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Commodity Taxation and Regulatory Competition

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Abstract

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

Keywords: Regulation, commodity tax, strategic interactions

JEL: F0, H1, H7, H87, L5

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1 Introduction

This paper studies competition in product market regulation and commodity taxation between trading partners. There is a large literature that investigates the existence and impact of tax interactions between countries but much less attention has been devoted to the interdependence between taxes and market regulation in an international context. This is puzzling because, as Oates ([42] p. 377) writes, the "economic competition among governments makes use of a wide class of policy instruments *including both fiscal and regulatory policies* [...]". In the present paper, we hypothesize that commodity taxation cannot be disentangled from product market regulation. Our hypothesis was suggested by the recent implementation of OECD regulatory guidelines in the OECD countries (OECD [39]), and in particular, by the case of Australia (OECD [40]). The regulatory transformation of Australian product markets and the resulting fall in telecommunication and electricity prices has been extremely beneficial given the importance of these sectors to business and households. Stronger competition in product markets has led to *increased tax revenues* and enhanced government's ability to provide social services such as education and health (OECD [40], p. 54). As suggested by an analysis of the OECD countries (Nicoletti and Scarpetta, [38]), the explanations proposed for the effects of these reforms in other OECD countries generally identify the same set of factors.

Product market regulation imposes costs on the production of goods and services, and on the entry of new firms. These costs impede the creation of new product varieties, and affect product prices, demand, the consumer surplus, and wages (see e.g. Blanchard and Giavazzi [8]), and ultimately alter the incentives for governments to increase commodity taxes (see Lockwood [31] for a survey). Analyzing this interdependence between product market regulation and taxation seems even more important given that consumption taxes (particularly VAT) represented over 20 percent of total government revenues in the developed economies in 2014, with steadily increasing tax rates (OECD [41]). Also, because the share of traded goods and services has increased strongly in recent decades, it is important to analyze this interdependence in an open economy setup. Indeed, when countries are open to trade, the effects of these two policy instruments are transmitted to trading partners, leading to strong interactions between countries' policy decisions.

Our aim is to investigate theoretically and empirically the existence of strategic interactions between commodity taxation and product market regulation in a setup of countries

open to trade. We address three questions: First, is there any strategic interaction in commodity taxation under the destination principle? This principle is the most widely used regime in developed countries and requires taxes to be collected at the consumption location. Second, how do regulation policies affect commodity tax rates in an international context? Third, does a country's decision to weaken its market regulation institutions encourage its trading partner countries to weaken or strengthen their own regulatory framework?

In the first part of the paper, we discuss a general equilibrium model with two trading countries. Commodity taxation follows the destination principle, and tax rates are set by benevolent governments to finance public goods. For regulation, we propose helping-hand government regulatory agencies which seek to protect consumer safety. Individuals working in firms consume private and public goods. Firms produce private goods, set their prices, and freely enter product markets. Regulation imposes additional costs on firms' physical fixed costs affecting entry in the product market. The regulation level is decided before commodity taxation to reflect governments' greater flexibility when setting tax rates compared to restructuring regulatory processes and standards.[1] The model generates three theoretical predictions. First, commodity taxes are independent instruments under the destination principle. Second, governments may lower commodity tax rates if regulation becomes stricter. This is because regulation reduces the resources for total consumption, both private and public. When individual demand for public goods is more elastic, governments cut their provision of public services, and therefore taxes. Finally, if consumers do not value product diversity excessively, regulation polices are strategic complement instruments.

In the empirical part of the paper, we investigate our predictions using panel data for 21 OECD countries. Product market regulation is measured using the number of days required to start up a business, and the OECD measure of market regulation. Commodity tax rates are proxied by average effective tax rates on consumption. To focus on application of the destination principle, we exclude tax items that are not subject to this principle (e.g. those subject to excise taxes). We use instrumental variables to account for endogeneity issues typical of empirical analyses of policy interactions (Brueckner [9]). To the best of our knowledge, this paper is the first to exploit exogenous variation in tax reforms (i.e. the introduction of VAT systems in OECD countries) and social preferences for regulation (see

[1] 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.

e.g. Inglehart [25], Aghion *et al.* [1]) to identify the strategic interaction effects of commodity taxation and product market regulation. Our empirical results confirm the absence of commodity tax competition under the destination principle. Our estimates suggest also that stricter domestic regulation reduces a country's ability to raise commodity taxes. We support the hypothesis that regulation policies are strategic complements. Finally, notice that the magnitudes of the estimated effects are non-negligible: we find that a deregulation process that reduces firms' start up time by 160 days (i.e. comparable to EU deregulations during the 1990s) induces a local rise in domestic commodity taxes of about 2.4 percentage points, and induces a deregulation process in trade partner countries which reduces firms' start up times by about 40 days, on average.

