Commodity Taxation and Regulatory Competition *

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Abstract

The purpose of this paper is twofold. We first investigate whether product market regulations affect commodity taxation in open-to-trade economies and second we study the strategic interaction in regulatory measures 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. Based on data for 21 OECD countries over the 1990-2008 period, we provide empirical evidence suggesting that product market regulations are strategic complement policies and that domestic regulations have a negative impact on domestic commodity taxation.

Keywords: Regulation, commodity tax, strategic interactions

JEL: F0, H1, H7, H87, L5

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1 Introduction

This paper firstly investigates how commodity taxation affects regulatory measures in product markets. Secondly, it questions whether product market regulations across trading countries are strategic decisions and establishes the nature of such interactions, if any. There is a large literature that investigates the existence and the impact of tax interactions between countries. However, much less attention has been devoted to the interdependence between taxes and market regulation in an international context. This is puzzling because, as Oates ([47] p. 377) writes, the "economic competition among governments makes use of a wide class of policy instruments *including both fiscal and regulatory policies* [...]".

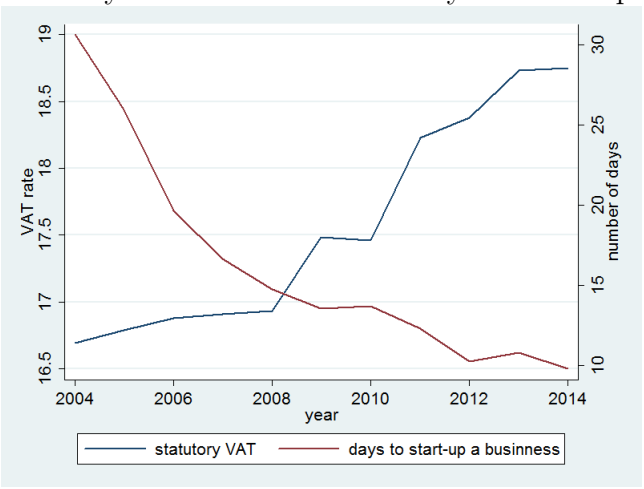
In the present paper, we push forward the hypothesis that the choice of commodity taxation cannot be disentangled from that of product market regulations. Figure 1 shows that between 2004 and 2014, OECD countries reduced their time to start-up a new business by about 20 days, on average. At the same time, they increased their statutory VAT rate by more than 2 percentage points, which suggests a positive effect of market deregulation on commodity tax rates. This actually dates back to the 1970s[1], and similar evidence is not documented for other taxes e.g. on labor 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 [19]). This may favor the creation of new product varieties, increase demand and consumer surplus (see e.g. Blanchard and Giavazzi [6]), and ultimately raise the incentives for governments to tax consumption (OECD [46]). It is important to analyze this interdependence in an open economy setup, because the share of traded goods and services has increased a lot in recent decades. 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.

We address two questions from both a theoretical and empirical viewpoint. First, how do regulation policies affect commodity tax rates in an international context? Second, 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 benevolent governments set tax rates to finance public goods. Helping-hand government regulatory agencies choose regulation to protect consumer safety. Individuals work in firms and consume private and public goods. Firms produce private goods, set their prices, and freely enter product markets. 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

[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.

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



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

regulatory processes and standards.[2] The model generates two theoretical predictions. First, governments may lower commodity tax rates if regulation becomes stricter. This is because regulation reduces 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. Second, countries' regulation polices are strategic complement if consumers do not value excessively product diversity.

In the empirical part of the paper, we test our predictions using panel data for 21 OECD countries. We measure product market regulation by the OECD indicator of product market regulation. Average effective tax rates on consumption proxy commodity tax rates. We use a novel weighting matrix that proxies for the exogenous structure of trade flows and instrumental variables to account for remaining endogeneity issues. To the best of our knowledge, this paper is the first to exploit exogenous variation in social preferences for regulation (see e.g. Inglehart [33], Aghion *et al.* [1]) to identify the strategic interaction effects of product market regulation. Our estimates suggest that stricter domestic regulation reduces countries' incentives to raise commodity taxes. They also support the hypothesis that regulation policies are strategic complements. Results are robust to other measures of tax rates and product market regulation like statutory taxes and days to start up a business. The magnitudes of the estimated effects are non-negligible: 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. It also leads to a deregulation process in trade partner countries that reduces their firms' start up times by about 40 days, on average.

This paper contributes to the existing literature in the following ways. This is the first paper

[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.

to investigate theoretically and empirically the impact of product market regulation on commodity taxation.[3] The paper contributes to the literature on entry regulation. Djankov *et al.* [18] and Aghion *et al.* [1] analyze the social and cultural factors that affect entry regulation. Miyagiwa and Sato [43] analyze the optimal entry policy in oligopolistic markets operating in a globalized world. Haaland and Wooton [28] and Davies and Vadlamannati [15] have studied strategic interactions of labor market regulations. Finally, our paper is the first one to consider a general equilibrium model with monopolistic competition where regulation addresses product market uncertainties by imposing constraints on firms that increase their entry costs.

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 market regulation decisions and (ii) countries' competition in terms of 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.[4] 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.[5] Third, to ease the discussion of entry decisions in a trade context, it is convenient to use the well-established Dixit-Stiglitz monopolistic competition framework.[6] Finally, we assume that public agencies produce public

[3]There are some studies in environmental economics such as Oates and Schwab's [48] or List and Gerking's [38] which discuss the impact of environmental regulations on taxes and welfare.

[4]Our main results maintain with rent seeking regulators. Calculations are available upon request.

[5]Terms of trade effects are present in Mintz and Tulkens [44] and Lockwood [40]. By contrast, Keen and Lahiri [34], Andersson and Forslid [3], Haufler and Pfluger [29], Haufler and Pfluger [30] assume a numeraire good that dampens terms of trade effects.

[6]Although it is commonly used in international trade theory, Krugman's [36] framework is not much discussed in the international tax competition literature where entry issues have not been extensively addressed (Haufler and Pfluger [29])

goods or services using inputs from the private sector.[7] 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 follow Krugman and Venables' [37] 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.[8] 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 frauds. 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 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 to deliver commodities after payment. 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

[7] In the OECD countries, public procurement ranges between 10% and 30% of GDP and between 20% and 50% of government expenditures (European Commission [23]). Public procurement is even larger share when interpersonal transfers are excluded from government expenditures.

[8] 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.

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 [5], the parameter $\nu \in [0, 1/(\sigma-1)]$ measures the love for variety. With $\nu = 0$, one obtains Dixit and Stiglitz's [17] 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 [4] 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.[9]

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.[10]

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

[10]In the OECD countries, public procurement ranges between 20% and 50% of government expenditures (European Commission [23]). Also, in modern economies, public goods and services are usually delivered by small independent

As in Ethier [22], 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 [37], 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. Finally, with a unit mass of public agencies, $q(\omega)$ denotes the demands for a commodity ω both by a single public agency and by the whole public sector. Similarly, G and B express the public good provision and expenditure of both a public agency and the whole public sector.

