, respectively. This period is generally not covered by any EVS wave, thus the majority of European countries is not surveyed. Surveys carried in 2000 for CAN, ESP, FIN, JPN; 2001 for KOR; 2004 for NZL.

*2005-08*: coverage by EVS4/WVS5. Surveys carried in 2005 for AUS, FIN, ITA, JPN, KOR, POL; 2006 for CAN, DEU, FRA, GBR, NLD, SWE, USA; 2007 for CHE, ESP; 2008 for AUS, CHE, CZR, DEU, DNK, ESP, FRA, GRC, HUN, IRE, NLD, NOR, POL, PRT, SLK. Notice that we have two observations for AUS (2005 and 2008), CHE (2007 and 2008), DEU (2006, 2008), ESP (2007, 2008), FRA (2006, 2008), NLD (2006, 2008), POL (2005, 2008), corresponding to both WVS5 and EVS4 being carried.

Observations were averaged out by country and period thus obtaining an unbalanced panel of (up to) 27 countries for the covering the period 1990-2008 in five years averages. Missing observations were obtained by linear interpolation. The initial observation covering the period 1980-89, has not been used in the empirical analysis, but provided the basis to ob-

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<sup>24</sup>Data for former Czechoslovakia actually refer to 1990 but we decided to assign them to this period as 1990 in these countries is still representative of the pre-transition (transition in former Czechoslovakia was launched in 1991).

tain the observation for the period 1990-94 by linear interpolation rather than extrapolation for countries where observations were missing for this period.

**VAT, EUVAT93:** Dummies equal to 1 when the VAT system/VAT EU reform is introduced (OECD Consumption Tax Trends, 2008).

### **Other variables used in the analysis**

*StartUp:* Number of days to set up a business (Doing Business, World Bank).

*Euro:* Dummy variable equal to 1 when a country accesses the European Monetary Union.

*Right:* Rightwing Orientation of the Government (EXECRLC=1, World Bank's DPI).

*POP:* Total population (millions of individuals, World Bank's WDI).

*GDP:* Gross Domestic Product, current US dollars (World Bank's WDI).

*GDPxc:* Per capita GDP: Gross Domestic Product/Total population (World Bank's WDI).

*CGSH:* Government final consumption expenditure as a share of total GDP (OECD National Accounts).

*Irate:* Long-term interest rate on government's bonds (OECD Economic Outlook).

*Output gap:* Percentage deviation of output from trend (OECD Economic Outlook).

*Real exchange rate:* Ratio of home country's prices to a weighted average of competitor country's prices, relative to a base year (2000) and measured in US dollars. Therefore an increase is an appreciation of the home country's real exchange rate (OECD Main Economic Indicators).

*Trade to GDP ratio:* Ratio of trade flows over total GDP (OECD Main Economic Indicators).

*Tax Morale:* percentage of respondents which give score 8-10 (i.e., 'always') to the question 'do you think it is justifiable cheating on taxes' (WVS/EVS).

### **Variables used for the construction of the weights**

*Imp:* Total Imports in 1980, US dollars importer report (IMF DOTS).

*contig:* dummy equal to 1 if countries share a border (CEPII gravity dataset).

*smctry:* dummy equal to 1 if countries were are the same country (CEPII gravity dataset).

*collink:* dummy equal to 1 if countries have had common colonizer after 1945 or have ever had a colonial link or are currently in a colonia relationship (CEPII gravity dataset).

*comlang:* dummy equal to 1 if countries share a common official language or if a language is spoken by at least the 9% of the population in both countries. (CEPII gravity dataset).

*legorig:* dummy equal to 1 if countries share the same legal origin (Data on regulation used in Botero et al. [6]).

*dist*: distance between the most important cities/agglomerations (in terms of population) of the two countries (CEPII gravity dataset).

*distwces*: distance between the most important cities/agglomerations (in terms of population) of the two countries weighted by the share of the city in the overall country's population according to the general formula by Head and Mayer [19] with sensitivity of trade flows to bilateral distance equal to -1 (CEPII gravity dataset).

## Appendix B Weights' construction: augmented gravity equation

Based on our theoretical priors, we want to weight the strategic interaction of country  $i$  with country  $j$  based on its propensity to import from country  $j$ . A natural measure of this propensity would be given by the share of country  $i$ 's imports from country  $j$  over total country  $i$ 's imports. This measure however is endogenous with respect to consumption taxation and product market regulation due to both reverse causality and omitted variables bias.<sup>25</sup>