This paper contributes to the existing literature in the following ways. First, there is an extensive literature on strategic interactions between governments' taxes which suggests that competition in commodity taxes is mitigated by adoption of the destination principle (Mintz and Tulkens [35], Haufler *et al.* [21] Behrens *et al.* [6], see Lockwood [31] for a survey). However, the present paper is the first to provide empirical evidence of the absence of strategic interactions in destination-based taxation.[2] Second, to our knowledge, the impact of product market regulation on commodity taxation has not been investigated from either a theoretical or an empirical perspective.[3] Our paper fills a gap in the corresponding literature. Third, the paper contributes to the literature on entry regulation. Djankov *et al.* [16] and Aghion *et al.* [1] analyze the social and cultural factors that affect entry regulation. Miyagiwa and Sato [34] analyze the optimal entry policy in oligopolistic markets operating in a globalized world. However, these papers do not discuss strategic interactions in product market regulation policy although governments' strategic interactions have been studied in the case of labor market regulation (e.g. Haaland and Wooton [19]).

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]There is empirical evidence of strategic interactions under the origin principle. For example, Lockwood and Migali [32] show that the introduction of the EU Single Market in 1993 triggered strategic interactions between excise taxes in EU countries.

[3]There are some studies in environmental economics such as Oates and Schwab's [43] or List and Gerking's [30] which discuss the impact of environmental regulations on taxes and welfare.

2 The Model

We describe a general equilibrium economy with two countries, home and foreign, and immobile populations with unit masses. Benevolent governments decide on local commodity tax rates. Government regulatory agencies choose regulation policies in the local product markets.[4] We follow the public interest theory of regulation (Pigou [45]) and consider the government regulatory agency as a benevolent -helping-hand - institution which cares about product market functioning in the context of uncertainty. Regulation aims at protecting consumers, guaranteeing their safety, checking professional accreditation, and providing business information so that consumers are less exposed to potential injuries, swindles, or fraud. To make this idea more explicit, we focus on a government regulatory agency which helps consumers to get good delivery of or good consumption from their purchases. 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. Indeed, we assume that the government regulatory agencies set regulation norms which lead to stronger control over firms but also to higher setup costs, which ultimately determines a smaller number of active firms in the markets.[5] In what follows, we first describe the economy and then discuss the taxation and regulation decisions. Variables pertaining to 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.

Private good demand In the domestic country, consumers' preferences are given by an increasing, separable, and concave utility function $U(C, G)$ where C is a bundle of private commodities and G is a bundle of public goods. Firms enter and offer (catalogs of) product varieties for purchase. Consumers purchase and pay for each product variety. Firms then produce their products and deliver them to final consumers. In some random state of nature, $s \in S$, firms are unable either to deliver either their goods or to deliver a good that is worth

[4]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.

[5]An alternative setup with a grabbing hand regulator can be found in an earlier version of the paper, Moriconi et al [36]).

consuming. We do not comment on whether the uncertainty stems from accident or evil intent. The probability of each state s is denoted by $\theta(s)$.

In this framework, the bundle of private commodities $\omega \in [0, N]$ is contingent on each state s and given by

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

where $c(\omega)$ is the private consumption of variety ω (decided before the realization of the states of nature) and $\lambda(s,\omega)$ is equal to 1 if the variety ω is actually delivered in state s and zero otherwise. The parameter σ, $\sigma > 1$, is the elasticity of substitution among varieties. The world number of varieties, N, is given by the sum of the endogenous numbers of domestic and foreign varieties, n and n^*. That is, $N = n + n^*$. As in Benassy [7], the parameter $\xi \in [-1/(\sigma-1), 0]$ measures the love for variety. With $\xi = 0$, one obtains Dixit and Stiglitz's [15] benchmark where the elasticity of substitution is equal to the love for variety. With $\xi = -1/(\sigma-1)$, the love for variety is absent. Ardelan [5] suggests an empirical value for ξ at about the middle of this range.

Each consumer maximizes expected utility function $E[U(C,G)] = \int_S \theta(s) U(C(s), G(s)) ds$ to choose private consumption $c(\cdot)$, subject to budget constraint

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

where $p(\omega)$ is the domestic (tax-inclusive) consumer price for variety ω and W is the consumer's income. In the following analysis, for simplicity we will assume that uncertainty affects the delivery of varieties symmetrically. Specifically, we assume that the probabilities of home and foreign varieties (ω, ω^*) being delivered are given by $\theta \equiv \int_S \theta(s)\lambda(s,\omega)\mathrm{d}s$ and $\theta^* \equiv \int_S \theta(s)\lambda(s,\omega^*)\mathrm{d}s$. Then, it can be shown (see Appendix A) that consumers' demands $c(\omega)$ have easy, closed-form solutions

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

where $P^{1-\sigma} = n\theta^{\sigma} p^{1-\sigma} + n^* \theta^{*\sigma} p^{*1-\sigma}$ is the domestic consumer price index. Then, we have $C = \frac{N^{\xi} W}{P}$.

Public good supply and demand In most modern economies, a large set of public goods is delivered by independent public agencies which purchase inputs from the private sector.