Commodity market equilibrium Each domestic firm locally produces a single commodity $\omega \in [0, n]$ and sells it 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. Home and foreign commodity tax rates are defined as $\tau - 1$ and $\tau^* - 1$ so that $\tau > 1$ and $\tau^* > 1$ denote the ratios between consumer and producer prices. Taxes, set by governments, are ad valorem and follow the destination principle. Finally, we assume that the fixed input embeds the input

public agencies like justice courts, public schools and universities. One can interpret our setting more narrowly as public procurement or outsourcing.

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 checks, accountability checks,...). 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 consumer (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 producer (tax-exclusive) prices p/τ and p^*/τ^* because of product market segmentation and 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 probabilities 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 [17]). 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 $U[R/\tau, R(1-1/\tau)]$ with $R=R\left[\sigma^{-1}(f+r)^{-1},\sigma^{-1}(f+r^*)^{-1},\theta,\theta^*\right]$.

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 The impact of regulation on commodity taxation

Each benevolent government sets the commodity tax rate to maximize its residents' utility, holding a balanced budget and taking the other tax and the regulatory settings as given. More specifically, the domestic government set the commodity tax rate $\tau - 1 = G/C$ that maximizes $U(C, G)$ subject to $C + G = R(n, n^*, \theta, \theta^*)$. Since R is independent of τ^*, the optimal domestic commodity tax τ is also independent of the foreign tax τ^*. Indeed, as mentioned above, the destination principle eliminates tax exporting issues. This is reminiscent to Mintz and Tulkens' [44] tax competition result under competitive good markets and Haufler and Pfluger [29] in the context of monopolistic competition.

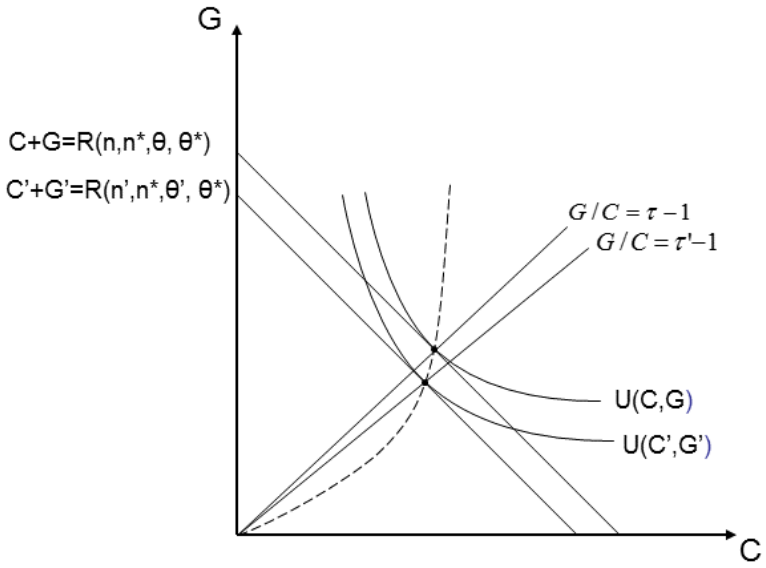
What is the impact of stronger domestic regulation on domestic tax rates? Each government maximizes its local welfare $U(C, G)$ subject to $C + G = R$. The first order condition is given by

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

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

Figure 2: Optimal commodity tax and regulation.



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.[11]

We can state the following proposition:

Proposition 1 *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.*

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

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

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.[12] This empirical issue will discuss below.

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

[12] See Durevall and Henrekson [21] for an evaluation of econometric studies on Wagner's law.

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 super-modular 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.[13] Therefore, regulation polices are a strategic complement if $\nu > 0$.

Proposition 2 *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

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

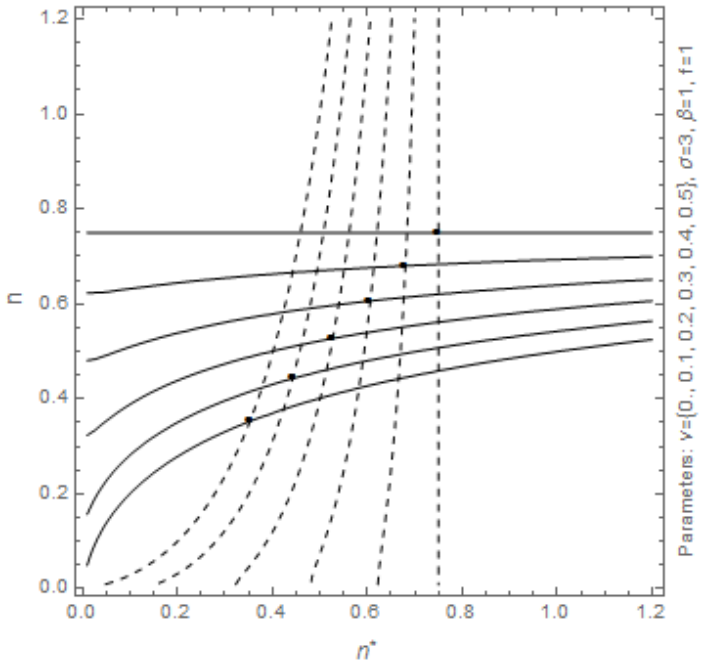
which is positive because the numerator and denominator are positive for $\nu \in (0, 1/(\sigma-1)]$. This confirms that regulation is a strategic complement if $\nu > 0$. Furthermore, it can be shown that this slope increases with weaker love for variety $\left(\left(\mathrm{d}^2 n\right)/\left(\mathrm{d}n^*\mathrm{d}\nu\right) > 0\right)$.[14] 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 ($v = 0.1, 0.2, ..., .0.5$).

---

[13] 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.

[14] 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.



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 $\frac{\mathrm{d}}{\mathrm{d}n}(n\theta^{\sigma}) > 0$). 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 ($\nu = 0$), 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.[15]

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

4 Empirical Evidence

4.1 Empirical Strategy

In this section, we test our theoretical findings in Proposition 1 and 2 using data on product market regulation and consumption taxation. In line with the model, we consider an empirical model in which tax and regulation decisions are taken sequentially in a two-stage game.

Our first empirical specification linearizes the best responses in commodity taxes to regulation levels and extends them to many countries and many time periods:

$$\tau_{it} = \beta z_{it-1} + \boldsymbol{\gamma}' \mathbf{x}_{it} + d_i + e_t + u_{it}, \tag{18}$$

where $i = 1, ..., I$ and $t = 1, ..., T$ respectively denote countries and time-periods. The variable τ_{it} is the commodity tax rate in country i at time t, set under the destination principle,[16] while the variable z_{it} is 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 coefficient of interest is β, which describes how country i's tax policy reacts to its own product market regulation z_{it-1}, with a one-year lag to reflect the delays in regulation restructuring processes.[17] According to our theoretical model, a significant negative value for β indicates that the government uses commodity taxes to mitigate the negative impact of stronger regulation on consumers' welfare.

Our second empirical specification linearizes and generalizes the regulators' best responses for multiple countries and periods as follows:

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

where the coefficients δ_{ij} measure how home regulation z_{it} responds to foreign regulation z_{jt} ($\delta_{ii} = 0$ by construction). A significant positive (resp. negative) value for δ_{ij}, $i \neq j$, indicates 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). The vector g_{it} includes indicators for local

[16] 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 that minimizes origin-based strategic interactions due to cross-border shopping. See more on this below.

