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Abstract

This paper studies theoretically and empirically competition in commodity taxation and product market regulation between trading partner countries. We present a two-country general equilibrium model in which destination-based commodity taxes finance public goods, and product market regulation affects both the number of firms in the market and product diversity. We provide empirical evidence based on data for 21 OECD countries over the 1990-2008 period. Our results suggest that commodity taxation and product market regulation are interdependent policies. We find absence of strategic interaction in commodity taxation between governments. Furthermore, we show that domestic regulation has a negative effect on domestic commodity taxation. Finally, we demonstrate that product market regulation is a strategic complementary policy.

JEL-Codes: F000, H100, H700, H870, L500.

Keywords: regulation, commodity tax, strategic interactions.

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1 Introduction

This paper studies competition in product market regulation and commodity taxation between trading partners. There is a large literature that investigates the existence and impact of tax interactions between countries but much less attention has been devoted to the interdependence between taxes and market regulation in an international context. This is puzzling because, as Oates ([46] p. 377) writes, the "economic competition among governments makes use of a wide class of policy instruments *including both fiscal and regulatory policies* [...]".

In the present paper, we hypothesize that the choice of commodity taxation cannot be disentangled from product market regulation. Figure 1 shows that between 2004 and 2014, OECD countries reduced their time to start-up a new business by about 20 days, on average, meanwhile increasing their statutory VAT rate by more than 2 percentage points. While this pattern actually dates back to the 1970s[1], similar evidence is not documented for other taxes e.g. on labour or corporate income. Product market deregulation reduces costs on the production of goods and services, and on the entry of new firms (see Doing Business [17]). This may favor the creation of new product varieties, increase demand and consumer surplus (see e.g. Blanchard and Giavazzi [8]), and ultimately raise the incentives for governments to tax consumption (OECD [45]). Also, because the share of traded goods and services has increased a lot in recent decades, it is important to analyze this interdependence in an open economy setup. Indeed, when countries are open to trade, the effects of these two policy instruments are transmitted to trading partners, leading to strong interactions between countries' policy decisions.

Our aim is to investigate theoretically and empirically the existence of strategic interactions between commodity taxation and product market regulation in a setup of countries open to trade. We address three questions: First, is there any strategic interaction in commodity taxation under the destination principle? This is the most widely used principle of commodity taxation in developed countries and requires taxes to be imposed at the consumption location (i.e. a zero tax rate is applied on exports). Second, how do regulation policies affect commodity tax rates in an international context? Third, does a country's decision to weaken its market regulation institutions encourage its trading partner countries to weaken or strengthen their own regulatory framework?

In the first part of the paper, we discuss a general equilibrium model with two trading countries. Commodity taxation follows the destination principle, and tax rates are set by benevolent governments to finance public goods. For regulation, we propose a model with helping-hand government regulatory agencies which seek to protect consumer safety. Individuals working in firms consume private and public goods. Firms produce private goods, set their prices, and freely enter product markets. Regulation

[1]Figure 1 limits to the period 2004-2014 only, due to constraints to the availability of the *Doing Business* measure of product market regulation. However, a similar figure can be drawn starting from the 1970s, using the OECD ETCR measure of product market regulation.

imposes additional costs on firms' physical fixed costs affecting entry in the product market. The regulation level is decided before commodity taxation to reflect governments' greater flexibility when setting tax rates compared to restructuring regulatory processes and standards.[2] The model generates three theoretical predictions. First, commodity taxes are independent instruments under the destination principle. Second, governments may lower commodity tax rates if regulation becomes stricter. This is because regulation reduces the resources for total consumption, both private and public. When individual demand for public goods is more elastic, governments cut their provision of public services, and therefore taxes. Finally, if consumers do not value product diversity excessively, regulation polices are strategic complement instruments.

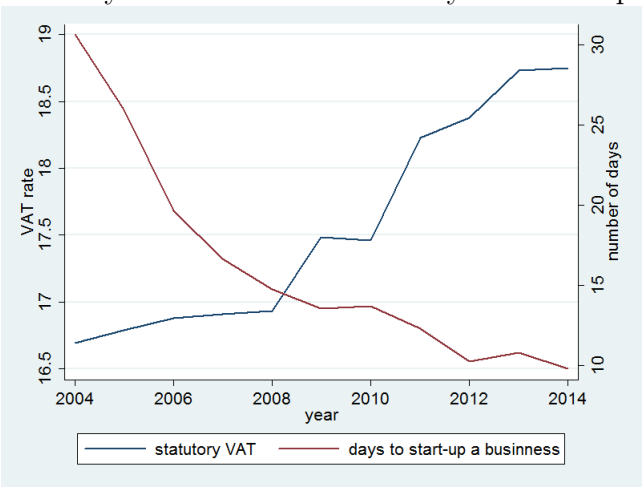
In the empirical part of the paper, we investigate our predictions using panel data for 21 OECD countries. Product market regulation is measured using the number of days required to start up a business, and the OECD measure of market regulation. Commodity tax rates are proxied by average effective tax rates on consumption. To focus on application of the destination principle, we exclude tax items that are not subject to this principle (e.g. those subject to excise taxes). We use instrumental variables to account for endogeneity issues typical of empirical analyses of policy interactions (Brueckner [9]). To the best of our knowledge, this paper is the first to exploit exogenous variation in tax reforms (i.e. the introduction of VAT systems in OECD countries) and social preferences for regulation (see e.g. Inglehart [28], Aghion *et al.* [1]) to identify the strategic interaction effects of commodity taxation and product market regulation. Our empirical results confirm the absence of commodity tax competition under the destination principle. Our estimates suggest also that stricter domestic regulation reduces a country's ability to raise commodity taxes. We support the hypothesis that regulation policies are strategic complements. Finally, notice that the magnitudes of the estimated effects are non-negligible: we find that a deregulation process that reduces firms' start up time by 160 days (i.e. comparable to EU deregulations during the 1990s) induces a local rise in domestic commodity taxes of about 2.4 percentage points, and induces a deregulation process in trade partner countries which reduces firms' start up times by about 40 days, on average.

This paper contributes to the existing literature in the following ways. First, there is an extensive literature on strategic interactions between governments' taxes which suggests that competition in commodity taxes is mitigated by adoption of the destination principle (Mintz and Tulkens [40], Haufler *et al.* [24], Behrens *et al.* [6]. See Lockwood [36] for a survey). However, the present paper is the first to provide empirical evidence of the absence of strategic interactions in destination-based taxation.[3]

[2] A reform on tax rates often requires specification of a single tax figure on which parliament votes, while a regulatory reform involves a long and cumbersome analysis of a nexus of laws and decrees and raises many industry-specific contentions before any vote is held.

[3] There is empirical evidence of strategic interactions under the origin principle. For example, Lockwood and Migali [37] show that the introduction of the EU Single Market in 1993 triggered strategic interactions between excise taxes in

Figure 1: Statutory VAT and number of days to start-up a business.



Notes: averages across 21 OECD countries, 2004-2014.

Second, to our knowledge, the impact of product market regulation on commodity taxation has not been investigated from either a theoretical or an empirical perspective.[4] Our paper fills a gap in the corresponding literature. Third, the paper contributes to the literature on entry regulation. Djankov *et al.* [16] and Aghion *et al.* [1] analyze the social and cultural factors that affect entry regulation. Miyagiwa and Sato [39] analyze the optimal entry policy in oligopolistic markets operating in a globalized world. However, these papers do not discuss strategic interactions in product market regulation policy although governments' strategic interactions have been studied in the case of labor market regulation (e.g. Haaland and Wooton [22]). Finally, this paper is the first one to consider a general equilibrium model with monopolistic competition where regulation is set to address product market uncertainties and thus it imposes checks and constraints on firms affecting their entry costs and the time to set up a business.

The paper is structured as follows. Section 2 presents the theoretical model. Section 3 studies the strategic interactions between regulation and commodity taxation in the case of a bureaucrat-regulator. Section 4 presents and discusses our empirical analysis. Section 5 concludes.

2 The Model

We present a model of two symmetric countries, home and foreign, each with a unit mass of immobile individuals and same production technologies. Benevolent governments collect commodity taxes to fund the provision of public goods by public agencies while regulatory agencies set the level of product market regulation. Our aim is to highlight (i) the relationship between commodity tax and product

EU countries.

[4]There are some studies in environmental economics such as Oates and Schwab's [47] or List and Gerking's [35] which discuss the impact of environmental regulations on taxes and welfare.

market regulation decisions and (ii) countries' competition in terms of commodity taxes and regulatory measures. For this purpose, we make four important modeling assumptions. First, we consider 'helping hand regulator' who aim at improving the functioning of commodity markets at the cost of entry delays (e.g. days to start a business). To our knowledge, such a positive role has not been discussed in the tax and regulation literature.[5] Second, because commodity taxes and product market regulation apply to the large majority of goods in trading countries, it is important to discuss those items in a general equilibrium setting where trade balance and factor price equalization are likely to affect consumption and taxes.[6] Third, to ease the discussion of entry decisions in a trade context, it is convenient to use the well-established Krugman's [33] monopolistic competition framework.[7] Finally, we assume that public agencies produce public goods or services using inputs from the private sector.[8] To the best of our knowledge, such a setting has not been studied in the tax and regulation literature. Importantly, to facilitate aggregation in product markets, we shall follow Krugman and Venables' [34] idea of homotheticity of consumers' preferences and public goods production technologies.

This model includes five types of agents: *individuals* who work in firms and consume commodities and public goods or services, *firms* that produce commodities for local and foreign markets, *public agencies* that provide public goods or services to local consumers, *governments* that set the commodity tax level and the budget of public agencies, and finally, *regulatory agencies* that independently set the regulation requirements applied to local producers.[9] Regulation helps product market functioning in the context of market uncertainties by protecting consumers, guaranteeing their safety, checking professional accreditation, and providing business information so that consumers are less exposed to potential injuries, swindles, or fraud. To make this idea explicit, we assume that some products may not be delivered at all, or may be sold at a quality not fit for consumption. The role of helping-hand regulatory agencies is to diminish the occurrence of such events.

In what follows, we first describe the economy and then discuss the taxation and regulation decisions. Variables of the foreign country are indexed by the superscript *. We describe the model for the domestic

[5]Our main results maintain with rent seeking regulators (see Moriconi *et al.* [42]).

[6]Terms of trade effects are present in Mintz and Tulkens [40] and Lockwood (2001). By contrast, Keen and Lahiri [30], Anderson and Forslid [3], Haufler and Pfluger [23], Haufler and Pfluger [25] assume a numeraire good that dampens terms of trade effects.

[7]Although it is commonly used in international trade theory, Krugman's [33] framework is not much discussed in the international tax competition literature where entry issues have not been extensively addressed (Haufler and Pfluger [23])

[8]In the OECD countries, public procurement ranges between 10% and 30% of GDP and between 20% and 50% of government expenditures (European Commission [20]). Public procurement is even larger share when interpersonal transfers are excluded from government expenditures.

[9]Regulatory agencies or bodies implement complex market regulatory and supervisory tasks which require economic expertise. To avoid political interference and opportunism, regulatory agencies are generally independent of other branches of government. Some examples of regulatory agencies are the Interstate Commerce Commission and the Food and Drug Administration in the US, Ofcom in the UK, and AGCOM in Italy.

country and the symmetric expressions holding for the foreign one.

Consumer demand In the domestic country, consumers' preferences are given by an increasing and concave utility function $U(C, G)$ where C is a bundle of commodities and G is a bundle of public goods and services. Firms enter and offer (catalogs of) commodities. Consumers purchase and pay for each commodity. Firms then produce the commodities and deliver them to consumers. In some random states of nature, $s \in S$, firms are unable to deliver either their good or a good that is worth consuming. We do not comment on whether the uncertainty stems from accident or intention. The probability of each state s, denoted by $\theta(s)$, is given for the firms and consumers but is affected by regulation, as explained later in Section 3.2. Labeling each commodity by $\omega \in [0, N]$ where N is the world number of commodities, the delivery status of commodity ω in state s is denoted by $\lambda(s, \omega)$, which is equal to 1 if ω is delivered in state s and zero otherwise.

In this framework, the bundle of commodities $\omega \in [0, N]$ is contingent on each state $s \in S$ and defined as

$$C(s) = N^{-\nu} \left[\int_0^N \lambda(s, \omega) c(\omega)^{\frac{\sigma-1}{\sigma}} \mathrm{d}\omega \right]^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where $\lambda(s, \omega)$ is its delivery status in state s and $c(\omega)$ is the consumer's order of commodity ω (decided before the realization of the state of nature). The parameter σ, $\sigma > 1$, is the elasticity of substitution among commodities. The world number of commodities, N, is equal to the sum of the endogenous numbers of domestic and foreign commodities, n and n^*. That is, $N = n + n^*$. As in Benassy [7], the parameter $\nu \in [0, 1/(\sigma - 1)]$ measures the love for variety. With $\nu = 0$, one obtains Dixit and Stiglitz's [15] benchmark where the elasticity of substitution is equal to the love for variety. With $\nu = 1/(\sigma - 1)$, the love for variety is absent as it is in homogeneous good models (e.g. Cournot models). Ardelan [5] suggests an empirical value for ν at about the middle of this range. In this paper, the love for product variety is an important aspect to be considered as it affects the value of new commodities, the entry of new firms and finally the welfare impact of regulation.