The first step to address endogeneity is to focus on imports in 1980 e.g. prior to the start of our sample. In this way we rid out the possibility of direct reverse causality from commodity taxes and product market regulation to imports. Using the past values of imports however does not address the issue of omitted variable bias in the presence of unobserved structural characteristics of the country which affect both regulation, taxation and imports. The second step we perform is then to construct a weight measure based on country  $i$ 's imports predicted by the structural characteristics of each  $ij$  couple of trade partners such as countries' size, distance, culture, legal origin, and historical relationship. We thus estimate the following augmented gravity equation where imports' flows are expressed as a function of the specific attributes of the importer and exporter (as captured by population size and per capita GDP) as well as time invariant 'dyadic' characteristics (see Head, Mayer and Ries [20] for details):

$$\begin{aligned} \ln(\text{Imp}_{ij}) = & a_1 \ln(\text{POP}_i) + a_2 \ln(\text{POP}_j) + a_3 \ln(\text{GDP}x_i) + a_4 \ln(\text{GDP}x_j) + & \text{(B-2)} \\ & + a_5 \ln(\text{Dist}_{ij}) + a_6 \text{contig}_{ij} + a_7 \text{collink}_{ij} + a_8 \text{comlang}_{ij} + a_9 \text{legor}_{ij} + \xi_{ij}. \end{aligned}$$

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<sup>25</sup>For example reverse causality may go from consumption taxes towards imports' shares if the level of taxes in country  $i$  influences the decision of country  $j$  to export in country  $i$  or in some other country  $-i$ . Along similar lines, product market regulation in country  $j$  determines the relative prices of its goods thus influencing the decision of country  $i$  whether to import from  $j$  or from some other country  $-j$ . Omitted variable bias may arise if unobserved structural characteristics exist of a country which affect both its over time variation in taxation, regulation and imports.

Results from OLS estimates are reported in Table B-1. From the estimate coefficients, we reconstruct the predicted imports' flows  $\widehat{Imp}_{ij}$ <sup>26</sup> and construct from it the exogenous weight as  $\omega_{ij} = \frac{\widehat{Imp}_{ij}}{\sum_{i \neq j} \widehat{Imp}_{ij}}$ .

Table B-1: Gravity equation - predicted imports.

$\ln(POP_i)$	0.76*** (0.03)
$\ln(POP_j)$	0.83*** (0.03)
$\ln(GDPxc_i)$	1.00*** (0.07)
$\ln(GDPxc_j)$	1.29*** (0.09)
$\ln(Dist_{ij})$	-0.65*** (0.03)
contig	0.18 (0.11)
collink	0.36* (0.19)
comlang	0.34*** (0.11)
legor	0.37*** (0.08)
Constant	-22.42*** (1.36)
R sq.	0.88
N	420

**Notes:** OLS estimates; robust standard errors in parentheses. Significance levels: \* : 10% \*\* : 5% \*\*\* : 1%.

<sup>26</sup>In equation (B-2) the coefficient of *contig* is very weakly significant at the 10% probably due to the fact that in our sample of 21 OECD countries the variation in the geographical position is mostly captured by the *distwces* variable. Nevertheless we decided to include *contig* in (B-2) due to the strong theoretical a priori in favour of the importance of shared borders to imports.

## Appendix C    Coefficients of the controls included in the main set of estimates

Table C-2: Commodity tax response: controls

	[1] OLS	[2] 2SLS	[3] GMM
EU	0.16 (0.29)	-0.10 (0.40)	-0.13 (0.38)
EMU	-0.42*** (0.12)	-0.53*** (0.15)	-0.53*** (0.14)
POP	-0.03*** (0.01)	-0.02 (0.01)	-0.02 (0.01)
GDP <sub>xc</sub>	0.22*** (0.03)	0.24*** (0.04)	0.24*** (0.04)
CGSH	0.13*** (0.04)	0.13*** (0.04)	0.13*** (0.04)
Irate	-0.21*** (0.03)	-0.20*** (0.03)	-0.20*** (0.03)
Right	0.11 (0.07)	0.07 (0.10)	0.07 (0.10)
Constant	6.17** (2.45)	-3.54 (7.90)	-3.53 (7.78)

**Notes:** These are the coefficients of the control variables in estimates reported in Table 1. Significance levels:    \* : 10%    \*\* : 5%    \*\*\* : 1%.

Table C-3: Regulation response

	[1] OLS	[2] 2SLS	[3] GMM
EU	-0.07 (0.15)	-0.07 (0.17)	-0.08 (0.17)
EMU	-0.54*** (0.11)	-0.55*** (0.13)	-0.55*** (0.13)
GDP <sub>xc</sub>	0.07*** (0.02)	0.07*** (0.02)	0.07*** (0.02)
POP	0.03*** (0.00)	0.03*** (0.00)	0.03*** (0.00)
Right	-0.12** (0.05)	-0.12** (0.06)	-0.13** (0.06)
Constant	-1.99*** (0.68)	-1.73* (0.96)	-1.60* (0.86)

**Notes:** These are the coefficients of the control variables in estimates reported in Table 2. Significance levels: \* : 10% \*\* : 5% \*\*\*: 1%.