[17] 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 [52]).

preferences for regulation, which are important predictors of the local levels of regulation (see Aghion *et al.* [1], and Pinotti [49]). Finally, 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. In the empirical analysis, we check the validity of this assumption regarding the timing of regulators' decisions relative to taxes.

Equation (19) shows that country i accounts for all its partners' regulation policies when it chooses its regulation levels z_{it}. However, the number of the $I(I-1)$ strategic interactions included in parameters δ_{ij} is too large to permit identification. As in Brueckner [8], our econometric approach assumes that country i responds to an average of its *trade partners*' policies. Denoting such average regulatory policies by z_{-it}, we can write:

$$z_{it} = \delta z_{-it} + \boldsymbol{\zeta}'\mathbf{y}_{it} + \boldsymbol{\gamma}'\mathbf{g}_{it} + d_i + e_t + v_{it}. \tag{20}$$

The coefficient δ in equation (20) measures the intensity of a country's regulatory response to the average regulation level across its trade partners. We compute the average trade partner regulatory policies $z_{-it} = \boldsymbol{\omega}_i'\mathbf{z}_t$ where the vectors $\boldsymbol{z}_t$ are countries' regulation levels $[z_{1t}, z_{2t}, ..., z_{It}]'$ 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 [8]). An important novelty of this paper is to use a weighting scheme that proxies for the exogenous structure of international trade flows. Towards this aim, we use the trade flows predicted by an augmented gravity equation that explains 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 [31]). This approach leads to a parsimonious specification of the heterogeneous trade relationships between the countries, which makes our estimates immune to Manski [42]'s reflection issues.[18] Predetermined trade flows predicted 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.[19]

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

[19]For example, our weights are not affected by strategic interactions between tax policies that might affect the size of

Endogeneity and Instrumental Variables

Commodity tax function. Endogeneity issues arise for z_{it-1} in equation (18). 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 exists a simultaneity problem if country i designs a five-year plan implementing simultaneous changes in the commodity tax and regulation. Finally, there may also exist an omitted variable bias if the unobserved policy package includes both an increase in product market regulation and a change in fiscal measures that increase commodity taxes.

To tackle these issues, we build instruments for z_{it} in equation (18) using two indicators titled "interpersonal distrust" $distrust_{it}$, and "demand for order" $order_{it}$. These indicators measure the level of interpersonal and institutional trust in a country. The former captures the level of distrust among people: how much people claim to trust each other. The latter measures preferences attached to institutions that are supposed to maintain order in the country. Both indicators are built with data from World Value Survey (WVS) and European Value Study (EVS) as explained in more detail in Section 4.2. To be suitable instruments, these indicators need to be correlated with the level of regulation z_{it}. We argue that both indicators are measures of the demand for regulation in a country and, as such, are strongly correlated with z_{it}. Building on the benevolent role of regulation presented in our theoretical model, one can see regulation as a mean to limit the behaviors of agents who may cause negative externalities on others. For instance, strong distrust towards other people shall be strongly correlated with high demand for regulation, which shelters from these externalities. This correlation is empirically and theoretically demonstrated in Aghion *et al.* [1] in a cross-section of countries. Pinotti [49] finds causal relationship between distrust and regulation. He also shows that differences in trust across 51 developed countries explains a large part of the variation in entry regulations. Strong interpersonal distrust creates public demand for regulation in an attempt to restrict the negative consumption externalities from individuals who are not considered trustworthy. Similarly, demand for order in a country signals materialistic attitudes, which create a social demand for regulations by citizens willing to enjoy safe consumption (Inglehart [33]).

Indicators of trust and demand for order display time variation, which features changes in demand for regulation. Studies in cultural economics such as Bisin *et al.* [7], Guiso *et al.* [26], and Tabellini [50] stress the role of two main forces on the evolution of trust: contemporaneous environment and beliefs inherited from earlier generations. Hence, trust includes a persistent component. Guiso, *et al.* [25],

trade flows. They also are not affected by the product market regulations in specific sectors (e.g. energy, transport, postal services) that influence international transportation costs.

[27] show how a temporary shock that modifies the benefits entailed by trust, can deeply affect trust levels in the society. Bozzoli and Mueller [9] analyze the effects of the July 2005 London bombings on individuals' trade-off between freedom and safety. They find a rise in the demand for safety regulation despite the restrictions that this brings on personal freedom. Finally, Algan and Cahuc [2] empirically identify the time variation in beliefs by comparing the evolution of inherited trust of US immigrants and natives in their countries of origin.

Instruments' validity requires these indicators are uncorrelated with the level of commodity taxes τ_{it} in the same country i. **While it is difficult to argue the complete exogeneity of our indicators**, studies of historical evolution of public expenditure do not include any theory of evolution of trust, but rather convey economic and political explanations (Dincecco [16]; Tanzi and Schuknecht [51]. These political models capture preference between those that wish high public goods expenditure or redistribution and those who prefer to limit the tax burden (Hindriks and Myles [32]). These theories do not ~~seem to~~ refer to interpersonal trust as one of the determinants of VAT taxes in the country. This **mitigates concerns regarding** first-order effects of interpersonal trust and demand for order on tax decisions τ_{it} in equation (18). It can still be argued that both product market regulation and commodity taxes include a cultural component (e.g. related to 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 (Litina and Palivos [39]; Knack and Keefer [35]; Algan and Cahuc [2]; Guiso *et al.* [25]). If not properly accounted for, this cultural component may violate the exclusion restriction and make the two indicators invalid instruments in equation (18). ~~**The inclusion of country fixed effects also alleviate concerns on the validity of the exclusion restrictions.**~~ Granger non-causality test by Dumitrescu and Hurlin [20] **reassures about** the lack of any direct effect on τ_{it}, even when we account for (up to) three lags in the effect of $distrust_{it}$ and $order_{it}$ (see Table B-3).

Regulation response function. In equation (20), the concern is about the endogeneity of the average regulation level in other countries, z_{-it}. Regulation levels z_{it} and z_{jt}, $j \neq i$ are simultaneously determined. There may exist a reverse causality from country i's regulation policy to its trade partners' policies. In addition, 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.

To address endogeneity issues, we use the indicators of interpersonal distrust and demand for order to build instruments for z_{-it}. In particular, we apply our weighting matrix to construct instruments for trade partners' averages:

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

As argued above, regulation in each country is positively correlated with the level of distrust and the

demand for order in the same country. As a result, the average trust indicators in trade partners, $distrust_{-it}$ and $order_{-it}$, are clearly correlated with the average regulation level z_{-it}.

The validity of the exclusion restriction **would require** that citizens of trade partner countries are not involved directly into the political process of country i (Aghion *et al.* [1]). **It is obvioulsy hard to provide direct evidence supporting this claim. However, we argue that** an average increase in the demand for regulation among citizens of country i's trade partners (i.e. an increase of $distrust_{-it}$ and $order_{-it}$) through the national political processes induces an increase in the level of regulation there (thus an increase of z_{-it}). Conversely, the demand of regulation in trade partner countries **should** not affect the levels of regulation in country i. The inclusion of dummies for EU and European Monetary Union ensures that indirect channels associated with supranational policy making are accounted for. We perform a Granger non-causality test, which confirms the lack of any direct effect of $distrust_{-it}$ and $order_{-it}$ on z_{it}, up to three lags (see Table B-3).