These public goods include infrastructure, supply and private sourcing for justice, communication, education, army, and social housing among others.[6] We assume a continuum of symmetric varieties of public goods. Each public good variety is produced by an independent public agency which uses private varieties in its production process. In particular, each public agency transforms a set of private varieties $\omega \in [0, N]$ into its own variety of public good using the following technology, which is subject to the same delivery uncertainty:

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

where $q(\omega)$ is the input demand of the public agency for variety ω. Each agency chooses the input mix that maximizes the expected level G of its public good variety, taking all prices as given and satisfying its budget constraint $\int_0^N p(\omega) q(\omega) \mathrm{d}\omega = B$, where B is the agency's budget line. It follows naturally that the input demand is given by

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

A higher probability of domestic product delivery, θ, increases both the demand for these goods and the global price index. Intuitively, under symmetric delivery probabilities, in reality consumers do not care which variety will not be delivered, and they make their decisions based on the aggregate measures of delivery probabilities (θ, θ^*). The consumption bundle then becomes a certainty from the consumer's viewpoint.[7]

Assuming symmetry of consumers' preferences and production technology across varieties of public goods, public agencies conveniently display the same demand for private varieties.[8] Assuming also a unit mass of varieties of public goods, then the total demand for a private variety ω by the public sector and the bundle of public goods are given by $q(\omega)$ and G. Similarly, the government's budget for the production of public goods is equal to the agency budget line B. Finally, public and private consumptions are proportionate. Indeed, one can check that

[6] One can interpret this setting more narrowly as public procurement or outsourcing. In the OECD countries, public procurement ranges between 10% and 30% of GDP and between 20% and 50% of government expenditures (European Commission [17]).

[7] Note that the parameter θ can also be seen as a product quality shifter. In this case, regulation therefore increases the product quality in the country.

[8] Under the above specification, public agencies benefit from no strategic (monopsony) power and have an input demand similar to that of consumers.

$$q(\omega)/c(\omega) = B/W \quad \text{and} \quad G/C{=}B/W. \tag{4}$$

Private production Each firm owns a single variety which it produces in one country and sells under monopolistic competition in both countries. Firms can be indexed as $\omega \in [0, N]$. A domestic firm ω obtains a profit given by

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

where $p(\omega)$ and $p^*(\omega)$ are its domestic and foreign prices, $c(\omega)$ and $q(\omega)$ are the demand from domestic private consumers and public agencies, and $c^*(\omega)$ and $q^*(\omega)$ are the demand from foreign consumers and public agencies. To produce a unit of the good, each firm hires a unit of labor paying a wage equal to W, and incurs a fixed labor input f which yields a fixed cost equal to Wf. This fixed input f embeds the input, f_0, needed to set up the firm's economic activity (e.g. management, R&D, marketing, distribution, etc.) and the cost of complying with regulatory requirements (e.g. quality compliance, transfers to renters, etc.). The mechanism underlying this cost is described in section 3.2. For simplicity, we measure domestic and foreign commodity taxes as the ratio between (tax-inclusive) consumer and (tax-exclusive) factory prices: $\tau > 1$ and $\tau^* > 1$. Commodity tax rates are simply equal to $\tau - 1$ and $\tau^* - 1$. Taxes, set by governments, are ad valorem and follow the destination principle.

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

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

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

$$x = (\sigma - 1) f, \tag{6}$$

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

Plugging the optimal prices (5) and their foreign counterparts into the price indices, we get the following property:

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

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

Labor and product market equilibrium In the domestic country, each firm demands $f + x = \sigma f$ units of labor, and the labor market clears when the total labor demand $n\sigma f$ equalizes its unit supply. Using the production scale (6) and applying the same argument to the foreign country, we get the following number of firms

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

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

For each domestic firm ω, the product supply x must satisfy the product demand: $x = c(\omega) + q(\omega) + c^*(\omega) + q^*(\omega)$. Using (2), (3), (5) and (7), we obtain

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

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

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

On the one hand, the relative wage falls with larger domestic production scales, and therefore, with larger domestic setup costs which can be caused by higher level of regulation. When setup costs rise, domestic firms need to sell more to break even, and therefore, set a lower price relative to foreign firms. Since firms set constant markups over wages, domestic firms can set a lower price only by paying a lower wage, relative to foreign firms. On the other hand, tighter domestic regulation leads to a higher probability of delivery of domestic goods θ, which increases demand for and the relative price of these goods. As a result, the terms of trade are more favorable to the home country. This is the effect of product market regulation on domestic purchasing power, or equivalently, on the domestic terms of trade, W/W^*. These two opposing effects are taken into account in the decision over the optimal level of regulation.