Each consumer maximizes her expected utility $\mathrm{E}[U(C, G)] = \int_S U(C(s), G(s))\theta(s)\mathrm{d}s$ and maximizes her consumption subject to budget constraint

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

where W is the consumer's income and $p(\omega)$ is the domestic (tax-inclusive) consumer price for commodity ω (again before the realization of the state of nature). In the following analysis, for simplicity we will assume that uncertainty affects the delivery of commodities symmetrically. Specifically, we assume that the probabilities of delivering home and foreign commodities (ω, ω^*) are given by $\theta \equiv \int_S \lambda(s, \omega)\theta(s)\mathrm{d}s$ and $\theta^* \equiv \int_S \lambda(s, \omega^*)\theta(s)\mathrm{d}s$. Then, it is shown in Appendix A that consumers' demand $c(\omega)$ has the following form:

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

where $P = [\int_0^n p(\omega)^{1-\sigma}\theta^{\sigma}\mathrm{d}\omega + \int_n^N p(\omega^*)^{1-\sigma}\theta^{*\sigma}\mathrm{d}\omega^*]^{\frac{1}{1-\sigma}}$ is the domestic consumer's (tax-inclusive) price index. Because each commodity has zero mass and identical delivery probability, consumers do not care which commodity will not be delivered and make their decisions based on the aggregate measures of delivery probabilities (θ, θ^*). As a result, a higher probability of domestic product delivery, θ, increases the demand for that commodity.[10]

Government demand We assume a unit mass of symmetric and independent public agencies that hold the same budget line B and produce each a public good or service using commodities as input.[11] As in Ethier [19], each public agency transforms the commodities into a public good or service $G(s)$ using the following technology:

$$G(s) = N^{-\nu}\left[\int_0^N \lambda(s,\omega) q(\omega)^{\frac{\sigma-1}{\sigma}}\mathrm{d}\omega\right]^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

where $s \in S$ is the random state of nature and $q(\omega)$ is the public agency's input for commodity ω. As Krugman and Venables [34], we assume that the public agency's input bundle is the same as the consumer's commodity bundle. Consumers' preferences and governments' production functions are therefore isomorphic.

Each agency chooses the input mix that maximizes its expected level of its public good or service satisfying its budget constraint $\int_0^N p(\omega)q(\omega)\mathrm{d}\omega = B$, where B is its budget line. Having a zero mass, each agency has no strategic power on aggregate variables and no monopsony power on input markets. One can show that its input demand is equal to

$$q(\omega) = \left[\frac{p(\omega)}{\theta P}\right]^{-\sigma} \frac{B}{P}. \tag{4}$$

Also, as consumers, public agencies consider only aggregate delivery rates (θ, θ^*). One can check that

$$\frac{q(\omega)}{c(\omega)} = \frac{B}{W}. \tag{5}$$

That is, the commodity consumptions by consumers and governments are proportionate. With a unit mass of public agencies, the public sector's total demand for a commodity ω, its total production and budget are identical to each public agency's demand $q(\omega)$, production G and budget B.

[10]The parameter θ can also be interpreted as a product quality shifter. Accordingly, regulation increases the product quality of national output.

[11]In most modern economies, a large set of public goods and services is delivered by independent public agencies which puchase inputs from the private sector. These public goods include infrastructure, justice, communication, health, education, army, and social housing among others. One can interpret our setting more narrowly as public procurement or outsourcing. In the OECD countries, public procurement ranges between 10% and 30% of GDP and between 20% and 50% of government expenditures (European Commission [20]).

Commodity market equilibrium Each domestic firm owns and locally produces a single commodity $\omega \in [0, n]$ while it sells in the home and foreign markets under monopolistic competition. To produce, the firm hires a unit of labor for each commodity and a fixed labor input f, all paid at the local wage W. The firm ω gets the profit

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

where $p(\omega)$ and $p^*(\omega)$ are its domestic and foreign prices, $c(\omega)$ and $q(\omega)$ are the demands by domestic consumers and public agencies, and $c^*(\omega)$ and $q^*(\omega)$ are the demands by foreign consumers and public agencies. In this expression, $\tau > 1$ and $\tau^* > 1$ denote the ratios between the domestic and foreign consumer prices and the mill prices. Commodity tax rates are equal to $\tau - 1$ and $\tau^* - 1$. Taxes, set by governments, are ad valorem and follow the destination principle. Finally, we assume that the fixed input embeds the input needed to set up the firm's economic activity, f (e.g. management, R&D, marketing, distribution, etc.), and the input needed to comply with regulatory requirements, r (e.g. quality compliance). The mechanism underlying this cost is described in Section 3.2.

Under monopolistic competition, each firm ω sets the domestic and foreign prices, $p(\omega)$ and $p^*(\omega)$ which maximize its profit in each market. Because the firm has zero mass it does not anticipate any impact on aggregate variables and takes those variables as givens. The optimal (tax-inclusive) prices are given by

$$p\,(\omega) = p \equiv \frac{\sigma}{\sigma - 1}\tau W \quad \text{and} \quad p^*\,(\omega) = p^* \equiv \frac{\sigma}{\sigma - 1}\tau^* W. \tag{6}$$

As usual under Dixit-Stiglitz' monopolistic competition, prices are set above marginal costs because firms have market power in their product niches. Note that the firm sets the same tax-exclusive prices p/τ and p^*/τ^* because they are able to segment markets and perceive iso-elastic demands. They firms 'pass through' the full commodity tax to its consumers. The domestic and foreign price indices P and P^* are given by the relationship

$$\frac{P}{\tau} = \frac{P^*}{\tau^*} = \frac{\sigma}{\sigma - 1}\left(n\theta^\sigma W^{1-\sigma} + n^*\theta^{*\sigma} W^{*1-\sigma}\right)^{\frac{1}{1-\sigma}}. \tag{7}$$

The price index is the same across countries once deflated by local commodity tax rates. Also, one computes the domestic commodity and public good bundles as

$$C(s) = C \equiv N^{-\nu}\frac{W}{P} \quad \text{and} \quad G(s) = G \equiv N^{-\nu}\frac{B}{P}. \tag{8}$$

(see Appendix A). Although commodities are delivered with uncertainty, the commodity and public good bundles bear no uncertainty. Consequently, aggregate variables are independent from specific delivery states s. We do not need to make reference to those states from now on.

Under monopolistic competition, firms enter until profits fall to zero. Each new entrant diminishes the other firms' revenues (business stealing effect) until revenues exactly balance entry fixed costs. Plugging

optimal prices in the above profit function we obtain the firm's commodity supply, $x \equiv c + q + c^* + q^*$, as

$$x = (\sigma - 1)(f + r). \tag{9}$$

The firm output increases with local setup costs. Similar expressions hold for the foreign country.

Government balance The government balances its tax revenues against its expenditure on the production of public goods so that $(\tau - 1) W = B$. From (5), (8) and the latter identity, it comes that

$$\tau - 1 = \frac{B}{W} = \frac{G}{C} = \frac{q}{c}. \tag{10}$$

So, from the second equality of (10), we can observe that public good and commodity bundles are directly related to the proportion the government budget in consumer earnings and therefore to the commodity tax rate. Interestingly, one may 'sum' commodity and public good bundles to get

$$C + G = \frac{\sigma - 1}{\sigma} \frac{N^{-\nu} W}{\left(n\theta^{\sigma} W^{1-\sigma} + n^* \theta^{*\sigma} W^{*1-\sigma}\right)^{\frac{1}{1-\sigma}}}. \tag{11}$$

At given wages, delivery probabilities and entry, the RHS of this expression is constant so that a unit increase of the provision of the public good bundle must be made at the expense of a unit decrease in the private consumption bundle. Put it differently, the marginal rate of transformation between public goods and commodities can be expressed in terms of the private and public good bundles and is equal to one: a rise in public spending increases public agencies' input demands by the same amount as it decreases the households' private consumption. The independence from tax rates is due to the application of the destination principle. The constant value of the marginal rate of substitution is due to the isomorphism between preferences and public good production while its unit value stems from the assumption of unit population mass. As will be shown below, this property conveniently simplifies the commodity tax decision.

Similarly, from the last equality in (10), we have that $c + q = (c/C)(C + G)$. This mirrors (11) at the level of the firm and yields the following relationship between private and public demands at the firm's level:

$$c + q = \frac{\sigma - 1}{\sigma} \frac{\theta^{\sigma} W^{1-\sigma}}{n\theta^{\sigma} W^{1-\sigma} + n^* \theta^{*\sigma} W^{*1-\sigma}}.$$

As a result, at given wages, delivery probabilities and entry, the domestic sales is invariant to the size of local public good bundle. Changes in public good provision only shift the firm's output between consumers and public agencies. Public demand for commodities substitutes for private demand. One can show that the symmetric property holds for the foreign demands addressed to the domestic firm, c^* and q^* so that the total demand for the domestic firm's product is equal to

$$x = \frac{\sigma - 1}{\sigma} \left(\frac{W}{\theta}\right)^{-\sigma} \frac{W + W^*}{n\theta^{\sigma} W^{1-\sigma} + n^* \theta^{*\sigma} W^{*1-\sigma}}, \tag{12}$$

which is also independent of public good bundles at given wages, delivery probabilites and entry. Commodity markets clear when this total commodity demand equates its supply (9).

Labor market equilibrium In the domestic country, each firm supplies an output $x = (\sigma - 1)(f + r)$ and therefore demands an amount of labor units equal to $x + f + r = \sigma(f + r)$. The labor market clears when the total labor demand $n\sigma(f + r)$ equalizes the labor supplied by the unit home population. Applying the same argument to the foreign country, the masses of domestic and foreign firms are given by

$$n = \frac{1}{\sigma(f + r)} \quad \text{and} \quad n^* = \frac{1}{\sigma(f^* + r^*)}. \tag{13}$$

The mass of local firms is therefore proportional to the local labor force and inversely proportional to the local entry costs, physical and regulatory fixed costs. Setting the local entry cost is therefore equivalent to setting the mass of local firms and product diversity.

Using commodity market clearing condition ((9) and (12)) and the last condition gives the value of the relative wage (or terms of trade)

$$\frac{W}{W^*} = \left[\frac{\theta^{-\sigma}(f + r)}{\theta^{*-\sigma}(f^* + r^*)}\right]^{-\frac{1}{\sigma}} = \left(\frac{n\theta^{\sigma}}{n^*\theta^{*\sigma}}\right)^{\frac{1}{\sigma}}. \tag{14}$$

Importantly, regulation has ambiguous impact on relative wages. Stronger domestic regulation increases both domestic setup costs and delivery probabilities. On the one hand, as setup costs rise, domestic firms no longer break even so that some of them exit the commodity market. This reduces labor demand and pushes the relative wage down. On the other hand, the higher delivery probability of domestic commodities increases the demand of the latter and entices new domestic firms to enter. Labor demand increases and raises the relative wage. Finally, note that the size of public good bundle does not affect the relative wages because public demand for input substitutes consumer's commodity demand.

Welfare By (11) and (14), the domestic welfare is given by $U(C, G)$ and must satisfy the constraint $C + G = R(n, n^*, \theta, \theta^*)$ where

$$R(n, n^*, \theta, \theta^*) \equiv \frac{\sigma - 1}{\sigma}\left[n\theta^{\sigma} + \left(\frac{n\theta^{\sigma}}{n^*\theta^{*\sigma}}\right)^{\frac{\sigma-1}{\sigma}} n^*\theta^{*\sigma}\right]^{\frac{1}{\sigma-1}} (n + n^*)^{-\nu}. \tag{15}$$

The function R can be interpreted as the government's (second best) resource, which takes into account term of trade effects and product market distortion (e.g. market power, inefficient product diversity, etc.; see Dixit and Stiglitz [15]). The domestic commodity tax rate is given by $\tau - 1 = G/C$. The masses of firms and commodities are given by $n = \sigma^{-1}(f + r)^{-1}$ and $n^* = \sigma^{-1}(f^* + r^*)^{-1}$. The symmetric expression holds for foreign welfare. Hence, the study of the above general equilibrium reduces to analysis a simple macro-economic framework, which encompasses commodity taxes and regulation

features. Expressed in terms of the government's instrument and regulators' variables, the domestic welfare therefore writes as $U\left[R/\tau, R\left(1-1/\tau\right)\right]$ with $R = R\left[\sigma^{-1}\left(f+r\right)^{-1}, \sigma^{-1}\left(f+r^*\right)^{-1}, \theta, \theta^*\right]$.

The effect of commodity taxation is purely local. This is because the destination principle eliminates tax externality issues and because government consumption does not create terms of trade effects. Changes in government consumption are balanced by changes in private consumption so that neither firms' labor demand nor relative wages are affected.

The effect of stronger domestic regulation on local welfare results from several forces. Consider first its impact of a better delivery probability θ. On the one hand, for a same expenditure level, it increases effective consumption of domestic commodities by local consumers and public agencies. This leads to higher consumption of domestic commodities and higher provision of public goods (see first term in the square bracket of (15)). On the other hand, it also increases the demand by foreign consumers, boosts exports and increases the relative wage W/W^* (which is reflected by the rise in the ratio $(n\theta^\sigma)/(n^*\theta^{*\sigma})$ in expression (15)). This increases domestic consumers' purchasing power and makes them better off. However, stronger regulation induces longer entry delays and higher entry costs, which reduces the mass of local firms n. This in turn decreases the supply of domestic commodities and entices individuals to consume less and public agencies to provide fewer public goods, which diminishes local welfare (see again first term in the square bracket of (15)). By the same argument as above, it also reduces the relative wage and harms domestic consumers.

Stronger regulation also reduces the set of available varieties and makes consumers worse off (see last bracket in (15)). To show this, one can neglect the effect of terms of trade and delivery issues by setting $(n\theta^\sigma)/(n^*\theta^{*\sigma})$ and θ and θ^* equal to 1 in expression (15). Then, one sees that R is proportional to $(n+n^*)^{\frac{1}{\sigma-1}-\nu}$. As stronger regulation reduces local product diversity n, it diminishes domestic utility to the extent that ν is smaller than $1/(\sigma-1)$ as is the case under Dixit-Stiglitz' preferences. When consumers express no taste for variety ($\nu = 1/(\sigma-1)$), the effect of product diversity is nil. Hence, the consumers' love for product diversity does matter in the welfare evaluation of regulation policies. Finally, a parallel discussion can be made about the impact of the foreign regulation on domestic welfare.

We now discuss the strategic interactions between governments and regulatory agencies.

3 Strategic interactions between governments and regulatory agencies

We model the interaction between governments and regulatory agencies as a sequential game in which first, government regulatory agencies set firms' entry requirements, and then governments set their commodity tax rates. We take the view that regulatory agencies' processes and standards are more

difficult to (re-)structure than commodity tax rates. The game is solved by backward induction.