Any violation of the exclusion restriction may occur only through features of trade partner countries which are correlated with local economic performance and local regulation (see e.g. Guiso *et al.* [25]). Time invariant **(e.g. cultural)** factors are accounted for by the country fixed effects. What remains after the inclusion of country fixed effects is the time variation in the social preferences (distrust and demand for order) within the same country. Unobserved shocks that determine variations of these preferences (e.g. an economic crisis, or a terrorist attack) do not pose a threat to this identification strategy **as long as there is not a common response of trust in different countries**. Trust is a value that evolves with the quality of the law and its enforcement in each country (see e.g. Guiso *et al.* [27]). **We cannot completely exclude some cross-country correlation in the evolution of trust and demand for order.** However, descriptive evidence in Figure 6 below, and the ensuing discussion support the view that their evolution during our sample period **is generally country-specific.**

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.[20] We proxy the commodity tax rate τ_i by the average effective tax rate on consumption, which is the ratio of tax revenue over consumption value. Effective tax rates allow to aggregate countries' multiple statutory tax rates into a single rate. They are also robust to unobserved changes of the tax bases (see Carey and Rabesona [11]). Their use is also consistent with our theoretical model where the

[20]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.

statutory tax rate is equivalent to the effective tax rate because of fixed tax bases and absence of tax evasion.

To focus on the destination principle, we include only the sales tax and the VAT in our definition of commodity taxes.[21] To proxy the level of product market regulation, PMR, we use 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.[22]

Figure 4 presents the relationship of our main variables in differences between their averages in the final and initial periods (resp., 2004-08 and 1990-94). Panel *a* plots commodity tax rates against PMR. It shows a negative correlation between changes in taxes and product market regulation, which suggests that countries that incurred a fall in PMR increased their effective tax rates during the sample period. Panel *b* plots PMR against trading partners' 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 does so.

To instrument product market regulation, 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]

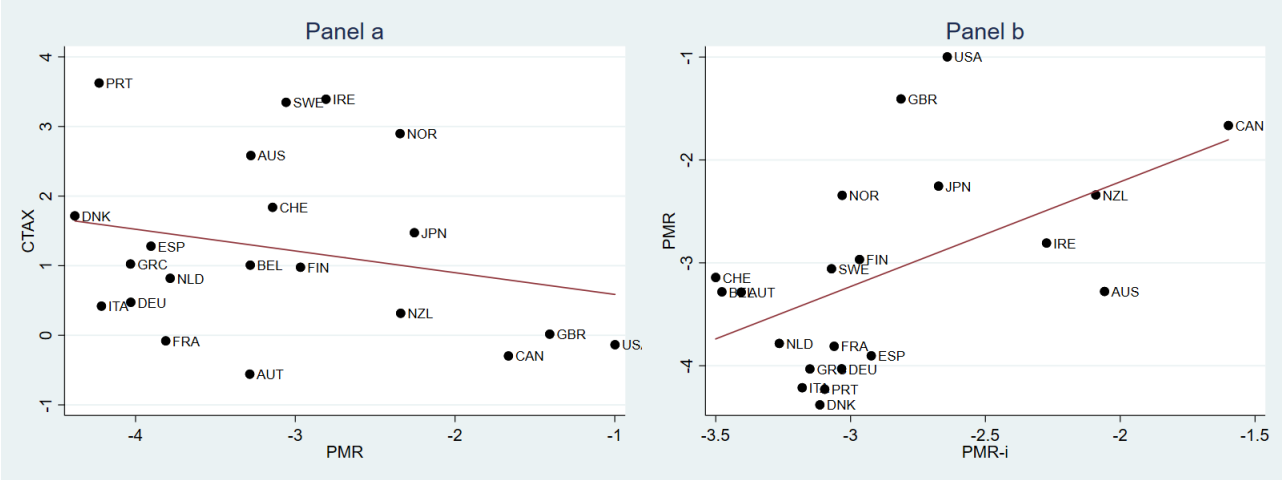
Figure 5 plots PMR against the indicators of distrust (Panel *a*) and demand for order (Panel *b*). Again, the variables are taken in differences between their averages in the 2004-2008 and 1990-1994

[21] 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.

[22] The long time span of this series makes it well suited to a panel study. In the robustness analysis, we also proxy regulation by the number of days required to start up a new business (see Djankov *et al.* [18]). This measure applies to the whole economy but is available for the shorter time period 1999-2008. The two series have a correlation coefficient equal to 0.50 and significant at the 1% level (see Section B.1 of the on-line appendix).

[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).

Figure 4: Commodity Taxation and PMR.



Notes: Panel a plots local commodity taxes CTAX (y-axis) vs. local PMR (x-axis). Panel b plots local PMR (y-axis) vs. average PMR in trade partners (x-axis). Commodity taxes are measured by average effective tax rates. PMR is measured by the ETCR index. Both panels plots the differences between country averages over periods 2004-2008 and 1990-1994. Authors' calculation using OECD data.

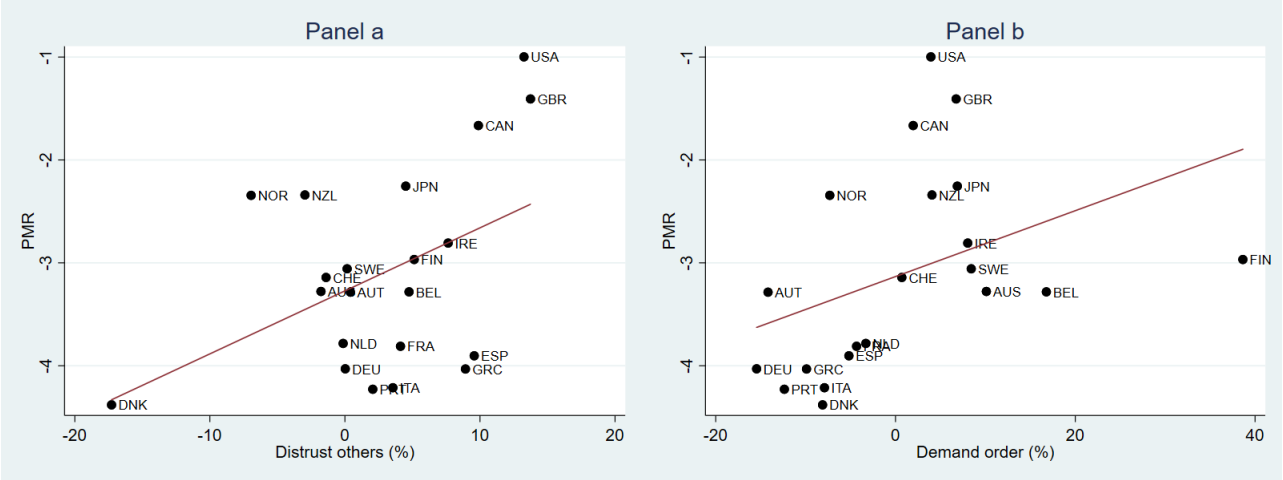
periods. The two figures confirm a positive correlation between PMR and our measures of demand for regulation, as suggested by Aghion *et al.* [1], and Inglehart [33]. The two correlations are significant at the 1% level.