Government balance and consumption The government balances its tax revenues against its expenditure on the production of public goods so that

$$(\tau - 1)\, W = B \tag{10}$$

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

$$C = \frac{W}{P} N^{\xi}, \tag{11}$$

and from (4) and (10) the public good consumption is equal to

$$G = (B/W)\, C = (\tau - 1)\, C. \tag{12}$$

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

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

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

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

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

where

$$C_0(n, n^{*}, \theta^{\sigma}, \theta^{*\sigma}) \equiv \frac{\sigma - 1}{\sigma} \left[n\theta^{\sigma} + \left(\frac{n\theta^{\sigma}}{n^{*}\theta^{*\sigma}} \right)^{1-\frac{1}{\sigma}} n^{*}\theta^{*\sigma} \right]^{\frac{1}{\sigma-1}} (n + n^{*})^{\xi} \tag{15}$$

It follows that $G = C_0\,(\tau - 1)\,/\tau$. Stricter domestic regulation reduces the number of domestic firms and domestic product diversity n, and thus, changes the utility from private consumption through two channels. The first channel works through the terms of trade. Stronger domestic regulation reduces local production and therefore, labor demand and wages. As a result, it decreases the terms of trade W/W^{*} which is reflected by the fall in

the ratio $(n\theta^{\sigma})/(n^{*}\theta^{*\sigma})$ in expression (15). Keeping other terms constant, regulation has a negative impact on domestic consumers' utility if it has a heavier impact on product diversity than on delivery probability. This is likely to occur if this probability is already close to 1. The second channel works through the taste for variety. To show this, we can negate 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, C_0 is proportional to $(n+n^{*})^{\frac{1}{\sigma-1}+\xi}$. As stronger regulation reduces local product diversity n, it diminishes domestic utility to the extent that ξ is larger than $-1/(\sigma-1)$ as is the case under Dixit-Stiglitz's preferences. When consumers express no taste for variety ($\xi=-1/(\sigma-1)$), the effect of product diversity is nil.

Finally, the overall effect of stronger regulation on the level of consumers' utility is the balance among three forces: *(i)* the impact of regulation on θ and *(ii)* the impact of regulation on n, both of which affect the terms of trade; and *(iii)* the impact of regulation on product diversity which on the strength of the taste for variety.

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

3.1 Commodity Tax Competition

Each government sets the commodity tax rate that maximizes its residents' utility, holding a balanced budget and taking the other tax and the regulatory settings as given. Because the domestic government maximizes $E\left[U(C,G)\right]$ or equivalently $E\left[U(C_0/\tau, C_0(\tau-1)/\tau)\right]$, and because C_0 is a function of only n, n^{*}, θ, and θ^{*},, the optimal domestic commodity tax τ is independent of the foreign tax. Indeed, in this setup, firms pass the entire commodity

tax τ "through" consumers, and the destination principle rules out cross-border shopping.

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

This is a well-known result in optimal taxation theory under the destination tax principle. In their seminal paper, Mintz and Tulkens [35] show the absence of commodity tax competition under the destination principle in perfectly competitive markets. Closer to our approach, Haufler and Pfluger [20] reach the same conclusion for two countries and monopolistic competition. Nevertheless, the type of competition matters as governments have incentives to use commodity taxes to correct the distortions that emerge in imperfectly competitive markets.[9] However, as in this paper, these incentives are mitigated if commodity taxes are used to finance public goods (Haufler and Pfluger [22]). In addition and in contrast to those contributions, here we consider the effects of terms of trade and product diversity (entry). Also, we consider the more realistic situation of a tax on all goods, and the use of tax receipts for the provision of public goods.

The choice of commodity taxes can be readily understood by reformulating the government's problem in the following way. Since $C = C_0/\tau$ and $G = C_0(\tau - 1)/\tau$, we get $C + G = C_0$ where C_0 is a function of n, n^*, θ and θ^*. As in Andersson and Forslid [3], aggregate private and public consumption reduces to a simple expression which is independent of commodity taxes and eases the analysis.[10] Thus, government's problem is simply to find the private and public consumption bundles that maximize each individual's utility $U(C, G)$ subject to the total resource constraint $C + G = C_0$. This yields the standard Samuelson condition

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

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

[9] In the presence of such distortions commodity taxes can be Pareto inefficient under the destination principle, even in the absence of strategic interactions (see Lockwood [31] for a synthesis). This applies in the case of imperfect competition in duopoly models (Keen and Lahiri [27], Haufler *et al.* [21]), monopolistic competition (Haufler and Pfluger [20]), or labor market imperfections which create unemployment in the economy (Moriconi and Sato [37]).

[10] This is the result of our modeling strategy for public agencies.

We can now analyze the impact of stronger domestic regulation on domestic tax rates. The domestic government sets the commodity tax τ which maximizes the domestic utility level $U\left[C_0/\tau, C_0(\tau-1)/\tau\right]$. This yields the first-order condition, $\mathcal{F} \equiv (\mathrm{d}/\mathrm{d}\tau)\, U\left[C_0/\tau, C_0(\tau-1)/\tau\right] = 0$,, and the second-order condition, $\mathrm{d}\mathcal{F}/\mathrm{d}\tau < 0$. The commodity tax falls with stronger regulation if it reduces the number of domestic firms. This means that $\mathrm{d}\tau/\mathrm{d}n = -\left(\mathrm{d}\mathcal{F}/\mathrm{d}n\right)/\left(\mathrm{d}\mathcal{F}/\mathrm{d}\tau\right) \geq 0$. This condition is true if and only if $\mathrm{d}\tau/\mathrm{d}n > 0 \iff \mathrm{d}\mathcal{F}/\mathrm{d}n \geq 0$. Some lines of computation show that this last condition is equivalent to

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

Consider the second parenthesis. If we denote the relationship between the delivery probability and the number of firms as $\theta(n)$, this imposes that $\partial C_0/\partial n + (\mathrm{d}\theta/\mathrm{d}n)\,(\partial C_0/\partial\theta) > 0$. Since the delivery probability is high (θ close to 1) as could reasonably be expected, $\mathrm{d}\theta/\mathrm{d}n$ is low, so that the first term, $\partial C_0/\partial n$, in the second parenthesis, dominates. It can be easily shown that indeed $\partial C_0/\partial n > 0$ if n/n^* does not depart much from 1 (see Appendix B).