Here, we need to be more specific about the production side of regulation. We have already mentioned that regulation aims at improving delivery and safety of commodities by checking professional accreditation and providing business information to consumers that are then less exposed to potential injuries, swindles or fraud. These regulatory requirements translate into fixed cost for the firms and are encompassed in our variable r. Hence, we assume that the delivery probability θ is equal to $1-(1/\beta)\cdot f/(f+r)$, where f and r are the fixed inputs of entry and regulatory compliance as presented above and where $\beta > 0$ is a regulation efficacy parameter. The delivery probability θ increases with stronger regulation and higher entry costs r and with stronger regulation efficacy β. This implies that the delivery probability is given by $\widehat{\theta}(n) \equiv 1-(f\sigma/\beta)\cdot n$. Positive delivery probabilities require that $n < \beta/(\sigma f)$, which holds if β is set sufficiently high.

We begin with analysis of governments' competition in commodity taxes and choice of commodity tax rate.

3.1 Commodity Tax Competition

Each benevolent government sets the commodity tax rate that maximizes its residents' utility, holding a balanced budget and taking the other tax and the regulatory settings as given. The domestic government set the commodity tax rate $\tau - 1 = G/C$ that maximizes $U(C,G)$ subject to $C+G = R(n,n^*,\theta,\theta^*)$. Our first result is therefore trivial: since R is independent of τ^*, the optimal domestic commodity tax τ is independent of the foreign tax τ^*. As mentioned above, the destination principle eliminates tax exporting issues.

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

This is a well-known result in optimal taxation theory. In their seminal paper, Mintz and Tulkens [40] show the absence of commodity tax competition under the destination principle in perfectly competitive markets. Haufler and Pfluger [23] reach the same conclusion in the context of monopolistic competition. The two important points are worth mentioning: the result shall not hold under the origin principle and taxation creates no side effects under the destination principle. In particular, in this model, commodity tax and government consumption do not alter the terms of trade. Nevertheless, the type of competition matters as governments have incentives to use commodity taxes to correct the distortions that emerge in imperfectly competitive markets.[12] In this paper, the incentives to correct the firms' market power are mitigated because commodity taxes are used to finance public goods as it is the case in Haufler and

[12]In the presence of such distortions commodity taxes can be Pareto inefficient under the destination principle, even in the absence of strategic interactions (see Lockwood [36] for a synthesis). This applies in the case of imperfect competition

Pfluger [25]. Also, in addition to the latter contribution, we consider the more realistic situation of a tax on all goods, and the use of tax receipts for the provision of public goods.

What is the impact of stronger domestic regulation on domestic tax rates? Each goverment maximizes its local welfare $U(C, G)$ subject to $C + G = R$. The first order condition is given by

$$\frac{U_C(C, G)}{U_G(C, G)} = 1 \tag{16}$$

where U_C and U_G are the partial derivatives of U with respect to C and G. A maximum is guaranteed under our concavity assumptions. The optimal bundles C and G are the solutions of equation (16) and $C + G = R$. Condition (16) is nothing less than the standard Samuelson condition according to which the sum (over the unit mass of consumers) of the marginal rate of substitution between public and private goods, $MRS \equiv U_C/U_G$, equates with the unit marginal rate of transformation between public and private good bundles. The main difference with the standard literature lies in the nature of the resource constraint R that accounts for trade and economic distortions and depends on regulation policies.

The commodity tax falls if the ratio of public to private consumption bundles G/C falls. Stronger domestic regulation decreases the mass of domestic firms, n, which decreases the resource level R if $\mathrm{d}R/\mathrm{d}n > 0$. Under this condition, stronger regulation induces a parallel and downward shift of the resource constraint. Note that the latter constraint replaces the budget constraint in a consumer's choice between public and private good G and C. Hence, stronger regulation has the same impact as the reduction of consumer's income. The change in the optimal bundles C and G therefore depends on the 'income effect' of the demands for the commodity and public good bundles. As shown in Figure 2, when the income effect is stronger for the demand of public good bundle, the downward shift of the resource constraint entices the government to reduce more the provision of public goods G than the consumption of private commodities C so that G/C falls. In this case, the government reduces the commodity tax rate τ. The opposite holds when the income effect is stronger for the demand of the commodity bundle. Changes in regulation have no impact on commodity tax rates when income effects on the demand for commodities and public goods are the same. This occurs when the marginal rate of substitution remains constant on the ray G/C.[13]

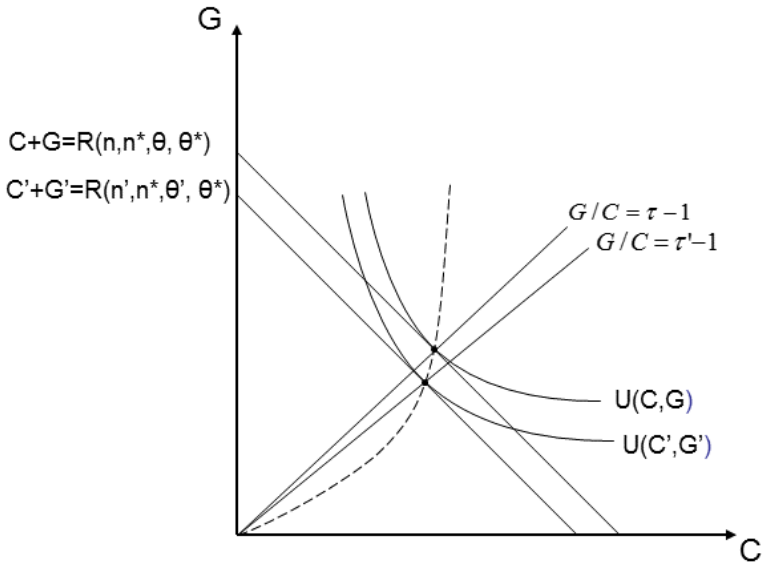
We can state the following proposition:

Proposition 2 *Suppose that the consumption of commodities increases with lower regulation* ($\mathrm{d}R/\mathrm{d}n > 0$*). Then, stronger product market regulation lowers commodity tax rates if and only if income has a stronger effect on the demand for public goods than on the demand for commodities.*

in duopoly models (Keen and Lahiri [30], Haufler *et al.* [24]), monopolistic competition (Haufler and Pfluger [23]), or labor market imperfections which create unemployment in the economy (Moriconi and Sato [41]).

[13]This is the case for Gorman preferences like quasi-linear or Cobb-Douglas preferences.

Figure 2: Optimal commodity tax and regulation.



The above result applies if $\mathrm{d}R/\mathrm{d}n > 0$. That is, if an increase in domestic firms raises the government's resource constraint. As $\mathrm{d}R/\mathrm{d}n = \partial R/\partial n + (\mathrm{d}\theta/\mathrm{d}n)(\partial R/\partial\theta)$, there are two effects. First, the effect of the number of firms on the resource constraint, $\partial R/\partial n > 0$, is intuitive: more firms shall bring more commodities and increase welfare, which should increase the bundles C and G and thus R. It can be easily shown that $\partial R/\partial n > 0$ in the case in any symmetric country model like this one where $n = n^*$ (see below). It is also the case in asymmetric configurations if n/n^* does not depart much from 1. Second, the mass of firms has an indirect effect on the resource constraint through the delivery probability. As consumers are positively affected by improvements in product delivery, one expects $\partial R/\partial\theta > 0$. However, because regulation imposes entry costs, a stronger regulation policy shall improve the delivery probability and lower the number of firms so that $\mathrm{d}\theta/\mathrm{d}n < 0$. In practice, one expects that the delivery probability is high (θ close to 1) so that $\mathrm{d}\theta/\mathrm{d}n$ is small and the first effect dominates. So, the condition $\mathrm{d}R/\mathrm{d}n > 0$ can be satisfied under reasonable conditions.

To our knowledge, the public economics literature has not identified clear patterns about the rate of substitution between private and public goods. However, the existing, positive correlation between the share of public expenditures and GDP per capita suggests that the demand for public services increases with a higher average income. This fact, known as Wagner's law, favors the hypothesis of a stronger income effect on a country's public good demand, and therefore suggests a negative effect of regulation on tax.[14] This empirical issue will discuss below.

[14]See Durevall and Henrekson [18] for an evaluation of econometric studies on Wagner's law.

3.2 Regulatory competition

Finally, we study the role of helping-hand regulatory agencies. We assume that domestic regulators maximize local welfare anticipating commodity taxes and taking the decision of foreign regulators as givens. Denoting the delivery probablity as the function $\widehat{\theta}(n)$ and the second stage domestic welfare as $V(n, n^*, \theta, \theta^*) = \max_{C,G} U(C, G)$ s.t. $C + G = R(n, n^*, \theta, \theta^*)$, we can write the regulator's problem as $\max_{n,\theta} V\left[n, n^*, \widehat{\theta}(n), \widehat{\theta}(n^*)\right]$. The first order condition is given by $(\mathrm{d}V/\mathrm{d}n) + \widehat{\theta}'(n)\,(\mathrm{d}V/\mathrm{d}\theta) = 0$, which by applying the envelop theorem on V yields

$$\frac{\mathrm{d}R}{\mathrm{d}n} = \frac{\partial R}{\partial n} + \widehat{\theta}'(n)\frac{\partial R}{\partial \theta} = 0.$$

The helping-hand regulatory agency chooses the regulation level that balances the effect of an increase in product diversity (first term) and the effect of product market safety on local consumption (second term). We assume that the second order condition holds. The same condition holds for the foreign regulator. Using our specification of $\widehat{\theta}(n)$ and the country symmetry, the equilibrium is given by

$$n = n^* \equiv \overline{n} = \frac{\beta}{f\sigma\,(\sigma+1)}\left[1 - \frac{\nu\sigma^2\,(\sigma-1)}{(\sigma+1)\,(2\sigma-1) - \sigma\nu\,(\sigma-1)}\right],$$

where the denominator of the ratio in the square bracket is positive for $\nu \in [0, 1/(\sigma-1)]$. The equilibrium mass of firms rises with higher regulation efficacy parameter β and higher love for variety (smaller ν). It can also readily be shown that the equilibrium mass of firms falls with higher elasticity of substitution σ whatever admissible ν. As in Dixit-Stiglitz models, the more substitutable commodities are, the lower the firms' markup and the lower their incentives to enter. The equilibrium delivery probability is then equal to

$$\theta = \theta^* \equiv \overline{\theta} = \frac{\sigma}{\sigma+1}\left[1 + \frac{\nu\sigma\,(\sigma-1)}{(\sigma+1)\,(2\sigma-1) - \sigma\nu\,(\sigma-1)}\right],$$

which can be shown to be smaller than one and falling with higher love of product variety (smaller ν). Hence, the more consumers love product variety, the less regulators are enticed to enforce commodity deliveries at the expense of the creation of new commodities. It can also be shown that $\overline{\theta}$ increases with higher σ. Regulators enforce higher commodity delivery when commodities are better substitutes. In this case, consumers do not attach much importance to product diversity and regulators protect consumers more against market delivery issues.

We now come to our main question: are regulation policies strategic complements? To see this, we differentiate totally the first order condition and use the second order condition to get

$$\frac{\mathrm{d}n}{\mathrm{d}n^*} \geq 0 \iff \frac{\mathrm{d}^2 R}{\mathrm{d}n\mathrm{d}n^*} \geq 0,$$

which evaluate at the equilibrium values of n, n^*, θ and θ^*. A general sufficient condition is that resource function R be supermodular in n and n^* but it is a daunting task to show. More simply, at the symmetric

equilibrium for our specification of $\widehat{\theta}(n)$, we get

$$\frac{\mathrm{d}^2 R}{\mathrm{d}n\mathrm{d}n^*} = \nu\ K,$$

where K is a strictly positive constant.[15] Therefore, regulation polices are a strategic complement if $\nu > 0$.

Proposition 3 *Suppose helping-hand regulatory agencies and symmetric risks of delivery failures. Then, regulation policies are strategic complements for $\nu > 0$ and independent instruments for $\nu = 0$.*

In this case, we can compute the slope of the best response of the domestic regulator about the equilibrium as

$$\frac{\mathrm{d}n}{\mathrm{d}n^*} = \frac{\nu\,(\sigma-1)\,\sigma^2\left[(2\sigma-1)^2+(1-\sigma)\,\nu\right]}{2\,(\sigma+1)\,(2\sigma-1)^3-\sigma\,(\sigma+4)\,(\sigma-1)\,(2\sigma-1)^2\,\nu+\sigma^2\,(4\sigma-3)\,(\sigma-1)^2\,\nu^2}, \tag{17}$$

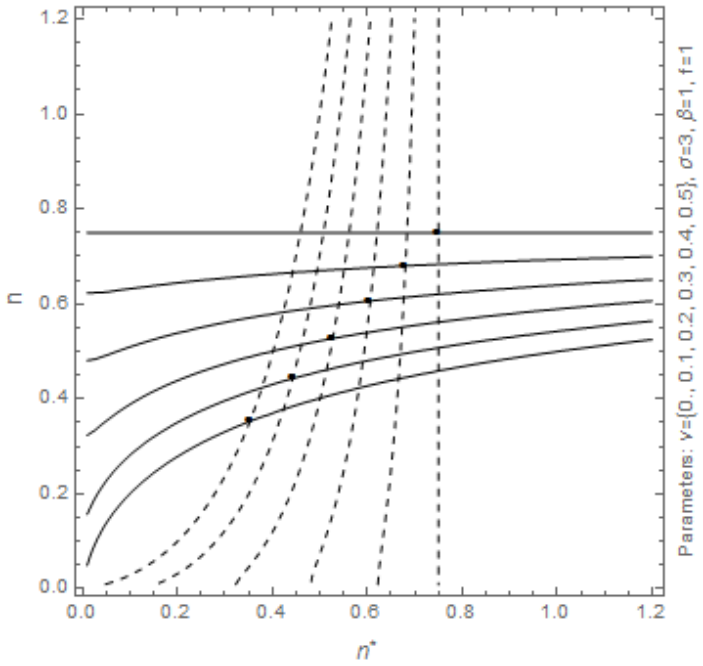
which is positive because the numerator and denominator are positive for $\nu \in (0, 1/(\sigma-1)]$. This confirms that regulation is a strategic complement if $\nu > 0$. Furthermore, it can be shown that this slope increases with weaker love for variety $\left(\left(\mathrm{d}^2 n\right)/\left(\mathrm{d}n^*\mathrm{d}\nu\right) > 0\right)$.[16] This property is illustrated by Figure 3 that displays the best responses of the domestic and foreign regulators (resp. solid and dashed curves) in terms of the number of entrants they induce when they reduce their regulatory checks. The domestic regulator's best responses is flat for strong love for variety ($\nu = 0$) and gets steeper for weaker love for variety ($v = 0.1, 0.2, ..., .0.5$).