Finally, Figure 6 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. Countries' observations are dispersed across the four quadrants of the graph. This highlights heterogeneity in countries behaviors and suggests 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

[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, the levels of trust in Australia were very low driven mostly by political inertia and

Figure 5: Indicators of demand for regulation and PMR.



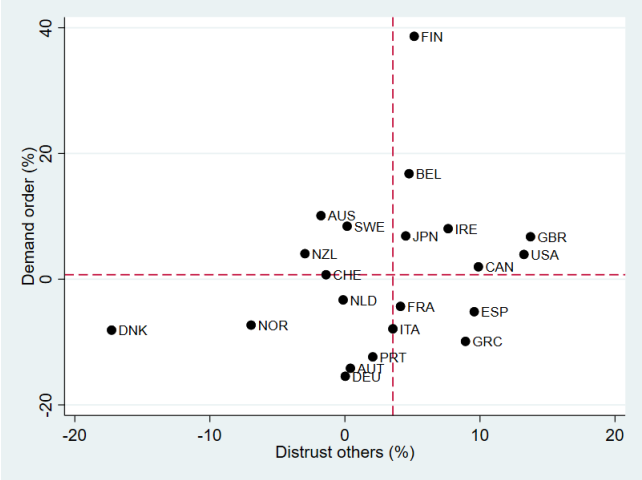
Notes: Local PMR (y-axis) vs. Local demand of regulation (x-axis), measured as % of distrustful people, and % of people that demand order in the country. Differences between country averages over the periods 2004-2008 and 1990-1994. Authors' calculation on EVS/WVS data.

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] All those elements strongly suggest that the variations in the levels of distrust and demand for order are 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.

economic depression. The rise in trust level may be attributed to the election of a liberal government that 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 may reflect the success and application of a referendum in favor of a mixed-proportional political representation (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.

Figure 6: Distrust versus demand for order.



Notes: % of people that demand order (y-axis) vs. % of distrustful people in the country (x-axis). Differences between country averages over the periods 2004-2008 and 1990-1994. Authors' calculation on EVS/WVS data.

4.3 Baseline Results

Table 1 reports our baseline estimates of the commodity tax function (18) in Panel A and the regulation response function (20) in Panel B. We use the average effective tax rate on consumption as a baseline measure of commodity taxation and the ETCR indicator of product market regulation. 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 controls for total population, per capita GDP, government consumption (as a % of GDP), real interest rate, real exchange rate, dummies for membership of the European Union and the European Monetary Union and application of a VAT system. Columns [4]-[6] also include indicators of local demand for order and distrust, which provide the basis of our empirical strategy.

We first discuss the coefficient of PMR in the commodity tax function of Panel A. OLS estimates in Column [1] show a non-significant coefficient while the same estimates with country fixed effects in Column [2] yields a negative significant coefficient. In Column [3] we present 2SLS estimates. Econometric tests suggest that the instruments are strongly correlated with the endogenous regressors in the first stage and provide valid exclusion restrictions in the second stage (details of first stage results are in Table B-4 of the Appendix). 2SLS estimates confirm the negative coefficient, significant at the 1% level. This provides evidence that stronger product market regulation induces lower commodity taxes.[27]

[27]The larger effect reported in the 2SLS estimation suggests that the OLS estimate in Column [2] is upward biased as it should be the case when governments introduce policy packages that jointly increase regulation levels and commodity taxes. **Notice also that the negative effect is also confirmed when we consider as a dependent variable commodity tax revenues instead of commity tax rates (see Table B-5 for details).**

Table 1: Commodity tax and regulation response functions

Panel: dependent variable	**A: Commodity Tax Rate**			**B: Product Market Regulation**		
	[1] OLS	[2] OLS FE	[3] 2SLS FE	[4] OLS	[5] OLS FE	[6] 2SLS FE
PMR (ETCR indicator)	–0.11	–0.15***	–0.56***			
	(0.10)	(0.06)	(0.18)			
PMR$-i$ (ETCR indicator $-i$)				1.10***	0.64***	0.52***
				(0.04)	(0.12)	(0.12)
Member of the European Union	1.17***	–0.28	–0.38	0.00	0.06	0.03
	(0.36)	(0.25)	(0.23)	(0.10)	(0.15)	(0.15)
Member of the European Monetary Union	0.56*	–0.55***	–0.79***	0.00	–0.53***	–0.56***
	(0.29)	(0.11)	(0.15)	(0.12)	(0.11)	(0.10)
Applies a Value Added Tax system	1.57**	0.75***	0.74***	–0.15	–0.41***	–0.40***
	(0.70)	(0.18)	(0.17)	(0.14)	(0.16)	(0.15)
Total population	–0.03***	–0.03***	–0.01	–0.00***	0.03***	0.03***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Per capita GDP	0.10***	0.22***	0.25***	0.00	0.08***	0.08***
	(0.03)	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)
Government consumption	0.49***	0.12***	0.12***	–0.07***	0.04	0.03
	(0.03)	(0.04)	(0.04)	(0.01)	(0.03)	(0.03)
Real interest rate	0.12**	–0.20***	–0.20***	–0.01	0.02	0.02
	(0.05)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Real exchange rate	–0.03	–0.00	–0.00	0.00	–0.01**	–0.01**
	(0.02)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Rightwing government in office	–0.64***	0.13*	0.07	–0.10	–0.12**	–0.13***
	(0.24)	(0.07)	(0.08)	(0.07)	(0.05)	(0.05)
Demand order in Nation (%)				0.02***	0.01	0.01
				(0.00)	(0.01)	(0.01)
Distrust other people (%)				0.03***	0.03***	0.03***
				(0.00)	(0.01)	(0.01)
Observations	389	389	389	390	390	390
K-P rk Wald F-stat			18.483			157.524
K-P rk LM-stat			29.500			88.685
p-value KP			0.000			0.000
Hansen J-stat			0.795			0.066
p-value Hansen			0.373			0.797

Notes: All specifications include time dummies. Columns [2],[3],[5] and [6] include country dummies. PMR is measured in seven non-manufacturing industries (ETCR indicator). Commodity taxes are measured by the average effective tax rate on consumption. In Panel A, the dependent variable is commodity taxation; PMR and individual controls are lagged one year in all specifications. Column [3] presents a 2SLS regression where PMR is instrumented by country-specific measures of demand for order and distrust other people (five year lags). In Panel B, the dependent variable is the regulation level PMR. Column [6] presents 2SLS estimates where PMR$_{-i}$ is instrumented by five year lags of average demand for order and distrust in the trade partners. Robust standard errors are in parentheses. Significance levels: $*$ = 10%, $**$ =5% and $***$= 1%.