The first parenthesis expresses the income effects on the marginal rates of substitution. Indeed, take any ray, $G/C = cst$, on which private and public consumptions are proportionate ($\mathrm{d}\ln C = \mathrm{d}\ln G$). When income effects on public and private goods are the same, the marginal rate of substitution remains constant on the ray. Changes in regulation, and thus in the number of domestic firms, have no impact on commodity tax rates. When income effects are stronger on the demand for public goods, the marginal rates of substitution increase on this ray if consumption rises proportionally, so that the term in parentheses becomes positive. As a result, stronger regulation reduces the number of domestic firms, and thus increases commodity taxes. We can state the following proposition:

Proposition 2 *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 private goods, provided that private consumption increases with lower regulation ($\partial C_0/\partial n + (\mathrm{d}\theta/\mathrm{d}n)\,(\partial C_0/\partial\theta) > 0$).*

3.2 Regulatory competition

Finally, we can study the role of helping-hand regulatory agencies. To allow comparison, we negate the effect of local regulation on local tax by assuming that the utility function of agents is log-linear, i.e., $U(C,G) = \alpha\ln C + (1-\alpha)\ln G$, where α is the specific domestic preference

for private consumption. The optimal commodity tax rate becomes $\tau_0 = 1/\alpha$ and the utility $V(C_0) = \ln C_0 + \ln\left[\alpha^\alpha (1-\alpha)^{1-\alpha}\right]$. The foreign country has similar characteristics.

Here, we need to be more specific about the production side of regulation. We assume that the delivery probability θ is equal to $\theta \equiv 1 - \beta f_0/f$, where f_0 is the physical fixed cost of entry and $\beta > 0$ is a regulation efficiency parameter. This probability θ increases with stronger control, which raises setup costs. This implies that $\theta \equiv 1 - \varphi n$ where $\varphi \equiv \beta\sigma f_0$. This set of assumptions imposes that $n < 1/\varphi$, which holds if β is set sufficiently low.

Therefore, the domestic regulatory agency chooses the regulatory level that maximizes local consumers utility $V(C_0)$ where $C_0 = C_0(n, n^*, \theta, \theta^*)$. This amounts to choosing the number of domestic firms n under the constraint $\theta = 1 - \varphi n$. The first-order condition with respect to n can be written as $V'(C_0)\left(\frac{\partial C_0}{\partial n} + \frac{\partial C_0}{\partial \theta}\frac{\mathrm{d}\theta}{\mathrm{d}n}\right) = 0$ or equivalently since $V' > 0$,

$$\frac{\partial \ln C_0}{\partial \ln n} + \frac{\partial \ln C_0}{\partial \ln \theta}\frac{\mathrm{d}\ln\theta}{\mathrm{d}\ln n} = 0$$

The helping-hand regulatory agency chooses the regulation level which balances the effect on local consumption of increases in product diversity and entry (first term), and in product market safety (second term). Because countries are symmetric, the equilibrium is given by $n = n^* \equiv \overline{n}$ where

$$\overline{n} = \frac{1}{\varphi}\left(\frac{1}{\sigma+1} + \frac{\sigma^2(\sigma-1)\xi}{(\sigma+1)(\sigma+2\sigma^2-\sigma\xi+\sigma^2\xi-1)}\right)$$

which falls with a more negative ξ. At equilibrium, we get

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

which is positive because the numerator and denominator are positive for $\xi \in [-1/(\sigma-1), 0)$. Therefore, regulation is a strategic complement to $\xi < 0$.

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

1. See Appendix B . ■

Consider the case where the consumer and the helping-hand regulatory agency put no value on product diversity. Then what matters is the effect of regulation on the terms of trade. When the foreign regulatory agency 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 terms of trade W/W^{*} deteriorate, reduce the home purchasing power, C_0, and increase the marginal purchasing power resulting from additional local varieties. The domestic regulatory agency then has an incentive to relax domestic regulation to restore its country's international competitiveness. More domestic firms enter as the terms of trade are restored, and the purchasing power of local consumers rises. Thus, regulatory decisions are strategic complements. In contrast, when the consumer and the helping-hand regulatory agency put a high value on product diversity, 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 $n = 1/(1+\varphi)$.