To clarify this point consider the case where consumers and regulators put no value on product diversity ($\nu = 1/(\sigma-1)$). Then, what matters is the effect of regulation on the terms of trade. When the foreign regulator relaxes its regulation intensity, more foreign firms enter and more delivery problems occur. Yet, foreign production increases and puts an upward pressure on foreign wages and prices (because $\frac{\mathrm{d}}{\mathrm{d}n}\left(n\theta^\sigma\right) > 0$). The domestic relative wages W/W^* deteriorate and reduce the home resource constraint, R. The domestic regulatory agency then has an incentive to relax domestic regulation and restore its country's international competitiveness. The terms of trade are restored, more domestic firms enter, and the purchasing power of local consumers rises. Thus, regulatory decisions are strategic complements. In contrast, when consumers and regulators put a high value on product diversity ($\nu = 0$),

[15] The constant is given by $K = \left(\frac{f_0}{2\beta}\right)^{2-\frac{1-(\sigma-1)\nu}{\sigma-1}} \cdot \sigma^{\frac{\sigma+1-(\sigma-1)\nu}{\sigma-1}-2} \cdot (2\sigma-1)^{\frac{\sigma}{\sigma-1}-2}\ \left[(2\sigma-1)^2-(\sigma-1)\nu\right] \cdot \left[2\sigma-1-\sigma(\sigma-1)\nu\right]^{\frac{1-(\sigma-1)\nu}{\sigma-1}-2} \cdot \left[2\sigma^2+\sigma-1-\sigma(\sigma-1)\nu\right]^{2-\frac{1-(\sigma-1)\nu}{\sigma-1}-\frac{\sigma}{\sigma-1}}$ where all terms under parentheses are positive.

[16] We have $\frac{d}{d\nu}\frac{\mathrm{d}n}{\mathrm{d}n^*} > 0$ if and only if $-(\sigma+1)\,(2\sigma-1)^3+2\nu\left(\sigma^2-1\right)(2\sigma-1)+2\nu^2\sigma\left(\sigma^2-\sigma-1\right)(\sigma-1)^2 < 0$. This polynomial function of ν is negative at $v = 0$ and $v = 1/(\sigma-1)$. For $\sigma > 1.618$, we have $\left(\sigma^2-\sigma-1\right) > 0$ so that it is convex and must therefore take negative values for $\nu \in [0, 1/(\sigma-1)]$. For $\sigma < 1.618$, it is concave and reaches its maximum at $\nu = \frac{-(2\sigma-1)(\sigma+1)}{2\sigma(\sigma-1)(\sigma^2-\sigma-1)} > \frac{1}{\sigma-1}$. So, the polynomial function is also negative $\nu \in [0, 1/(\sigma-1)]$.

Figure 3: Regulators' best response functions.



they are better off if the foreign regulatory agency relaxes its regulation intensity because this increases world product diversity. In the domestic market, the marginal value of additional product variety falls so that the regulatory agency is encouraged to cut down on local product diversity to improve local good safety. In the case of Dixit-Stiglitz preferences, the latter effect exactly balances the former, so that the regulatory agency sets an independent regulation level given by $n = \beta/(\beta + f\sigma)$.

Finally, it is worth noticing that results displayed in the above propositions hold under a number of alternative assumptions, like for rent-seeking regulators, more than two countries, countries with asymmetric sizes, and finally (iceberg) trade costs.[17]

4 Empirical Evidence

4.1 Empirical Strategy

In this section, we estimate the direction of the forces described in the theoretical setup using data on product market regulation and consumption taxation. We consider an empirical model in which tax and regulation decisions are taken sequentially in a two-stage game.

The link between taxation and regulation is determined by countries' best reply functions obtained in the second stage of the game presented in section 3 (see equation (16)). Our first empirical specification linearizes the best responses in commodity taxes and extends them to many countries and many time

[17]The corresponding analysis of these extensions can be found in Section A of the on-line appendix of the paper.

periods:

$$\tau_{it} = \sum_{j \neq i} \alpha_{ij} \tau_{jt} + \beta z_{it-1} + \boldsymbol{\gamma}' \mathbf{x}_{it} + d_i + e_t + u_{it}, \tag{18}$$

where $i = 1, ..., I$ and $t = 1, ..., T$ respectively denote countries and time-periods. The variable τ_{it} denotes the commodity tax rate in country i at time t, set under the destination principle,[18] while the variable z_{it} is our observation of the regulation level in country i at time t. $\mathbf{x}_{it}$ is the vector of country i's relevant country characteristics (i.e. population size, per capita GDP, size of the public sector, political orientation of the government, membership of the EU, EMU, characteristics of the commodity tax system) and business cycle controls (i.e. real interest rate, real exchange rate), d_i and e_t are country and time dummies, and u_{it} is the error term. Our coefficients of interest are α_{ij} (with $i \neq j$) and β. The coefficients α_{ij} measure how country i's commodity tax responds to the commodity tax in other countries $j \neq i$ (note that $\alpha_{ii} = 0$ by construction). A zero value for α_{ij}, would be evidence of absence of strategic interaction, and therefore would confirm our theoretical analysis and would be in line with previous studies on the destination principle of commodity taxation (see Haufler and Pfluger [25]). The coefficient β describes how country i's tax policy reacts to its own product market regulation z_{it-1}, with a one-year lag to reflect any difficulties encountered in regulation restructuring processes.[19] According to our theoretical model, a significant negative value for β would indicate that the government uses commodity taxes to mitigate the negative impact of stronger regulation on consumers' welfare.

In the first stage of the theoretical model, regulators choose their regulatory pressure. Our second empirical specification linearizes and generalizes the regulators' best responses (see Propositions 2 and 3) for multiple countries and periods as follows:

$$z_{it} = \sum_{j \neq i} \delta_{ij} z_{jt} + \boldsymbol{\zeta}' \mathbf{y}_{it} + d_i + e_t + v_{it}, \tag{19}$$

where coefficients δ_{ij} measure how home regulation z_i responds to foreign regulation z_j ($\delta_{ii} = 0$ by construction). A significant positive (resp. negative) value for δ_{ij}, $i \neq j$, would indicate that country i's regulation policy is a strategic complement (resp. substitute) of country j's regulation. The vector $\mathbf{y}_{it}$ includes the same set of controls as in equation (18) and also includes indicators for local preferences for regulation. d_i and e_t are country and time dummies and v_{it} is the error term. Note that each regulator chooses its regulatory pressure anticipating and internalizing its effects on commodity taxes, so that taxes do not appear in the model estimated for regulators' responses.

[18] Equation (18) itself does not have any implication for the specific principle of commodity taxation. Application of the destination principle is guaranteed by the exclusion of origin based taxes (e.g. excises) from the computation of τ_{it}, and by the choice of a weighting matrix which minimizes origin-based strategic interactions due to cross-border shopping. See more on this below.

[19] The idea that the implementation of product market reforms takes at least 1 year is consistent with descriptive evidence for the OECD countries (see Conway *et al.* [14] and the World Bank's *Doing Business* report [54]).

Equations (18) and (19) show that country i accounts simultaneously for all its partners' tax and regulation policies when it chooses its tax and regulation levels τ_{it} and z_{it}. However, the number of the $2I(I-1)$ strategic interactions included in parameters α_{ij} and δ_{ij} is too large to allow identification. As in Brueckner [9], our econometric approach is to assume that country i responds to an average of its *trade partners*' policies. Denoting such average policies by τ_{-it} and z_{-it}, we can write:

$$\tau_{it} = \alpha\tau_{-it} + \beta z_{it-1} + \boldsymbol{\gamma}'\mathbf{x}_{it} + d_i + e_t + u_{it}, \tag{20}$$

$$z_{it} = \delta z_{-it} + \boldsymbol{\zeta}'\mathbf{y}_{it} + d_i + e_t + v_{it}. \tag{21}$$

Coefficients α and δ in equations (20) and (21) measure the intensity of a country's response to its trade partners' average tax and regulation policies. Coefficient β in equation (20) measures the response of government i's tax policy to the level of local product market regulation.

As in Brueckner [9], we compute the average trade partner policies τ_{-it} and z_{-it} by using a weighting matrix $\boldsymbol{\omega}$ such that :

$$\tau_{-it} = \boldsymbol{\omega}_i'\boldsymbol{\tau}_t, \quad \text{and} \quad z_{-it} = \boldsymbol{\omega}_i'\mathbf{z}_t.$$

Vectors $\boldsymbol{\tau}_t$ and $\boldsymbol{z}_t$ are countries' tax and regulation levels $[\tau_{1t}, \tau_{2t}, ..., \tau_{It}]'$ and $[z_{1t}, z_{2t}, ..., z_{It}]'$ and $\boldsymbol{\omega}_i$ is a vector of weights $[\omega_{i1}, \omega_{i2}, .., \omega_{iI}]'$ that satisfy $\omega_{ii} = 0$, $\omega_{ij} \geq 0$ for $i \neq j$ and $\sum_{j\neq i}\omega_{ij} = 1$.

The literature provides an extensive discussion on the choice of appropriate weights, which depends critically on the nature of the strategic interaction under investigation (see Brueckner [9]). One important novelty of this paper is to adopt a weighting scheme, which proxies for the exogenous structure of international trade flows. In practice, we project trade flows from an augmented gravity equation which predicts country i's imports (logs) ten years before the start of the sample of observations (i.e. in 1980) as a function of countries' 'monadic' characteristics (log of population and GDP) in 1980, and time invariant 'dyadic' characteristics (distance and common border, legal origins, colonial relationship or common language with trade partners, etc., as in Head, Mayer and Ries [26]). This novel approach is very convenient in a number of respects. First, compared to the neighborhood weights typically used in the empirical tax competition literature, weights based on predicted trade flows minimize strategic interactions that may occur under the origin principle due to cross-border shopping. Accordingly, these weights allow a better focus on the destination principle. Second, these weights allow parsimonious specification of the heterogeneous trade relationships between the countries in the sample, which makes our estimates immune to Manski [38]'s reflection issues.[20] Finally, predetermined trade flows predicted

[20]The reflection problem arises whenever strategic interactions occur among countries in a fixed reference group. Our weighting matrix specifies a different reference group for each country (importer), as shown in table B-2. For example, our matrix accounts for the fact that trade relationships are stronger between countries with common legal origins (e.g. Belgium, Spain, France, Greece, Italy, the Netherlands, and Portugal, which have common French legal origins), or common language (e.g. Austria and Germany which are German speaking). It accounts for the fact that a EU country

by exogenous monadic and dyadic characteristics preserve the exogeneity of the weighting matrix, e.g. exclude spurious reverse causality from current tax or regulation policies to trade flows and weights.[21]

4.1.1 Endogeneity and Instrumental Variables

Overall, the vector $\boldsymbol{\omega}_i$ introduces exogenous cross-sectional heterogeneity in tax and regulation policy interactions. However, when estimating equations (20) and (21) by ordinary least square (OLS), one concern is over the endogeneity of tax and regulation policies. To address these endogeneity issues, we implement an instrumental variable estimator based on exogenous variation in tax reforms and social preferences for regulation. We describe these endogeneity issues and instruments separately for the commodity tax and regulation response functions.

Commodity tax response: In equation (20), our first endogeneity concern is over the $\boldsymbol{\tau}_t$ vector. First, τ_{it} and all τ_{jt}'s that enter in $\boldsymbol{\tau}_t$ are determined simultaneously. Second, it is reasonable to suspect reverse causality because trade partners' tax policies react to country i's tax policy. Finally, country i's tax policy is affected not only by the unobserved factors stemming from its constituencies but also by the unobserved characteristics of its trade partners. These may be related to asymmetric economic shocks (e.g. economic and financial turmoil in Europe, following Germany's unification) or multilateral trade agreements (e.g. NAFTA, Uruguay Round).

To address these endogeneity issues, we build an instrument for τ_{-it} using information on the *adoption* of the VAT system in OECD countries. We consider the vector $\boldsymbol{vat}_t = [vat_{1t}, vat_{2t}, ..., vat_{It}]'$ such that $vat_{it} = 1$ if there is a VAT system in commodity taxation in place in country i at time t, and $vat_{it} = 0$ otherwise. The proposed instrument measures VAT adoption amongst trade partners

$$vat_{-it} = \boldsymbol{\omega}_i' \boldsymbol{vat}_t. \tag{22}$$

First, to be a good instrument for τ_{-it} in equation (20), vat_{-it} has to have a clear effect on τ_{-it}. It is generally acknowledged that VAT-based systems are more efficient than general sales taxes or consumption-based tax systems because they enhance tax compliance, avoid double marginalization, and induce higher tax rates on consumption (Kato [29]). Therefore, commodity taxes are likely to respond to the adoption of a VAT system. Second, vat_{-it} is a valid instrument if it is uncorrelated with τ_{it} in equation (20). This exclusion restriction is valid under two conditions. The first condition is that trade partners' adoption vat_{-it} must not vary systematically with local commodity taxes τ_{it}. We claim

may have stronger trade links with other EU countries, relative to non-EU ones (since EU countries are closer, and are more likely to have common legal and colonial origins).