Panel b reports the estimates of the regulation policy response function (20). The OLS estimation in Columns [4] shows a positive coefficient for PMR_{-i}, which is significant at the 1% level and suggests strategic complementarity in product market regulation policies. The size of the effect however decreases once we account for country fixed effects in Column [5]. This potentially stems from time-invariant unobserved characteristics that determine product market regulations in trade partners (e.g. common legal origins). 2SLS results in Column [6] confirm that the coefficient of PMR_{-i} is positive and very significant. Econometric tests confirm the power and validity of instruments in the first and second stages (See Table B-4 for details). Finally, the estimated coefficient in Column [6] is smaller than 1, which ensures stationarity in the spatial lag model.

Turning to the controls, Table 1 shows that EU membership does not affect commodity taxation and regulation levels while membership to the EMU mitigates tax and regulation policies. The application of

VAT system has a positive and significant effect on effective consumption tax rate and negative impact on regulation. GDP per capita is positively associated with both commodity taxes and product market regulations. As one expects, government consumption increases commodity taxes. Higher interest rates are correlated with lower commodity taxes. An appreciation of the home country's real exchange rate is associated with local regulations. The presence of right-wing government is negatively associated with weaker regulation. Finally, notice that our indicators of distrust and demand order are included in Panel B and they raise the local levels of product market regulation.

Table 2 reports the same estimations with alternative measures of commodity taxes (Panel A) and product market regulation (Panel B). Each country's commodity tax rate is measured as its main statutory VAT rate and its regulation level by the number of days required to start up a new business (see Djankov *et al.* [18]). The table displays the OLS FE and 2SLS FE estimates for all possible combinations of our measures of commodity taxation and regulation. Results confirm the negative association between product market regulation and commodity taxation and the strategic complementarity in product market regulation policies. Estimates using the days to start up measure of regulation are less precise (particularly in Panel A), due to the shorter time span for which this indicator is available. Also, due to the high persistence of statutory rates, instruments do not pass the Hansen test in Column [4].

Finally, Table 3 checks for the possibility of a reverse timing in tax and regulation decisions. Differently from our theoretical model, [28] the estimation reported in Table 3 makes the hypothesis that regulation is chosen after the decisions on tax rates. Results suggest that the possibility of a reverse timing can be excluded.

Economic magnitudes. It is instructive to use estimates in Table 1 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 Columns [3] and [6] as a benchmark. We 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 1999-2008 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 that features a standard deviation of ETCR over the 1990-2008 period (i.e., 1.49) is $1.49 * 20/0.56 \approx 53$ (days). This is about one-third of the decrease in the days to start up a business achieved during the 1990s' EU deregulation 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 $(-0.56 * -1.49 \approx)$ 0.83 percentage points. The 2SLS estimate in Panel b also implies that a country cuts its days to start up a new business by $(53 * 0.52/1.49 \approx)$ 18.5 days in response to a

[28] In the model government regulatory agencies set firms' entry requirements, and then governments set their commodity tax rates, as regulatory agencies' processes and standards are more difficult to (re-)structure than commodity tax rates.

Table 2: Alternative measures of taxation and regulation

Panel: dependent variable	**A: Commodity Tax Rate**				**B: Product Market Regulation**	
Measure	*Effective tax rate*		*Statutory VAT rate*		*Days to start up*	
	[1] OLS FE	[2] 2SLS FE	[3] OLS FE	[4] 2SLS FE	[5] OLS FE	[6] 2SLS FE
PMR (days to start up)	–0.00	–0.07*				
	(0.00)	(0.04)				
PMR (ETCR indicator)			–0.12	–0.49*		
			(0.09)	(0.23)		
PMR$-i$ (days to start up $-i$)					0.30	1.13**
					(0.36)	(0.45)
Total population	–0.04***	–0.02	–0.04	–0.01	0.33	–0.02
	(0.01)	(0.03)	(0.03)	(0.03)	(0.28)	(0.26)
Per capita GDP	0.13	0.71**	–0.04	–0.00	7.34***	6.17***
	(0.09)	(0.36)	(0.05)	(0.05)	(1.60)	(1.48)
Government consumption	–0.08	–0.23**	0.19***	0.19***	–1.90*	–1.66*
	(0.07)	(0.12)	(0.05)	(0.04)	(1.09)	(1.00)
Real interest rate	–0.30***	0.19	–0.09***	–0.10**	3.21*	2.27
	(0.11)	(0.29)	(0.03)	(0.03)	(1.87)	(1.61)
Real exchange rate	–0.01	–0.00	–0.01*	–0.01*	–0.07	–0.23**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.11)	(0.11)
Rightwing government in office	0.06	0.37	0.25**	0.21**	4.00*	3.88*
	(0.12)	(0.28)	(0.11)	(0.11)	(2.35)	(2.09)
Member of the European Monetary Union	–0.47	0.26	–0.00	–0.23	7.46	10.58**
	(0.29)	(0.68)	(0.16)	(0.23)	(5.86)	(4.87)
Demand order in Nation (%)					0.19	0.10
					(0.22)	(0.20)
Distrust other people (%)					0.15	0.16
					(0.29)	(0.25)
Observations	189	189	351	351	209	209
K-P rk Wald F-stat		1.969		19.941		26.840
K-P rk LM-stat		5.042		30.419		43.383
p-vale KP		0.080		0.000		0.000
Hansen J-stat		1.410		9.717		0.458
p-value Hansen		0.235		0.002		0.499

Notes: Commodity tax rates are measured with statutory VAT rates in Columns [3] and [4]. Product market regulation PMR is measured by the number of days to start up a business in Columns [1], [2], [5] and [6]. All specifications include time and country dummies. Estimates in Columns [1] and [2] are carried out using the short panel 1999-2008, while estimates in Columns [3] and [4] are based on a sample, which includes each country starting from the year of introduction of a VAT system. Thus, for the sake of comparability, dummies for EU, and application of VAT system are omitted from all specifications. In 2SLS FE estimates, PMR is instrumented by country specific preferences for order and distrust (lagged five years). Robust standard errors are in parentheses. Significance levels: $*$ =10%, $**$ =5% and $***$=1%.

deregulation wave in trade partner countries which cuts their days to start up by 53 days.

To sum up, these results highlight the existence of *a negative effect of product market regulation on local commodity taxation* and *strategic complementarity between product market regulations across trade partners.*

5 Sensitivity Analysis

In this section, we present a number of robustness checks of estimates in Table 1. Results are reported in tables from C-1 to C-4 in Appendix C .

We estimate simultaneously the system of equations (18) and (20) and performed seemingly unrelated regressions (SUR) and three stages least squares (3SLS). The results of this exercise confirm the negative

Table 3: Regulation response function: alternative timing

Dependent variable:	**Product Market Regulation**			
	[1] OLS FE	[2] 2SLS FE	[3] OLS FE	[4] 2SLS FE
PMR$-i$ (ETCR indicator $-i$)	0.62***	0.50***	0.75***	0.58***
	(0.12)	(0.12)	(0.15)	(0.16)
Demand order in Nation (%)	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Distrust other people (%)	0.03***	0.03***	0.03***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
Effective commodity tax rate	–0.05	–0.05		
	(0.04)	(0.04)		
Statutory VAT rate			–0.00	–0.01
			(0.04)	(0.04)
Observations	390	390	352	352
K-P rk Wald F-stat		160.067		116.396
K-P rk LM-stat		93.999		77.002
p-value KP		0.000		0.000
Hansen J-stat		0.054		1.852
p-value Hansen		0.816		0.174

Notes: The dependent variable is product market regulation PMR, measured by the ETCR indicator. All specifications include time, country dummies and the same set of controls as Table 1. Estimates in Columns [3] and [4] are based on a sample, which includes each country starting from the year of introduction of a VAT system. In 2SLS FE estimates, PMR$-i$ is instrumented by average country specific preferences for order and distrust across neighbors (five year lags). Robust standard errors are in parentheses. Significance levels: $*$ = 10%, $**$ = 5%, $***$= 1%.

impact of product market regulation on commodity taxation, and strategic complementarity in product market regulation.