4 Empirical Evidence

4.1 Empirical Strategy

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

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

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

where $i = 1, ..., I$ and $t = 1, ..., T$ respectively denote countries and time-periods. The variable τ_{it} denotes the commodity tax rate in country i at time t, set under the destination principle,[11] while the variable z_{it} is our observation of the regulation level in country i at time

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

t. $\mathbf{x}_{it}$ is the vector of country i's relevant country characteristics (i.e. population size, per capita GDP, size of the public sector, political orientation of the government, membership of the EU, EMU, characteristics of the commodity tax system) and business cycle controls (i.e. real interest rate, real exchange rate), d_i and e_t are country and time dummies, and u_{it} is the error term. Our coefficients of interest are α_{ij} (with $i \neq j$) and β. The coefficients α_{ij} measure how country i's commodity tax responds to the commodity tax in other countries $j \neq i$ (note that $\alpha_{ii} = 0$ by construction). A zero value for α_{ij}, would be evidence of absence of strategic interaction, and therefore would confirm our theoretical analysis and would be in line with previous studies on the destination principle of commodity taxation (see Lockwood [31]). The coefficient β describes how country i's tax policy reacts to its own product market regulation z_{it-1}, with a one-year lag to reflect any difficulties encountered in regulation restructuring processes.[12] According to our theoretical model, a significant negative value for β would indicate that the government uses commodity taxes to mitigate the negative impact of stronger regulation on consumers' welfare.

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

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

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

Equations (18) and (19) show that country i accounts simultaneously for all its partners' tax and regulation policies when it chooses its tax and regulation levels τ_{it} and z_{it}. However, the number of the $2I(I-1)$ strategic interactions included in parameters α_{ij} and δ_{ij} is too

[12]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 [49]).

large to allow identification. As in Brueckner [9], our econometric approach is to assume that country i responds to an average of its *trade partners*' policies. Denoting such average policies by τ_{-it} and z_{-it}, we can write:

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

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

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

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

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

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

The literature provides an extensive discussion on the choice of appropriate weights, which depends critically on the nature of the strategic interaction under investigation (see Brueckner [9]). In this paper, the appropriate weights proxy for the exogenous structure of international trade flows, because these are the main channels of the interactions in commodity tax and regulation in our theoretical analysis. In practice, we project trade flows from an augmented gravity equation which predicts country i's imports (logs) ten years before the start of the sample of observations (i.e. in 1980) as a function of countries' 'monadic' characteristics (log of population and GDP) in 1980, and time invariant 'dyadic' characteristics (distance and common border, legal origins, colonial relationship or common language with trade partners, etc., as in Head, Mayer and Ries [23]). This approach is very convenient in a number of respects. First, compared to the neighborhood weights typically used in the empirical tax competition literature (e.g. Lockwood and Migali [32]), weights based on predicted trade flows minimize strategic interactions that may occur under the origin principle due to cross-border shopping. Accordingly, these weights allow a better focus on the destination principle. Second, these weights allow parsimonious specification of the heterogeneous trade relationships between the countries in the sample, which makes

our estimates immune to Manski [33]'s reflection issues.[13] Finally, 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.[14]

4.1.1 Endogeneity and Instrumental Variables

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

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

To address these endogeneity issues, we build an instrument for τ_{-it} using information on the *adoption* of the VAT system in OECD countries. We consider the vector $\boldsymbol{vat}_t =$

[13] 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 C-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 closer, and are more likely to have common legal and colonial origins).

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

$[vat_{1t}, vat_{2t}, ..., vat_{It}]'$ such that $vat_{it} = 1$ if there is a VAT system in commodity taxation in place in country i at time t, and $vat_{it} = 0$ otherwise. The proposed instrument measures VAT adoption amongst trade partners

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

First, to be a good instrument for τ_{-it} in equation (20), vat_{-it} has to have a clear effect on τ_{-it}. It is generally acknowledged that VAT-based systems are more efficient than general sales taxes or consumption-based tax systems because they enhance tax compliance, avoid double marginalization, and induce higher tax rates on consumption (Kato [26]). Therefore, commodity taxes are likely to respond to the adoption of a VAT system. Second, vat_{-it} is a valid instrument if it is uncorrelated with τ_{it} in equation (20). This exclusion restriction is valid under two conditions. The first condition is that trade partners' adoption vat_{-it} must not vary systematically with local commodity taxes τ_{it}. We claim that this condition holds: On the one hand, the introduction of a VAT system during our period of analysis occurs only in four countries: Switzerland, Australia, Finland, and Canada. In these countries, political discussion of this issue was lengthy (e.g. in Australia) so that the timing of these countries' decisions and their implementation of a VAT system can be considered independent (Kato [26]). This view is confirmed by the fact that the reforms are not temporally concentrated but span a 10 year period (from 1991 in Canada to 2001 in Australia). These arguments support the idea that the timing of the introduction of VAT in each country is not due to responses to common unobserved shocks or supranational directives. On the other hand, these countries have very limited trade relationships with each other, and a very strong heterogeneity in their import compositions (see Appendix table C-2). This also supports the view that there are no network effects in the introduction of their VAT systems. The second condition for the validity of the exclusion restriction is that vat_{-it} must not have any direct effect on τ_{it}. This condition is guaranteed by the cross-border neutrality of VAT, which is explicitly stated in the international guidelines (see OECD [41]). Under this principle, the introduction of a VAT system in a country's trade partner has no efficiency effect for that country's commodity taxes. Finally, notice that, some of our estimates refer to the period $2002 - 2008$ when vat_{-it} does not exhibit any time variation. In these estimates, we follow empirical analyses of tax competition (Lockwood and Migali [32]), and use other instruments for commodity taxes i.e. trade partners' average population, and government expenditure

on final consumption.