[21] For example, weights are not affected by strategic interactions between trade partners' tax policies which affect the size of trade flows. They also are not affected by the product market regulations in specific sectors (e.g. energy, transport, postal services) which influence international transportation costs.

that this condition holds: on the one hand, the introduction of a VAT system during our period of analysis occurs only in four countries: Switzerland, Australia, Finland, and Canada. In these countries, political discussion of this issue was lengthy (e.g. in Australia) so that the timing of these countries' decisions and their implementation of a VAT system can be considered independent (Kato [29]). This view is confirmed by the fact that the reforms are not temporally concentrated but span a 10 year period (from 1991 in Canada to 2001 in Australia). These arguments support the idea that the timing of the introduction of VAT in each country is not due to responses to common unobserved shocks or supranational directives. On the other hand, these countries have very limited trade relationships with each other, and a very strong heterogeneity in their import compositions (see Appendix table B-2). This also supports the view that there are no network effects in the introduction of their VAT systems. The second condition for the validity of the exclusion restriction is that vat_{-it} must not have any direct effect on τ_{it}. This condition is guaranteed by the cross-border neutrality of VAT, which is explicitly stated in the international guidelines (see OECD [45]). Accordingly, the introduction of a VAT system in a country's trade partner has no efficiency effect for that country's commodity taxes. Finally, notice that, some of our estimates refer to the period $2002 - 2008$ when vat_{-it} does not exhibit any time variation. In these estimates, we follow empirical analyses of tax competition (Lockwood and Migali [37]), and use other instruments for commodity taxes i.e. trade partners' average population, and government expenditure on final consumption.

Endogeneity issues arise also for z_{it-1} in equation (20). The government in country i may have regulated its product market in response to local commodity taxes in previous time periods. Since product market regulation and commodity taxes are persistent institutions, past commodity tax policies may affect current regulatory decisions. Moreover, product market regulations and commodity taxes may be part of a broader policy package. For example, there could be a simultaneity problem if the government in country i designed five-year plans that implemented simultaneous increases in the commodity tax and regulation. Finally, an omitted variable bias would emerge if the unobserved policy package included both an increase in product market regulation and a change in fiscal measures which increased commodity taxes.

To tackle these issues, we build instruments for z_{it} in equation (20) from two indicators for "interpersonal distrust" $distrust_{it}$, and "demand for order" $order_{it}$. Aghion *et al.* [1] show that high levels of interpersonal distrust in a country generate demand for regulation, in an attempt to restrict the negative consumption externalities from individuals who are not considered trustworthy. Similarly, Inglehart [28] argues that demand for order in a country signals materialistic attitudes which create a social demand for regulations from citizens desirous of enjoying safe consumption. Accordingly, $distrust_{it}$ and $order_{it}$ have a clear effect on z_{it}. To be valid instruments for z_{it} in equation (20), these indicators must be uncorrelated with τ_{it}. A priori, social patterns of interpersonal distrust and demand for order can be

considered as independent from commodity taxes. However, it can be argued that both dimensions have a cultural component (e.g. related to lack of social capital and materialistic attitudes), which is persistent over time, and has an effect on growth, per capita income, and individual propensities to pay taxes (Knack and Keefer [31]; Algan and Cahuc [2]; Guiso et al [21]). If not properly accounted for, this cultural component may violate the exclusion restrictions and make $distrust_{it}$ and $order_{it}$ invalid instruments in equation (20). However, it is well-known that a country's culture can be considered reasonably time invariant (see Tabellini [52]). Accordingly, the cultural component of distrust and demand for order is accounted for by the inclusion of country fixed effects, which guarantees the validity of the exclusion restrictions.

Regulation response: In equation (21), the concern is over the endogeneity of z_{-it}. As in the case of taxes in equation (20), there is simultaneous determination of z_{it} and all z_{jt}'s that enter in the $\boldsymbol{z}_t$ vector. Similarly, there can be reverse causality from country i's regulation policy to its trade partners' policies. Finally, it is also reasonable to expect that country i's regulation policy is affected by unobserved characteristics e.g. policy recommendations from supranational organizations (e.g. IMF, World Bank, OECD), which may cause co-movement with the product market regulations of trade partners.

In this case, we propose also to build instruments for z_{-it} from the indicators of interpersonal distrust and demand for order. In particular, we apply our weighting matrix to construct instruments for trade partners' averages:

$$distrust_{-it} = \boldsymbol{\omega}_i' \boldsymbol{distrust}_t; \qquad order_{-it} = \boldsymbol{\omega}_i' \boldsymbol{order}_t.$$

The same arguments discussed above for country i apply to its trade partners, on average: High levels of distrust and demand for social order in country i's trade partners generate product market regulations in that country, so that $distrust_{-it}$ and $order_{-it}$ have a clear effect on z_{-it}. In our view, $distrust_{-it}$ and $order_{-it}$ are also valid instruments for z_{-it} in equation (21) since they can be considered independent of z_{it}. Variation in distrust and social order is triggered by unobserved shocks (e.g. a political scandal). If such a shock hits a trade partner of country i, it increases distrust and demand for order in the partner country, but not necessarily in country i. In addition, when a common unobserved shock hits both country i and its trade partners, the effects on distrust and demand for order are country specific and independent of z_{it}. Descriptive evidence supports this interpretation (see figure 7 below, and the ensuing discussion). It is also natural to exclude the direct effects of trade partners' preferences on local regulation because local regulatory systems are designed to respond to local but not foreign preferences. Also in this case, any violation of the exclusion restriction may occur only through the cultural features of trade partner countries which are correlated with local economic performance and local regulation (see e.g. Guiso *et al.* [21]). However, as mentioned above, these cultural factors are time invariant and are accounted for by the country fixed effects. What remains after the inclusion of country fixed effect

is variation over time in the social preferences (distrust and materialistic attitudes) within the same country which is likely to affect local regulation policy but plausibly is uncorrelated with the regulation policy in trade partner countries for the reasons stated above.

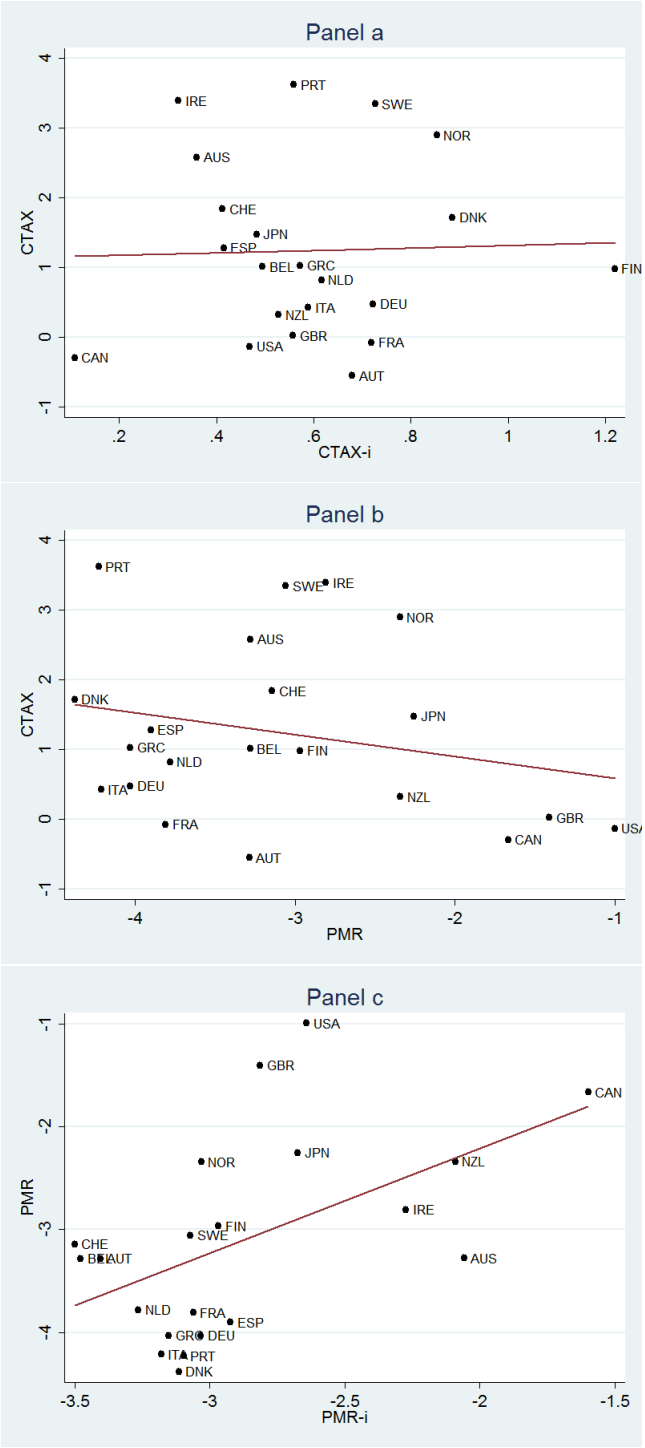
4.2 Data and Descriptive Statistics

We exploit a unique data set that combines information on product market regulation, consumption taxation, institutional characteristics, and social preferences for 21 OECD countries over the 1990-2008 period.[22] We proxy the commodity tax rate τ_i by the average effective tax rate on consumption, which measures each country's tax revenues as a percentage of the total value of its consumption (see Carey and Rabesona [11]). To focus on the destination principle, we include only the sales tax and the VAT in our definition of commodity taxes ($CTAX$). In other words, we exclude excise taxes, customs and import duties, profits from public monopolies, and taxes on specific services whose revenues may partly reflect application of the origin principle to consumers' transactions. We use two empirical proxies for product market regulation (PMR), z. Our first measure for regulation is the number of days required to start up a new business (see Djankov *et al.* [16]). This measure applies to the whole economy but is available for the time period 2002-2008. Our second measure is the index of energy, transport and communication regulation indicator (ETCR) constructed by Conway and Nicoletti [14]. On a scale from 0 to 6, this index aggregates information on entry barriers (fixed costs) in seven non-manufacturing industries (electricity, gas, air passenger transport, rail transport, road freight, and postal services) for the entire period 1990-2008. The longer time span of this series makes it better suited to a panel study. Nevertheless, the two series are strongly correlated with a correlation coefficient equal to 0.50 and significant at the 1% level (details of both measures of regulation are in Section B.1 of the on-line appendix).

Figure 4 presents the relationships between our main variables in differences between their averages in the final and initial periods (resp., 2004-08 and 1990-94). The average commodity tax and product market regulation levels (based on the ETCR measure) for country i's trade partners ($CTAX_{-i}$, PMR_{-i}) are obtained by weighting trade partners according to the weights ω_{ij} presented in the previous section. Panel a plots $CTAX$ against $CTAX_{-i}$. In this panel, country observations are scattered across their whole range but the fitted line is rather flat. This suggests that each country's commodity tax is not correlated with its trade partners' average commodity tax. Panel b plots $CTAX$ against PMR. It shows a negative correlation between changes in taxes and product market regulation, which suggests

[22] The countries we consider are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, the UK and the US. Section B.1 in the on-line appendix describes the data sources and the construction of variables. It also presents our control variables and/or the variables used for the robustness checks.

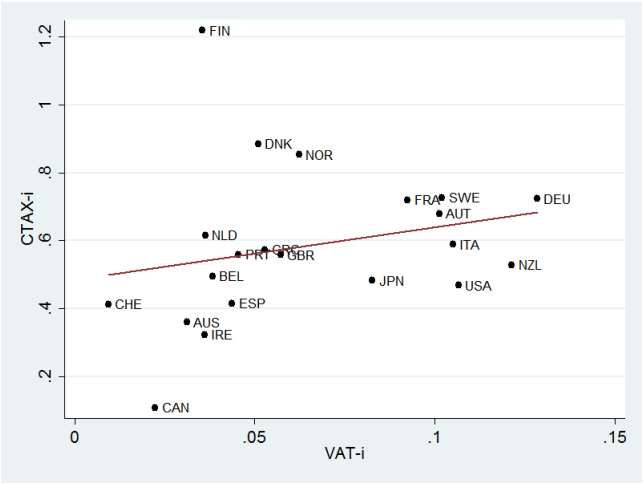
Figure 4: Commodity Taxation and PMR.



Notes: Commodity taxes are measured by average effective tax rates. PMR is measured by the ETCR index. Differences between country averages over the periods 2004-2008 and 1990-1994. Authors' calculation on OECD data.

that countries that incurred a fall in PMR increased their effective tax rates during the sample period. Panel c plots PMR against PMR_{-i}. It shows a positive correlation between the two variables which is consistent with the view that a country is more likely to deregulate if its trade partners deregulate.

Figure 5: Introduction of a VAT system and commodity taxes in trade partner countries



Notes: Differences between country averages over the periods 2004-2008 and 1990-1994. Authors' calculation on OECD data.

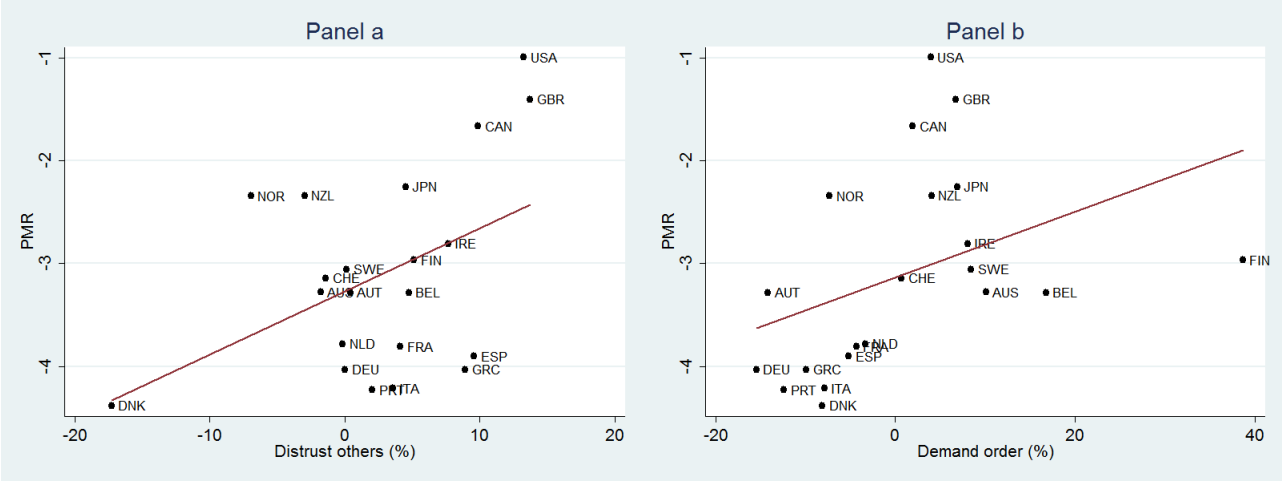
We now describe the variables we use as instruments. To instrument $CTAX_{-i}$ in equation (20), we exploit the variation associated with the introduction of a VAT system in trade partner countries. We construct a dummy variable equal to 1 if a VAT system is at work in country i at time t and zero otherwise. We then apply the weights ω_{ij} and construct a weighted average VAT_{-i}, which includes both cross-section and time variations (see Table B-3 in the on-line appendix). Figure 5 plots $CTAX_{-i}$ against VAT_{-i}, taking variables in differences between the averages in the 2004-2008 and 1990-1994 periods. The figure shows that VAT_{-i} is positively correlated with $CTAX_{-i}$. This suggests that the introduction of a VAT system in each trade partner country induces an increase in their commodity tax rates. This is consistent with the view that VAT systems are more efficient than general sales tax or consumption-based tax systems (Kato [29]).