We also check our results in a dynamic model i.e. introduce in the specification the one year lag of the dependent variable. We estimate this model by OLS FE, 2SLS FE, and continuously updated GMM (see e.g. Davies and Vadlamannati [15]). In all these models, the lagged dependent variable has a strong positive coefficient and our main results are preserved.

We check the robustness of our main results on regulatory competition to the use of alternative weighting schemes based on contiguity in culture, legal origins, and geographical location. We also present 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, legal and border proximity still induce regulatory competition. However, cultural and geographical factors create a direct channel between domestic regulation and preferences in trade partner countries. This violates the exclusion restrictions in the regulation response function. Finally, the use of placebo weights eliminates the strategic interactions we found in the baseline estimates. This confirms that complementarities in regulation stems directly from the matrix based on bilateral trade relationships.

Finally, 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 on commodity taxes i.e. to distinguish the effects of domestic and foreign regulation and assuming regulation is exogenous. Our results hold in both cases. Similarly, 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. We find that regulation polices are strategic complements as long as consumers do not value product variety too highly. Furthermore, 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. We present evidence supporting these theoretical predictions. 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 0.83 percentage points and triggers a deregulation process of about 19 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.

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 [45]).

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

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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. 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.[29]

[29] 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 [31] 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 $\widehat{Imp}_{ij}$[30] 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.

[30]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.

Table B-3: Granger non-causality test

Panel A: Commodity Tax Rate						
	Granger non-causality of $distrust_{it}$					
	1 lag		2 lags		3 lags	
Z-bar tilde (p-value)	2.8745	(0.2450)	2.5743	(0.2200)	0.3964	(0.8200,)
	Granger non-causality of $order_{it}$					
	1 lag		2 lags		3 lags	
Z-bar tilde (p-value)	1.2739	(0.4150)	-0.3761	(0.8300)	-0.8189	(0.5350)
Panel B: Product Market Regulation						
	Granger non-causality of $distrust_{-it}$					
	1 lag		2 lags		3 lags	
Z-bar tilde (p-value)	1.2739	(0.4150)	2.0201	(0.3350)	4.5211	(0.0650)
	Granger non-causality of $order_{-it}$					
	1 lag		2 lags		3 lags	
Z-bar tilde (p-value)	1.0343	(0.4750)	1.5923	(0.3300)	2.2365	(0.1650)

Notes: Granger non-causality test as in Dumitrescu and Harlin [20], performed based upon the routine developed by Lopez and Weber [41]. H0: regressor does not Granger-cause Commodity Tax Rate (Panel A), Product Market Regulation (Panel B). p-values in parentheses computed using 200 bootstrap replications..

Table B-4: First stage results

Panel: dependent variable	**A: PMR (ETCR indicator)**	**B: PMR-i (ETCR indicator)**
Demand order in Nation (%)	0.01	0.01***
	(0.01)	(0.00)
Distrust other people (%)	0.04***	0.01***
	(0.01)	(0.00)
Demand order in Nation -i (%)		0.09***
		(0.01)
Distrust other people -i (%)		0.10***
		(0.01)
Member of the European Union	–0.19	–0.09**
	(0.15)	(0.04)
Member of the European Monetary Union	–0.64***	–0.20***
	(0.09)	(0.02)
Applies a Value Added Tax system	–0.31*	0.03
	(0.16)	(0.05)
Total population	0.03***	–0.00
	(0.00)	(0.00)
Per capita GDP	0.07***	–0.00
	(0.02)	(0.01)
Government consumption	–0.01	–0.04***
	(0.03)	(0.01)
Real interest rate	0.01	–0.01**
	(0.02)	(0.01)
Real exchange rate	–0.00	0.0001*
	(0.00)	(0.00)
Rightwing government in office	–0.11**	0.02*
	(0.05)	(0.01)
Observations	389	390
K-P rk Wald F-stat	18.483	157.524
K-P rk LM-stat	29.500	88.685
p-vale KP	0.000	0.000
Hansen J-stat	0.795	0.066
p-value Hansen	0.373	0.797

Notes: In Panel A, and B, we report first stage results relative to 2SLS FE estimates in Table 1, Panel A (column [3]) and Panel B (column [6]), respectively. All specifications include time and country fixed effects. Robust standard errors in parentheses. Significance levels: $* = 10\%$, $** = 5\%$, $*** = 1\%$.

CTA is dependent var?

Table B-5: Commodity tax revenues and product market regulation

PMR (ETCR indicator)	–0.57**
	(0.25)
Member of the European Union	–0.84***
	(0.18)
Member of the European Monetary Union	–0.51**
	(0.21)
Applies a Value Added Tax system	–0.28
	(0.19)
Government consumption	0.16**
	(0.06)
Total population	–0.28***
	(0.11)
GDP	0.01***
	(0.00)
Real interest rate	0.07***
	(0.03)
Real exchange rate	–0.02
	(0.01)
Rightwing government in office	–0.10
	(0.10)
Observations	389
K-P rk Wald F-stat	20.325
K-P rk LM-stat	31.635
p-vale KP	0.000
Hansen J-stat	0.828
p-value Hansen	0.363

Notes: All specifications include time and country fixed effects. The dependent variable is commodity tax revenues (in millions US dollars constant 2000 prices). PMR is instrumented by country-specific measures of demand for order and distrust other people (five year lags). Robust standard errors in parentheses. Robust standard errors in parentheses. Significance levels: $* = 10\%$, $** = 5\%$, $*** = 1\%$.

Appendix C Sensitivity analysis

Table C-1: Simultaneous estimation of commodity tax and regulation response functions

	[1] SURE FE		[2] 3SLS FE	
Dependent Variable	Commodity Tax Rate	Product Market Regulation	Commodity Tax Rate	Product Market Regulation
PMR	–0.23***		–0.58***	
	(0.06)		(0.14)	
PMR$-i$		0.67***		0.67***
		(0.12)		(0.11)
Member of the European Union	–0.30*	–0.01	–0.39**	–0.01
	(0.16)	(0.13)	(0.17)	(0.13)
Member of the European Monetary Union	–0.59***	–0.46***	–0.80***	–0.46***
	(0.11)	(0.09)	(0.14)	(0.09)
Applies a Value Added Tax System	0.75***	–0.39***	0.74***	–0.38***
	(0.14)	(0.12)	(0.15)	(0.12)
Total population	–0.03***	0.03***	–0.01	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
Per capita GDP	0.22***	0.05***	0.25***	0.06***
	(0.02)	(0.02)	(0.02)	(0.02)
Government consumption	0.12***	0.03	0.12***	0.03
	(0.03)	(0.03)	(0.03)	(0.03)
Real interest rate	–0.20***	0.03*	–0.20***	0.03*
	(0.02)	(0.02)	(0.02)	(0.02)
Real exchange rate	–0.00	–0.00	–0.00	–0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Rightwing government in office	0.12**	–0.09**	0.07	–0.10**
	(0.06)	(0.05)	(0.06)	(0.05)
Demand order in Nation (%)		0.01**		0.01**
		(0.00)		(0.00)
Distrust other people (%)		0.04***		0.04***
		(0.01)		(0.01)
Observations	389	389	389	389

Notes: PMR is measured by the ETCR indicator. Commodity tax rate is measured by the average effective tax rate on consumption. All specifications include time, and country dummies. Estimates in Column [1] by Seemingly Unrelated Regressions (SURE). Estimates in Column 2 by three Stages Least Squares (3SLS). Robust standard errors are in parentheses. Significance levels: $* = 10\%$, $** = 5\%$, $***= 1\%$.