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

To tackle these issues, we build instruments for z_{it} in equation (20) from two indicators for "interpersonal distrust" $distrust_{it}$, and "demand for order" $order_{it}$. Aghion *et al.* [1] show that high levels of interpersonal distrust in a country generate demand for regulation, in an attempt to restrict the negative consumption externalities from individuals who are not considered trustworthy. Similarly, Inglehart [25] argues that demand for order in a country signals materialistic attitudes which create a social demand for regulations from citizens desirous of enjoying safe consumption. Accordingly, $distrust_{it}$ and $order_{it}$ have a clear effect on z_{it}. To be valid instruments for z_{it} in equation (20), these indicators must be uncorrelated with τ_{it}. A priori, social patterns of interpersonal distrust and demand for order can be considered as independent from commodity taxes. However, it can be argued that both dimensions have a cultural component (e.g. related to lack of social capital and materialistic attitudes), which is persistent over time, and has an effect on growth, per capita income, and individual propensities to pay taxes (Knack and Keefer [28]; Algan and Cahuc [2]; Guiso et al [18]). If not properly accounted for, this cultural component may violate the exclusion restrictions and make $distrust_{it}$ and $order_{it}$ invalid instruments in equation (20). However, it is well-known that a country's culture can be considered reasonably time invariant (see Tabellini [47]). Accordingly, the cultural component of distrust and demand for order is accounted for by the inclusion of country fixed effects, which guarantees the validity of the exclusion restrictions.

Regulation response: In equation (21), the concern is over the endogeneity of z_{-it}. As in the case of taxes in equation (20), there is simultaneous determination of z_{it} and all z_{jt}'s that

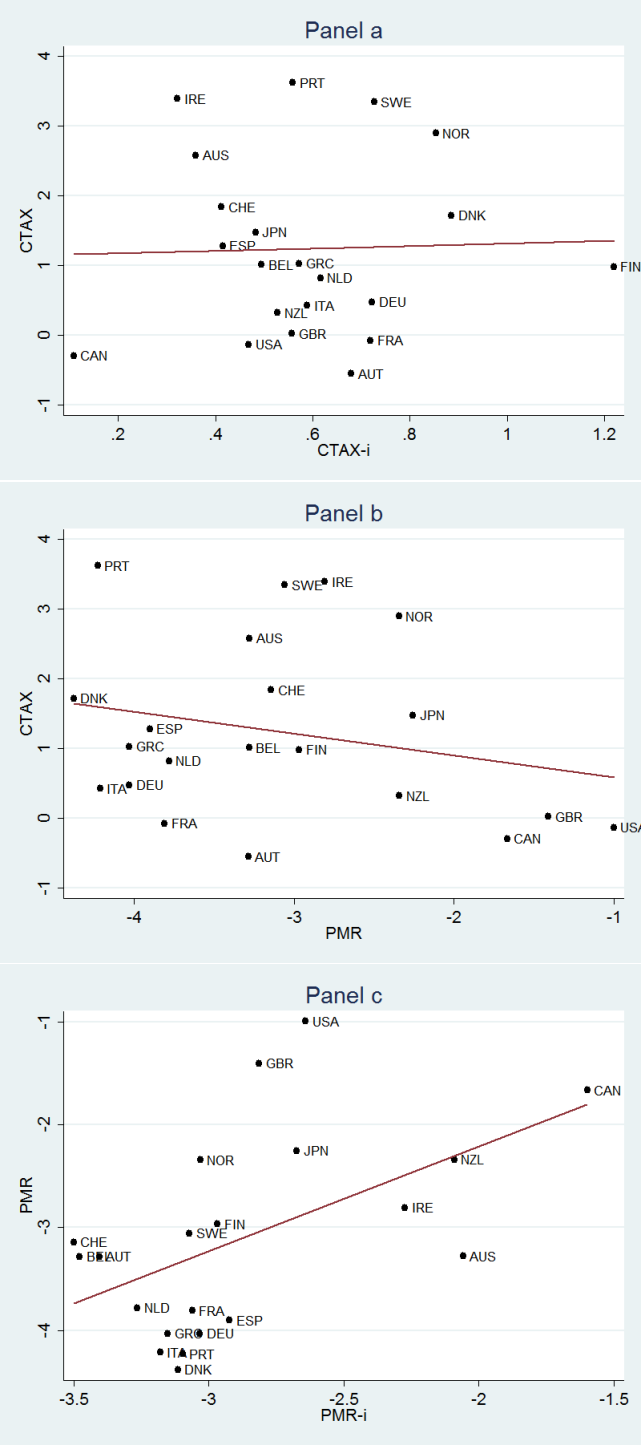
enter in the $\boldsymbol{z}_t$ vector. Similarly, there can be reverse causality from country i's regulation policy to its trade partners' policies. Finally, it is also reasonable to expect that country i's regulation policy is affected by unobserved characteristics e.g. policy recommendations from supranational organizations (e.g. IMF, World Bank, OECD), which may cause co-movement with the product market regulations of trade partners.