To instrument PMR in equation (20) and PMR_{-i} in equation (21), we construct two measures for the demand for regulation in each country using the last four waves of the *World Value Survey* (WVS) and the last three waves of the *European Value Study* (EVS). The first measure is the percentage of respondents who answer '*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?*'. The second measure is the percentage of individuals who respond '*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?*' We take the averages by country over the 1990-1994, 1995-1999, 2000-2004 and 2005-2008 periods and obtain two

time-varying measures of demand for regulation.[23]

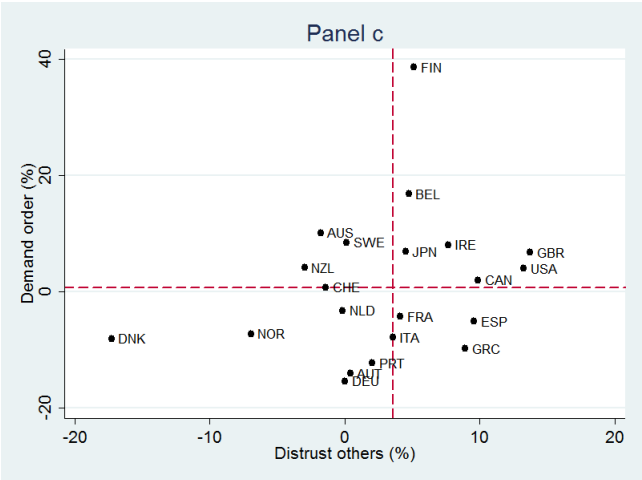
Figure 6 plots PMR against the indicators of distrust (Panel a) and demand for order (Panel b). Again, the variables are taken in differences between their averages in the 2004-2008 and 1990-1994 periods. The two figures confirm a positive correlation between PMR and our measures of demand for regulation, as suggested by Aghion *et al.* [1], and Inglehart [28]. The two correlations are significant at the 1% level.

Figure 6: Indicators of demand for regulation and PMR.



Notes: Differences between country averages over the periods 2004-2008 and 1990-1994. Authors' calculation on EVS/WVS data.

Figure 7: Distrust versus demand for order.



Notes: Differences between country averages over the periods 2004-2008 and 1990-1994. Authors' calculation on EVS/WVS data.

[23]WVS and EVS data consist of fully comparable survey waves. They describe social attitudes, which are persistent in each country over the years covered. Thus, it can be argued that social preferences change between two consecutive waves, while remaining constant in the years covered by each single wave. (Details are in Section B.1 of the on-line appendix).

Finally, figure 7 plots the percentages of individuals who demand order and those who do not trust other people, in differences between the final and initial period averages. The dashed lines denote the sample medians of the changes in the two measures between 1990 and 2008. Figure 7 shows that country observations are dispersed across the four quadrants of the graph. This highlights heterogeneity in country behaviors and the absence of common trends in the demand for regulation. In the top right quadrant, we find countries that have experienced a higher demand for order due to social, political, and economic unrest (e.g. Finland and Belgium),[24] and characterized by a significant increase in distrust stemming from rising inequalities (e.g. Ireland) and fears over terrorism (e.g. 9/11 in the USA and 7/7 in the UK). The top left quadrant includes countries where political inertia and economic depression at the beginning of the 1990s increased the demand for order, and where the ensuing political reforms in the late 1990s increased general trust levels (e.g. Australia and New Zealand).[25] The bottom left panel includes countries that experienced successful welfare and workfare reforms inspired by the "flexicurity" principle in the 1990s (e.g. Denmark, Norway and Germany). Finally, the bottom right panel includes countries which experience a resurgence of nationalism and political scandals during the 1990s, and whose mediocre economic performance boosted public support for more freedom and autonomy in the private sector (e.g. Italy, Greece, and Spain).[26]

It follows from these arguments that the change in distrust and demand for order in each country during this time period was the result of country-specific exogenous shocks. Although some shocks hit multiple countries at the same time, their effects on social distrust and demand for order can be considered as specific to each country, and therefore not spatially correlated.

[24] At the end of the 1980s, social unrest increased in Finland and Sweden due to the rise of social equality movements and the contrast between Swedish majority and minority groups. Also, the collapse of the Soviet Union and the ensuing great economic depression in the first half of the 1990s increased the demand for social, political, and economic stabilization. Similarly, in Belgium demand for order increased as a consequence of serial crime episodes and the dioxin food crisis during the mid 1990s.

[25] At the beginning of the 1990s, levels of trust in Australia were very low driven mostly 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 liberalization and structural reforms. The path was somewhat similar in New Zealand where up to the early 1990s, national governments carried out reforms that may not have reflected the mood of the electorate. The rising level of trust in the 2000s seems to reflect the success of the referendum to change the electoral system to a mixed proportional representation, which led to the effective change in political representation in the country (Castels and Mitchell [13]).

[26] It is generally acknowledged that the 'shock' that triggered the resurgence of distrust in these countries during the 1990s was the fall of the Communist regime in Russia and Eastern Europe. Also, the fall of the Communist system and the Yugoslav wars fostered fear, and opposition to rising immigration. Immigrants were often perceived as 'dangerous' to national communities, and this has led to the election of governments supported by extreme right and nationalist parties (see European Commission [10]). In Italy, the increase in distrust and demand for freedom and autonomy was also triggered by the "Mani Pulite" political scandal.

4.3 Baseline Results

Table 1 reports our baseline estimates of the commodity tax response function (20) in Panel a and the regulation response function (21) in Panel b. In each panel, we present a first set of estimates in Columns [1]-[3], based on number of days to start up a business as a measure of product market regulation, and a second set of estimates in Columns [4]-[6], where we use the ETCR measure. Each set of estimates includes a simple OLS model (Columns [1] and [4]), an OLS model with fixed effects (Columns [2] and [5]), and a two stage least squares (2SLS) model with fixed effects (Columns [3] and [6]). All estimates include as controls total population, per capita GDP, government consumption (as a % of GDP), real interest rate, real exchange rate. Estimates in Columns [4]-[6] also include dummies for membership of the European Union and the European Monetary Union.

We start by commenting on the coefficient of $CTAX_{-i}$ in the commodity tax response function in Panel a. The OLS estimates in Columns [1] and [4] show a positive coefficient, significant at the 1% level, which provides prima facie evidence in favor of commodity taxes being strategic complement policies. However, this evidence disappears when we add the country fixed effects (Columns [2] and [5]). This suggests that the coefficient of $CTAX_{-i}$ in the OLS estimates reflects time-invariant characteristics determining commodity taxes in both the domestic country and its trade partners, which are controlled for through the inclusion of the country fixed effects.[27] In Columns [3] and [6], we present the 2SLS estimates.[28] Econometric tests confirm that the instruments are sufficiently correlated with the endogenous regressors in the first stage and provide valid exclusion restrictions in the second stage.[29] The coefficient of $CTAX_{-i}$ in Columns [4] and [6] remains not significantly different from zero. This allows us to conclude the absence of strategic interactions in commodity taxation.

We next discuss the coefficient of PMR in the commodity tax response function in Panel a. The

[27]The negative significant coefficient of $CTAX_{-i}$ in Column [5] is driven by omitted variables associated with the economic turmoil during 1990-1997, which followed the reunification of Germany, the European Monetary System crisis, and the systemic banking crises in Finland, Sweden and France (Kovzanadze, [32]). Governments hit by these shocks simultaneously increased their spending without increasing their tax revenues. This is reflected by a spatially correlated decrease in effective tax rates which provides false evidence of strategic interaction. The results of the robustness checks are available in Section B.2 of the on-line appendix

[28]As mentioned above, due to lack of VAT reforms during 2002-2008, for 2SLS estimates in column [3] we use trade partners' average population and government expenditure on final consumption as instruments for $CTAX_{-i}$ (see Lockwood and Migali [37]).

[29]The K-P weak identification statistics approach the critical values associated with a maximum size distortion of the Wald test of 25% (Stock and Yogo [51]). These distortions imply that we may be too quick to conclude that the endogenous tax regressors are statistically significant in instrumental variables estimates. In the robustness checks we discuss how this apparently large distortion is due to the large number of controls reducing the power of the instruments in the baseline specification: More parsimonious specifications reduce the size of the maximum distortion to reassuring levels (e.g. to 10%. compare Stock and Yogo [51], Table 5.2), without affecting our main results.

OLS estimates show a non-significant coefficient in Column [1], and a negative coefficient, significant at the 1% level in Column [4]. Results remain stable in Columns [2] and [5] where we include the country fixed effects. 2SLS estimates in Columns [3] and [6] show that in both specifications the coefficient of PMR is negative and significant at the 1% level. This evidence suggests that high product market regulation in a country induces lower commodity taxes in that country.[30] In relation to the controls, note the positive significant coefficient of VAT in Columns [4]-[6]. This is consistent with the view that the introduction of a value-added system of commodity taxation increases the efficiency of commodity taxation, raising the effective tax rate on consumption by about 0.7 percentage points after the inclusion of country fixed effects (See Table B-4 in the on-line appendix for the full set of controls).

Panel *b* reports the estimates of the regulation policy response function (21). As in Panel *a*, Columns [1]-[3] report the estimates of PMR based on the number of days to start up, while Columns [4]-[6] display those based on ETCR. OLS estimates in Columns [1] and [3] show a positive coefficient of PMR_{-i}, significant at the 1% level which suggests strategic complementarity in product market regulation policies. However, the positive effect of PMR_{-i} vanishes in Column [2], and becomes smaller in Column [4], once we account for the country fixed effects. This suggests that evidence of strategic complementarity in regulation policies in the OLS estimates partly reflects time-invariant unobserved characteristics which determine product market regulations in trade partners (e.g. common legal origins). Columns [3] and [6] present the 2SLS estimates. Econometric tests confirm that the instruments are strongly correlated with the endogenous regressors in the first stage and provide valid exclusion restrictions in the second stage. The coefficient of PMR_{-i} is now positive, large, and significant at the conventional levels in both Columns [3] and [6]. The coefficient in Column [6] is below 1, which ensures stationarity in the spatial lag model. Among the controls, the shares of people who distrust others and demand order are significant and take a positive sign, in line with Aghion *et al.* [1] and Inglehart [28] (the full set of controls is reported in Table B-4 of the on-line appendix).

It is instructive to discuss the economic magnitude of the effects of both local regulation on local commodity tax and of trade partners' regulation on local regulation. For this purpose, we use the 2SLS estimates in Column [6] as a benchmark, and interpret the coefficient of PMR in terms of the days to start up a business, which is a more intuitive dimension of product market regulation. Over the 2002-2008 period, for which the ETCR and days to start up measures are both available, the two measures are strongly correlated and have standard deviations of 0.56 (on a scale of 0 to 6) and 20 (days), respectively. Thus, the number of days to start up a business corresponding to the standard deviation of ETCR over the 1990-2008 period (i.e., 1.49) can be approximated by $1.49 * 20/0.56 \approx 53$ (days). This is about one-third of the decrease in the days to start up a business achieved during the 1990s' EU deregulation

[30]The larger negative effect in the 2SLS estimates suggests that OLS fixed effect estimates in Columns [2] and [5] are upward biased (e.g. due to policy packages that simultaneously increase regulation and commodity taxes).

waves. Taken at face value, the 2SLS estimate in Panel *a* suggests that a deregulation wave that cuts 53 days to start up a business raises the effective commodity tax rate by $(-0.47 * -1.49 =)$ 0.70 percentage points. The 2SLS estimate in Panel *b* also implies that a country will cut its days to start up a new business by $(53 * 0.46/1.49 \approx)$ 16 days in response to a deregulation wave in trade partner countries which cuts their days to start up by 53 days.

To sum up, the estimates in table 1 highlight three main results. First, we find no evidence of strategic interaction in commodity taxation under the destination principle. Second, we establish a negative impact of product market regulations on the level of commodity taxes in a country. Third, we reveal strategic complementarity in regulation policies between trade partners. The first result adds to the previous work on strategic complementarity in commodity taxation under the origin principle (Lockwood and Migali [37]). In terms of our theoretical model, the second result provides indirect evidence that the demand for public goods is more sensitive to income than the demand for private goods. This is in line with Wagner's law, which implies that the development of an industrial economy is accompanied by an increased share of public expenditure in the gross national product (see Peacock and Wiseman, [48], for an application to the U.K.). The third result can be interpreted in terms of our theoretical model as indirect evidence of a weak taste for variety. This is consistent with empirical findings in Hummels and Klenow [27] and Ardelean [5].

5 Sensitivity Analysis

In this section, we discuss the results from a number of robustness checks, selecting as our benchmark the specification based on the ETCR measure of product market regulation. The robustness check results are reported in tables from C-1 to C-5 in Appendix C .

First, we account for potential correlation between the commodity tax and regulation decisions at country level, and estimate a system of four equations, i.e. equations (20), (21) and their foreign counterparts. We performed seemingly unrelated regressions (SUR) and three stages least squares (3SLS). The exclusions restrictions described in Section 4.1 allow us to assign instruments to the relevant regressors. The results of this exercise confirm the absence of commodity tax competition, and (even larger) strategic complementarity in product market regulation.