Table C-2: Dynamic models of commodity tax and regulation response functions

Panel: dependent variable	**A: Commodity Tax Rate**			**B: Product Market Regulation**		
	[1] OLS FE	[2] 2SLS FE	[3] CU GMM	[4] OLS FE	[5] 2SLS FE	[6] CU GMM
Commodity tax rate $t-1$	0.58***	0.57***	0.58***			
	(0.07)	(0.07)	(0.07)			
PMR $t-1$	–0.11***	–0.25*	–0.26*	0.78***	0.77***	0.77***
	(0.04)	(0.14)	(0.15)	(0.04)	(0.04)	(0.04)
PMR $-i$				0.01	0.13*	0.14*
				(0.07)	(0.07)	(0.07)
Member of the European Union	–0.18	–0.21	–0.16	0.08	0.10	0.06
	(0.29)	(0.28)	(0.29)	(0.11)	(0.10)	(0.10)
Member of the European Monetary Union	–0.30***	–0.39***	–0.38***	–0.31***	–0.29***	–0.28***
	(0.09)	(0.11)	(0.12)	(0.07)	(0.06)	(0.06)
Applies a Value Added Tax System	0.40**	0.39***	0.39**	–0.08	–0.09	–0.08
	(0.16)	(0.15)	(0.16)	(0.10)	(0.09)	(0.10)
Total population	–0.01**	–0.01	–0.01	0.01**	0.01**	0.01**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Per capita GDP	0.08***	0.10***	0.11***	0.04***	0.03***	0.03***
	(0.03)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)
Government Consumption	0.06**	0.06***	0.07***	–0.01	–0.00	–0.00
	(0.03)	(0.02)	(0.03)	(0.02)	(0.01)	(0.01)
Real interest rate	–0.08***	–0.08***	–0.08***	–0.00	–0.00	–0.00
	(0.03)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)
Real exchange rate	–0.01***	–0.01***	–0.01***	–0.00**	–0.00**	–0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Rightwing government in office	0.09	0.07	0.06	–0.04	–0.04	–0.04
	(0.06)	(0.05)	(0.06)	(0.03)	(0.03)	(0.03)
Demand order in Nation (%)				0.00	0.00	0.00
				(0.00)	(0.00)	(0.00)
Distrust other people (%)				0.00	0.00	0.00
				(0.00)	(0.00)	(0.00)
Observations	370	370	370	371	371	371
K-P rk Wald F-stat		16.198	16.198		150.517	150.517
K-P rk LM-stat		25.284	23.849		89.912	84.822
p-value KP		0.000	0.000		0.000	0.000
Hansen J-stat		1.525	1.419		1.424	1.322
p-value Hansen		0.217	0.235		0.233	0.248

Notes: PMR is measured by the ETCR indicator. Commodity tax rate is measured by the average effective tax rate on consumption. All specifications include time, and country dummies. Estimates in columns [3] and [6] by "continuously updated"panel GMM instrumental variables estimator. Robust standard errors are in parentheses. Significance levels: $* = 10\%$, $** = 5\%$, $***= 1\%$.

Table C-3: Regulation response function: alternative weighting schemes

	[1] cultural weights	[2] legal weights	[3] neighborhood weights	[4] placebo weights
PMR_{-i}	0.72***	0.55***	0.35***	–0.05
	(0.18)	(0.11)	(0.11)	(0.21)
Observations	390	390	390	390
K-P rk Wald F-stat	12.992	84.771	28.644	13.543
K-P rk LM-stat	24.024	75.092	40.874	23.314
p-value KP	0.000	0.000	0.000	0.000
Hansen J-stat	3.388	0.331	8.595	0.139
p-value Hansen	0.066	0.565	0.003	0.709

Notes:. PMR is measured by the ETCR indicator. 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 include the usual set of controls, plus time and country dummies. Significance levels: $* = 10\%$, $** = 5\%$, $***= 1\%$.

Table C-4: Commodity tax and regulation response functions: battery of robustness checks

	[1] only country and time dummies	[2] country spec. time trends	[3] economic cycle	[4] trade openness	[5] tax morale	[6] HAC standard errors	[7] PMR_i and PMR_{-i}	[8] 5 years averages
Panel A: Commodity Tax Rate								
PMR	–0.31**	–0.67***	–0.69***	–0.66***	–0.77***	–0.68***	–0.67***	–0.75**
	(0.14)	(0.20)	(0.20)	(0.20)	(0.21)	(0.24)	(0.21)	(0.29)
PMR$-i$							–0.00	
							(0.24)	
Observations	399	390	390	390	390	390	390	83
K-P rk Wald F-stat	32.452	16.260	16.832	16.391	17.358	10.557	7.966	5.452
K-P rk LM-stat	45.186	26.833	27.784	27.949	27.309	16.427	27.090	10.111
p-value KP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
Hansen J-stat	3.405	0.026	0.081	0.006	0.004	0.007	0.420	0.016
p-value Hansen	0.065	0.872	0.776	0.940	0.951	0.933	0.811	0.900
Panel B: Product Market Regulation								
PMR$-i$	0.85***	0.52***	0.52***	0.56***	0.55***	0.52***		0.51**
	(0.11)	(0.12)	(0.12)	(0.13)	(0.12)	(0.15)		(0.21)
Observations	399	390	390	390	390	390		83
K-P rk Wald F-stat	193.265	158.213	160.465	132.098	153.904	92.369		29.290
K-P rk LM-stat	94.444	88.976	88.485	83.375	86.946	49.923		24.710
p-value KP	0.000	0.000	0.000	0.000	0.000	0.000		0.000
Hansen J-stat	2.111	0.073	0.405	0.144	0.131	0.045		0.015
p-value Hansen	0.146	0.787	0.524	0.704	0.718	0.832		0.904

Notes: PMR is measured by the ETCR indicator. Commodity taxes are measured by the average effective tax rate on consumption. 2SLS estimates with robust standard errors in parentheses. Specifications in panels A,B include the usual set of dummies and controls. 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 include PMR_{-i} and instrument it by average country specific preferences for order and distrust among neighbors (lagged five years). Significance levels: $* = 10\%$, $** = 5\%$, $*** = 1\%$.