We checked the robustness of our main results to the use of alternative weighting schemes based on contiguity in culture, legal origins, and geographical location. We also presented the results for some 'placebo' weights, using a 'nonsense' procedure based on the position of each country's initials in the Latin alphabet (see e.g. Case *et al.* [12]). The main insight from these robustness exercises is that cultural and legal factors do not induce commodity tax competition but create a direct channel between domestic regulation and preferences in trade partner countries, which violates the exclusion

restrictions in the regulation response function. The use of neighboring weights highlights the strategic behavior of countries under the origin principle, which induces strategic complementarity in commodity taxes. Finally, the use of placebo weights eliminates the strategic interactions we found in the baseline estimates. This confirms that complementarities in regulation, and absence of interaction in commodity taxes stem directly from the matrix based on bilateral trade relationships.

To check whether or not effective tax rates on consumption are under the direct control of government or not, we re-estimated both response functions using statutory instead of effective commodity tax rates; the results were unaffected.

It could be argued that the choice of the empirical specification for the commodity tax response function (i.e. taxes as a function of regulation) stems from the timing of government decisions in the theoretical setting. We considered an alternative empirical specification where regulations are expressed as a function of taxes. The results suggest that commodity taxes do not have any effect on product market regulations in a country, which is indirect evidence in favor of the timing we assumed in the theoretical model.

Finally, we performed an additional battery of robustness checks. We run a more parsimonious specification, which includes only country and time fixed effects. This increases the correlation of the instruments in the first stage to reassuringly high levels, but also introduces some omitted variables in the estimates. We control for any unobserved heterogeneity associated with asymmetric shocks and changes in social preferences (i.e. tax morale). We show that this is not a concern in our estimates. We also carried out some sensitivity analysis with respect to the estimated impact of product market regulation in the commodity tax response function i.e. to distinguish the effects of domestic and foreign regulation and assuming regulation is exogenous. Our results hold in both cases. Finally, we show that our baseline results hold in this medium-run perspective by running regressions on five-year periods.

6 Conclusion

In this paper, we studied competition in product market regulation and commodity tax rates between two trading partners using a general equilibrium model in which destination-based consumption taxes finance the provision of public goods, 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 polices are strategic complements as long as consumers do not value product variety too highly. Third, regulation has a negative impact on commodity tax rates if the demand for public goods is more sensitive to income than the demand for commodities. In the empirical part of the paper, we specify an empirical model to estimate the direction of the forces described by

the theory using data on OECD countries. We find evidence supporting the absence of strategic tax interactions, 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 firms' start up time by 53 days leads to a rise in the effective commodity tax rate of 0.70 percentage points and triggers a deregulation process of about 16 days for startup in trade partner countries. Overall, these magnitudes are non-negligible considering that EU countries reduced firms' start up time by an average of 160 days in the 1990s.

Finally, our results shed light on the relationship between the various policies of trading partners. First, (de)regulation policies significantly change the magnitude of the tax revenues collected through consumption taxes. This is particularly important as commodity taxation remains an important public finance instrument, particularly in the EU. Our research suggests that the deregulation of commodity markets leads to an increase in commodity tax revenues. Our findings suggest also that foreign deregulation has an indirect impact on domestic tax revenues because it leads domestic governments to deregulate, and therefore, to raise their effective tax rates and revenues. These are very important findings, which should be carefully considered by the OECD Regulatory Impact Analysis (RIA) to design future regulatory reforms (see e.g. OECD [44]).

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.

Table 1: Commodity tax and regulation response functions

	[1] OLS	[2] OLS FE	[3] 2SLS FE	[4] OLS	[5] OLS FE	[6] 2SLS FE
Panel a: Commodity tax response						
$CTAX_{-i}$	0.79***	–0.56	–1.05	0.86***	–0.61**	1.12
	(0.11)	(0.41)	(1.25)	(0.14)	(0.30)	(0.98)
PMR (days to start up)	0.01	–0.00	–0.07***			
	(0.01)	(0.00)	(0.02)			
PMR (ETCR)				–0.36***	–0.18***	–0.47**
				(0.10)	(0.06)	(0.21)
VAT				2.31***	0.73***	0.72***
				(0.68)	(0.20)	(0.21)
Partial Rsq $CTAX_{-i}$	-	-	0.39	-	-	0.11
Partial Rsq PMR	-	-	0.06	-	-	0.11
K-P rk Wald F-stat	-	-	3.100	-	-	3.981
K-P rk LM-stat (p-value)	-	-	13.79 (0.03)	-	-	21.42 (0.00)
Hansen J-stat (p-value)	-	-	0.80 (0.67)	-	-	1.568 (0.21)
Panel b: Regulation response						
PMR_{-i} (days to start up)	0.67***	–0.28	2.58**			
	(0.19)	(0.72)	(1.15)			
PMR_{-i} (ETCR)				1.05***	0.57***	0.46***
				(0.05)	(0.12)	(0.11)
Preference for order (%)	0.92***	0.35	–0.06	0.02***	0.01	0.01
	(0.24)	(0.41)	(0.43)	(0.00)	(0.01)	(0.01)
Distrust others (%)	0.23*	0.44	0.66	0.03***	0.03***	0.03***
	(0.14)	(0.66)	(0.63)	(0.00)	(0.01)	(0.01)
Partial Rsq PMR_{-i}	-	-	0.21	-	-	0.60
K-P rk Wald F-stat	-	-	12.55	-	-	78.25
K-P rk LM-stat (p-value)	-	-	21.91 (0.00)	-	-	149.8 (0.00)
Hansen J-stat (p-value)	-	-	0.012 (0.91)	-	-	0.03 (0.86)
Observations	146	146	146	390	390	390

Notes: All specifications include controls for total population, per capita GDP, government consumption (as a % of GDP), real interest rate, real exchange rate, and time dummies. Specifications, in Columns [2],[3],[5],[6] include country dummies. Estimates in Columns [4]-[6] also include dummies for membership of the European Union and the European Monetary Union (see Table B-4 in the on-line appendix for the coefficients). In panel a $CTAX_{-i}$ is instrumented by average government consumption, and average population in trade partners in Column [3] and VAT_{-i} Column [6]. PMR (lagged one year) is instrumented by preferences for order and distrust (lagged five years) in Column [3] and Column [6]. In panel b, PMR_{-i} is instrumented by five year lags of preferences for order and distrust in the trade partner in Columns [3] and [6], and instruments for $CTAX_{-i}$ in Panel a are included in the vector of controls. Robust standard errors are in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

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Appendix A Demand under delivery uncertainties.

In this appendix we suppose that delivery uncertainty symmetrically affects the commodities so that the probabilities of home and foreign commodities (ω, ω^*) to be delivered are given by $\theta = \int_S \theta(s)\lambda(s,\omega)\mathrm{d}s$ and $\theta^* = \int_S \theta(s)\lambda(s,\omega^*)\mathrm{d}s$. We then show that the optimal individual consumption and consumption bundle are given by

$$c(\omega) = p(\omega)^{-\sigma}\frac{\theta^\sigma W}{P^{1-\sigma}} \text{ and } C = \frac{N^{-\nu}W}{P} \text{ where } \quad P^{1-\sigma} = n\theta^\sigma p^{1-\sigma} + n^*\theta^{*\sigma}p^{*1-\sigma}$$

The first order condition with respect to consumption $c(\omega)$ yields

$$\int_S \theta(s)U'_C(C(s),G(s))N^{-\nu\frac{\sigma-1}{\sigma}}C(s)^{\frac{1}{\sigma}}\lambda(s,\omega)^{\frac{\sigma-1}{\sigma}}c(\omega)^{-\frac{1}{\sigma}}\mathrm{d}s = \mu p(\omega)$$

where μ is the Lagrange multiplier of the budget constraint. We get the consumption function

$$c(\omega) = p(\omega)^{-\sigma}\frac{A(\omega)^\sigma}{\mu^\sigma}$$

where

$$A(w) = \int_S \theta(s)U'_C(C(s),G(s))N^{-\nu\frac{\sigma-1}{\sigma}}C(s)^{\frac{1}{\sigma}}\lambda(s,\omega)^{\frac{\sigma-1}{\sigma}}\mathrm{d}s \tag{A-1}$$

Inserting this in the budget constraint and solving for μ, we get the consumption function

$$c(\omega) = \frac{p(\omega)^{-\sigma}A(\omega)^\sigma W}{\int_0^N p(\omega')^{1-\sigma}A(\omega')^\sigma \mathrm{d}\omega'} \tag{A-2}$$

Individuals' demand is iso-elastic in own price $p(\omega)$. The consumption bundle is

$$C(s) = \frac{N^{-\nu}\left[\int_0^N (\lambda(s,\omega)p(\omega)^{-\sigma}A(\omega)^\sigma)^{\frac{\sigma-1}{\sigma}}\mathrm{d}\omega\right]^{\frac{\sigma}{\sigma-1}}W}{\int_0^N p(\omega')^{1-\sigma}A(\omega')^\sigma\mathrm{d}\omega'} \tag{A-3}$$

Under the assumption of symmetric delivery uncertainty, the probability of the commodity ω to be delivered is the same for all commodities in the same country and given by $\theta = \int_S \theta(s)\lambda(s,\omega)\mathrm{d}s$. Hence, $\int_0^n \lambda(s,\omega)\mathrm{d}\omega$ is equal to the number of domestic delivered commodities $n\theta$. Similarly, $\theta^* = \int_S \theta(s)\lambda(s,\omega)\mathrm{d}s$ and $\int_n^{n+n^*}\lambda(s,\omega^*)\mathrm{d}\omega^* = n^*\theta^*$ for foreign commodities $\omega^* \in (n, n+n^*]$. Because of this symmetry, we must have: $A(\omega) \equiv A$ for $\omega \in [0,n]$ and $A^*(\omega^*) \equiv A^*$ for $\omega^* \in (n, n+n^*]$ where A and A^* are constants. The symmetry also imposes that $C(s)$ is the same in any state so that $C(s) \equiv C$ and therefore $G(s) \equiv G$. Noting that $\int_S \theta(s)\lambda(s,\omega)^{\frac{\sigma-1}{\sigma}}\mathrm{d}s = \int_S \theta(s)\lambda(s,\omega)\mathrm{d}s$ and plugging those values in (A-1) yields

$$\begin{aligned}
A &= \int_S \theta(s)\lambda(s,\omega)\mathrm{d}s\ U'_C(C,G)N^{-\nu\frac{\sigma-1}{\sigma}}C^{\frac{1}{\sigma}}, \quad \omega \in [0,n] \\
&= \theta U'_C(C,G)N^{-\nu\frac{\sigma-1}{\sigma}}C^{\frac{1}{\sigma}} \\
A^* &= \int_S \theta(s)\lambda(s,\omega^*)\mathrm{d}s\ U'_C(C,G)N^{-\nu\frac{\sigma-1}{\sigma}}C^{\frac{1}{\sigma}}, \quad \omega^* \in (n, n+n^*] \\
&= \theta^* U'_C(C,G)N^{-\nu\frac{\sigma-1}{\sigma}}C^{\frac{1}{\sigma}}
\end{aligned}$$

This gives the consumption function

$$c(\omega) = \frac{p(\omega)^{-\sigma} A^{\sigma} W}{\int_0^n p(\omega')^{1-\sigma} A^{\sigma} \mathrm{d}\omega' + \int_n^{n+n^*} p(\omega^*)^{1-\sigma} A^{*\sigma} \mathrm{d}\omega^*}$$

or equivalently,

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

where $P^{1-\sigma} = \int_0^n p(\omega)^{1-\sigma} \theta^{\sigma} \mathrm{d}\omega + \int_n^{n+n^*} p(\omega^*)^{1-\sigma} \theta^{*\sigma} \mathrm{d}\omega^*$, which gives (2).

Now, when commodities are symmetric in the preferences and in the production function, it must be that in equilibrium $p(\omega) \equiv p$, $\omega \in [0, n]$, and $p(\omega^*) \equiv p^*$, $\omega^* \in (n, n+n^*]$. So, from (A-3) we successively get

$$\begin{aligned} C &= \frac{N^{-\nu} \left[(p^{-\sigma} A^{\sigma})^{\frac{\sigma-1}{\sigma}} \int_0^n \lambda(s,\omega) \mathrm{d}\omega + (p^{*-\sigma} A^{*\sigma})^{\frac{\sigma-1}{\sigma}} \int_n^{n+n^*} \lambda(s,\omega) \mathrm{d}\omega \right]^{\frac{\sigma}{\sigma-1}} W}{\int_0^N p(\omega')^{1-\sigma} A(\omega')^{\sigma} \mathrm{d}\omega'} \\ &= \frac{N^{-\nu} \left[(p^{-\sigma} \theta^{\sigma})^{\frac{\sigma-1}{\sigma}} \int_0^n \lambda(s,\omega) \mathrm{d}\omega + (p^{*-\sigma} \theta^{*\sigma})^{\frac{\sigma-1}{\sigma}} \int_n^{n+n^*} \lambda(s,\omega) \mathrm{d}\omega \right]^{\frac{\sigma}{\sigma-1}} W}{p^{1-\sigma} \theta^{\sigma} + p^{*1-\sigma} \theta^{*\sigma}} \\ &= \frac{N^{-\nu} W}{\left[n p^{1-\sigma} \theta^{\sigma} + n^* p^{*1-\sigma} \theta^{*\sigma} \right]^{\frac{1}{1-\sigma}}} \\ &= \frac{N^{-\nu} W}{P} \end{aligned}$$

where

$$P^{1-\sigma} = n \theta^{\sigma} p^{1-\sigma} + n^* \theta^{*\sigma} p^{*1-\sigma}.$$

From (A-2), we then get the consumption of a commodity

$$c(\omega) = p(\omega)^{-\sigma} \frac{\theta^{\sigma} W}{P^{1-\sigma}}$$

Demand is iso-elastic in own price $p(\omega)$.

Our main results maintain with rent seeking regulators (see Moriconi *et al.* [42]). They also hold for different country sizes, multiple countries and trade costs (text available upon request to the authors.)

Appendix B Derivation of the weighting matrix

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 country i's total imports. However, this measure is endogenous with respect to consumption taxation and product market regulation due to both reverse causality and omitted variables bias.[31]

[31] 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 to country i or in some other country $-i$. Along similar lines, product

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 exclude 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 the country's unobserved structural characteristics which affect regulation, taxation, and imports. The second step then is to construct a weight measure based on country i's imports predicted by the structural characteristics of each ij pair of trade partners such as country size, distance, culture, legal origin, and historical relationship. We estimate the following augmented gravity equation where import flows are expressed as a function of the specific attributes of the importer and exporter (captured by population size and per capita GDP) as well as time invariant 'dyadic' characteristics (see Head, Mayer and Ries [26] for details):

$$ln(Imp_{ij}) = a_1 ln(POP_i) + a_2 ln(POP_j) + a_3 ln(GDPxc_i) + a_4 ln(GDPxc_j) + \\ + a_5 ln(Dist_{ij}) + a_6 contig_{ij} + a_7 collink_{ij} + a_8 comlang_{ij} + a_9 legor_{ij} + \xi_{ij}. \tag{B-4}$$

Results of the OLS estimates are reported in table B-1. From the estimated coefficients, we reconstruct the predicted imports' flows $\widehat{Imp}_{ij}$[32] and construct from it the exogenous weight as $\omega_{ij} = \frac{\widehat{Imp}_{ij}}{\sum_{i \neq j} \widehat{Imp}_{ij}}$. Table B-2 displays the weighting matrix.

market regulation in country j determines the relative prices of its goods, thus influencing the decision of country i over whether to import from j or from some other country $-j$. Omitted variable bias may arise if unobserved structural characteristics exist in a country which affect both its over time variation in taxation, regulation and imports.

[32]In equation (B-4) 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-4) due to the strong theoretical a priori in favor of the importance of shared borders to imports.

Table B-1: Gravity equation estimates

$\ln(POP_i)$	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 based on total 1980 imports by country (Source IMF DOTS). Estimates used to construct weighting matrix based on predicted imports; robust standard errors in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-2: Weighting matrix based on predicted imports

exporter/importer	AUS	AUT	BEL	CAN	CHE	DEU	DNK	ESP	FIN	FRA	GBR	GRC	IRE	ITA	JPN	NLD	NOR	NZL	PRT	SWE	USA
AUS	**	0.004	0.002	0.009	0.003	0.005	0.005	0.005	0.007	0.004	0.013	0.008	0.007	0.005	0.028	0.003	0.006	0.094	0.006	0.006	0.026
AUT	0.009	**	0.013	0.004	0.043	0.064	0.019	0.014	0.017	0.017	0.014	0.024	0.010	0.031	0.023	0.013	0.018	0.008	0.015	0.019	0.012
BEL	0.014	0.034	**	0.011	0.037	0.093	0.034	0.037	0.026	0.111	0.047	0.038	0.024	0.043	0.024	0.220	0.033	0.012	0.039	0.031	0.019
CAN	0.053	0.011	0.010	**	0.012	0.014	0.014	0.016	0.019	0.026	0.042	0.019	0.025	0.015	0.041	0.010	0.019	0.053	0.021	0.018	0.270
CHE	0.015	0.089	0.031	0.011	**	0.113	0.029	0.030	0.025	0.078	0.030	0.033	0.019	0.090	0.036	0.026	0.028	0.013	0.029	0.028	0.020
DEU	0.073	0.401	0.231	0.037	0.338	**	0.267	0.115	0.148	0.189	0.157	0.147	0.097	0.163	0.179	0.246	0.178	0.062	0.121	0.190	0.096
DNK	0.009	0.014	0.010	0.005	0.011	0.033	**	0.012	0.034	0.014	0.017	0.016	0.012	0.015	0.016	0.016	0.050	0.008	0.013	0.079	0.012
ESP	0.016	0.018	0.019	0.009	0.018	0.024	0.020	**	0.021	0.056	0.024	0.042	0.019	0.044	0.026	0.023	0.023	0.013	0.109	0.022	0.045
FIN	0.007	0.007	0.004	0.003	0.005	0.010	0.018	0.007	**	0.007	0.008	0.011	0.006	0.008	0.012	0.006	0.030	0.006	0.008	0.080	0.009
FRA	0.058	0.095	0.248	0.062	0.211	0.172	0.103	0.247	0.092	**	0.149	0.168	0.090	0.266	0.097	0.157	0.108	0.049	0.190	0.104	0.114
GBR	0.121	0.055	0.071	0.069	0.055	0.097	0.086	0.073	0.072	0.101	**	0.070	0.396	0.071	0.071	0.091	0.098	0.104	0.083	0.085	0.175
GRC	0.005	0.006	0.004	0.002	0.004	0.006	0.006	0.009	0.007	0.008	0.005	**	0.004	0.015	0.008	0.006	0.006	0.004	0.009	0.007	0.006
IRE	0.005	0.003	0.002	0.003	0.002	0.004	0.004	0.004	0.004	0.004	0.027	0.003	**	0.003	0.004	0.003	0.005	0.004	0.005	0.004	0.007
ITA	0.035	0.085	0.046	0.016	0.116	0.070	0.052	0.092	0.052	0.126	0.050	0.143	0.035	**	0.056	0.058	0.054	0.029	0.088	0.055	0.043
JPN	0.115	0.037	0.015	0.029	0.028	0.047	0.034	0.033	0.048	0.028	0.030	0.050	0.024	0.034	**	0.021	0.044	0.096	0.040	0.042	0.077
NLD	0.019	0.032	0.221	0.010	0.032	0.099	0.053	0.046	0.037	0.070	0.060	0.051	0.032	0.055	0.033	**	0.049	0.016	0.050	0.046	0.026
NOR	0.009	0.011	0.008	0.005	0.008	0.017	0.039	0.011	0.043	0.011	0.015	0.014	0.011	0.012	0.016	0.012	**	0.008	0.012	0.062	0.012
NZL	0.018	0.001	0.000	0.002	0.000	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.004	0.000	0.001	**	0.001	0.001	0.005
PRT	0.002	0.002	0.002	0.001	0.002	0.003	0.003	0.013	0.003	0.005	0.003	0.005	0.003	0.005	0.004	0.003	0.003	0.002	**	0.003	0.003
SWE	0.017	0.022	0.014	0.009	0.016	0.035	0.118	0.020	0.220	0.021	0.026	0.028	0.018	0.024	0.030	0.021	0.120	0.014	0.022	**	0.022
USA	0.399	0.072	0.047	0.704	0.058	0.095	0.097	0.217	0.126	0.124	0.281	0.129	0.166	0.099	0.293	0.064	0.127	0.405	0.140	0.118	**

Notes: Importers in columns, exporters in rows. Weights are predicted import shares (sum by importer =1), obtained from estimates of the gravity model reported in Table B-1.

Appendix C Sensitivity analysis

Table C-1: Alternative weighting schemes

	[1] cultural weights	[2] legal weights	[3] neighborhood weights	[4] placebo weights
Panel a: Commodity tax response				
$CTAX_{-i}$	–0.08	–0.15	0.84***	0.27
	(0.52)	(0.31)	(0.30)	(0.21)
PMR	–0.70***	–0.75***	–0.11	–0.60***
	(0.20)	(0.22)	(0.21)	(0.17)
K-P rk Wald F-stat	3.332	7.243	4.724	10.19
K-P rk LM-stat (p-value)	9.942 (0.07)	16.51 (0.00)	21.24 (0.00)	22.98 (0.00)
Hansen J-stat (p-value)	0.10 (0.74)	0.16 (0.71)	0.61 (0.44)	1.17 (0.28)
Panel b: Regulation response				
PMR_{-i}	0.56***	0.64***	0.39***	–0.19*
	(0.13)	(0.11)	(0.11)	(0.12)
K-P rk Wald F-stat	20.22	75.68	29.56	26.93
K-P rk LM-stat (p-value)	34.98 (0.00)	63.61 (0.00)	42.89 (0.00)	38.61 (0.00)
Hansen J-stat (p-value)	5.171 (0.02)	0.058 (0.81)	7.853 (0.01)	1.49 (0.22)
Observations	390	390	390	390

Notes: Cultural weights are constructed considering an exogenous score equal to 1 for each of the cultural controls in the initial gravity equation. The legal and neighborhood weights include trade partners that share the same legal origin and the same border, respectively. Placebo weights are based on a 'nonsense' procedure. It assigns $\omega_{ij} = 1/N$ to each of the N countries whose name starts with the same letter as country i or whose first letter is just before or just after that of country i in the Latin alphabet. It assigns $\omega_{ij} = 0$ otherwise. 2SLS estimates with robust standard errors in parentheses. PMR are measured in seven non-manufacturing industries (ETCR). All specifications in panel a,b include the same set of controls as in table 1, plus time and country dummies. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table C-2: Simultaneous equations models - domestic equations

	[1] **SUR**		[2] **SUR, FE**		[3] **3SLS, FE**	
	CTAX	PMR	CTAX	PMR	CTAX	PMR
$CTAX_{-i}$	1.04***		–0.70***		0.41	
	(0.12)		(0.23)		(0.35)	
PMR	–0.50***		–0.23***		–0.28**	
	(0.10)		(0.06)		(0.11)	
VAT	2.00***		0.82***		0.84***	
	(0.47)		(0.15)		(0.15)	
PMR_{-i}		1.16***		1.01***		0.98***
		(0.04)		(0.11)		(0.11)
Preference for order (%)		0.01**		0.01***		0.01**
		(0.00)		(0.00)		(0.00)
Distrust others (%)		0.03***		0.03***		0.03***
		(0.00)		(0.01)		(0.00)
Observations	389	389	389	389	389	389

Notes: SUR and 3SLS estimates of four equations' system with four endogenous variables ($CTAX$, PMR, $CTAX_{-i}$, PMR_{-i}). We assign the measures of domestic distrust and demand for order only to the domestic regulation PMR and the measures of trade partners' average distrust and demand for order to the trade partners' average regulation level PMR_{-i}. We assign VAT to the domestic commodity tax $CTAX$ and VAT_{-i} to the average commodity tax of trade partners, $CTAX_{-i}$. PMR are measured in seven non-manufacturing industries (ETCR). All specifications include the usual set of controls, plus time and country dummies. Only estimates for the domestic country are reported. Estimates for the average of trade partners are in Table B-5 in the on-line appendix. Robust standard errors in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table C-3: Statutory VAT rates

	[1] OLS	[2] OLS FE	[3] 2SLS FE
$CTAX_{-i}$ (statutory)	0.48***	–0.35***	0.52
	(0.11)	(0.10)	(0.36)
PMR	0.15	–0.06	–0.68**
	(0.13)	(0.09)	(0.32)
K-P rk Wald F-stat			8.22
K-P rk LM-stat (p-value)			20.51 (0.00)
Hansen J-stat (p-value)			10.8 (0.00)
Observations	352	352	352

Notes: 2SLS estimates with robust standard errors in parentheses. PMR are measured in seven non-manufacturing industries (ETCR). Consumption taxes measured in statutory tax rates. All specifications include the usual set of controls. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table C-4: Alternative timing

	[1] OLS	[2] OLS FE	[3] 2SLS FE	[4] 2SLS FE
PMR_{-i}	1.05***	0.55***	0.49***	0.54***
	(0.05)	(0.11)	(0.11)	(0.12)
CTAX	–0.00	–0.07	–0.07	–0.06
	(0.02)	(0.04)	(0.04)	(0.04)
$CTAX_{-i}$				0.22
				(0.18)
K-P rk Wald F-stat			161.76	153.27
K-P rk LM-stat (p-value)			95.03 (0.00)	94.29 (0.00)
Hansen J-stat (p-value)			0.10 (0.75)	0.17 (0.68)
Observations	390	390	390	390

Notes: 2SLS estimates with robust standard errors in parentheses. PMR are measured in seven non-manufacturing industries (ETCR). All specifications include the usual set of controls. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table C-5: Alternative specifications

	[1] only country and time dummies	[2] country spec. time trends	[3] economic cycle	[4] trade openness	[5] tax morale	[6] PMR$_{-i}$ instead of CTAX$_{-i}$	[7] exogenous regulation	[8] 5 years averages
Panel a: Commodity tax response								
CTAX$_{-i}$	0.03	1.08	1.12	1.28	1.29		2.04	1.09
	(0.81)	(1.00)	(0.99)	(0.99)	(1.03)	(1.12)		(1.22)
PMR	–0.40***	–0.47**	–0.48**	–0.39*	–0.56***	–0.68***	–0.12*	–0.55**
	(0.13)	(0.21)	(0.21)	(0.22)	(0.21)	(0.24)	(0.20)	(0.23)
K-P rk Wald F-stat	11.40	3.973	3.943	3.742	4.061	8.40	10.092	3.941
K-P rk LM-stat (p-value)	21.26 (0.00)	21.63 (0.00)	21.29 (0.00)	20.45 (0.00)	22.95 (0.00)	28.44 (0.00)	12.83 (0.00)	9.87 (0.01)
Hansen J-stat (p-value)	6.51 (0.01)	1.57 (0.21)	1.65 (0.20)	1.70 (0.19)	1.20 (0.27)	1.96 (0.38)	–	2.17 (0.14)
Panel b: Regulation response								
PMR$_{-i}$	0.85***	0.46***	0.46***	0.53***	0.50***			0.38**
	(0.11)	(0.12)	(0.11)	(0.13)	(0.11)			(0.19)
K-P rk Wald F-stat	193.27	148.97	156.4	124.29	146.91	-	-	18.85
K-P rk LM-stat (p-value)	94.44 (0.00)	76.58 (0.00)	77.59 (0.00)	78.38 (0.00)	76.79 (0.00)	-	-	24.21 (0.00)
Hansen J-stat (p-value)	2.11 (0.15)	0.04 (0.84)	0.35 (0.55)	0.17 (0.68)	0.10 (0.75)	-	-	0.04 (0.83)
Observations	399	390		390	390	390	390	83

Notes: 2SLS estimates with robust standard errors in parentheses. PMR are measured in seven non-manufacturing industries (ETCR). Most specifications in panel a,b include the same set of controls as in Table 1. 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; Columns [4] where we add a control for trade openness; Column [5], where we include a control for tax morale; Column [6], panel a, where we replace $CTAX_{-i}$ by $ETCR_{-i}$ and instrument it by the five years lags of $OrderNation_{-i}$ and $DisTrust_{-i}$. Significance levels: $*$: 10% $**$: 5% $***$: 1%.