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

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

The same arguments discussed above for country i apply to its trade partners, on average: High levels of distrust and demand for social order in country i's trade partners generate product market regulations in that country, so that $distrust_{-it}$ and $order_{-it}$ have a clear effect on z_{-it}. In our view, $distrust_{-it}$ and $order_{-it}$ are also valid instruments for z_{-it} in equation (21) since they can be considered independent of z_{it}. Variation in distrust and social order is triggered by unobserved shocks (e.g. a political scandal). If such a shock hits a trade partner of country i, it increases distrust and demand for order in the partner country, but not necessarily in country i. In addition, when a common unobserved shock hits both country i and its trade partners, the effects on distrust and demand for order are country specific and independent of z_{it}. Descriptive evidence supports this interpretation (see figure 4 below, and the ensuing discussion). It is also natural to exclude the direct effects of trade partners' preferences on local regulation because local regulatory systems are designed to respond to local but not foreign preferences. Also in this case, any violation of the exclusion restriction may occur only through the cultural features of trade partner countries which are correlated with local economic performance and local regulation (see e.g. Guiso et al. [18]). However, as mentioned above, these cultural factors are time invariant and are accounted for by the country fixed effects. What remains after the inclusion of country fixed effect is variation over time in the social preferences (distrust and materialistic attitudes) within the same country which is likely to affect local regulation policy but plausibly is uncorrelated with the regulation policy in trade partner countries for the reasons stated above.

Figure 1: Commodity Taxation and PMR.



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

4.2 Data and Descriptive Statistics

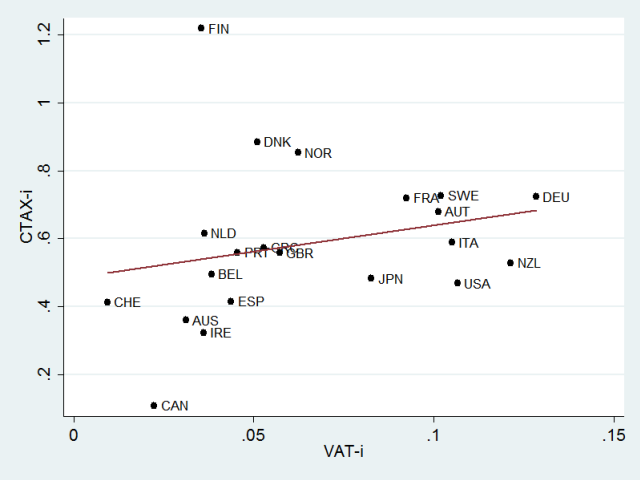
We exploit a unique data set that combines information on product market regulation, consumption taxation, institutional characteristics, and social preferences for 21 OECD countries over the 1990-2008 period.[15] We proxy the commodity tax rate τ_i by the average effective tax rate on consumption, which measures each country's tax revenues as a percentage of the total value of its consumption (see Carey and Rabesona [11]). To focus on the destination principle, we include only the sales tax and the VAT in our definition of commodity taxes ($CTAX$). In other words, we exclude excise taxes, customs and import duties, profits from public monopolies, and taxes on specific services whose revenues may partly reflect application of the origin principle to consumers' transactions. We use two empirical proxies for product market regulation (PMR), z. Our first measure for regulation is the number of days required to start up a new business (see Djankov *et al.* [16]). This measure applies to the whole economy but is available for the time period 2002-2008. Our second measure is the index of energy, transport and communication regulation indicator (ETCR) constructed by Conway and Nicoletti [14]. On a scale from 0 to 6, this index aggregates information on entry barriers (fixed costs) in seven non-manufacturing industries (electricity, gas, air passenger transport, rail transport, road freight, and postal services) for the entire period 1990-2008. The longer time span of this series makes it better suited to a panel study. Nevertheless, the two series are strongly correlated with a correlation coefficient equal to 0.50 and significant at the 1% level (see On Line Appendix A for details of both measures of regulation).

Figure 1 presents the relationships between our main variables in differences between their averages in the final and initial periods (resp., 2004-08 and 1990-94). The average commodity tax and product market regulation levels (based on the ETCR measure) for country i's trade partners ($CTAX_{-i}$, PMR_{-i}) are obtained by weighting trade partners according to the weights ω_{ij} presented in the previous section. Panel a plots $CTAX$ against $CTAX_{-i}$. In this panel, country observations are scattered across their whole range but the fitted line is rather flat. This suggests that each country's commodity tax is not correlated with its trade partners' average commodity tax. Panel b plots $CTAX$ against PMR. It

[15] 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 A describes the data sources and the construction of variables. It also presents our control variables and/or the variables used for the robustness checks.

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 c plots PMR against PMR_{-i}. It shows a positive correlation between the two variables which is consistent with the view that a country is more likely to deregulate if its trade partners deregulate.

Figure 2: Introduction of a VAT system and commodity taxes in trade partner countries



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

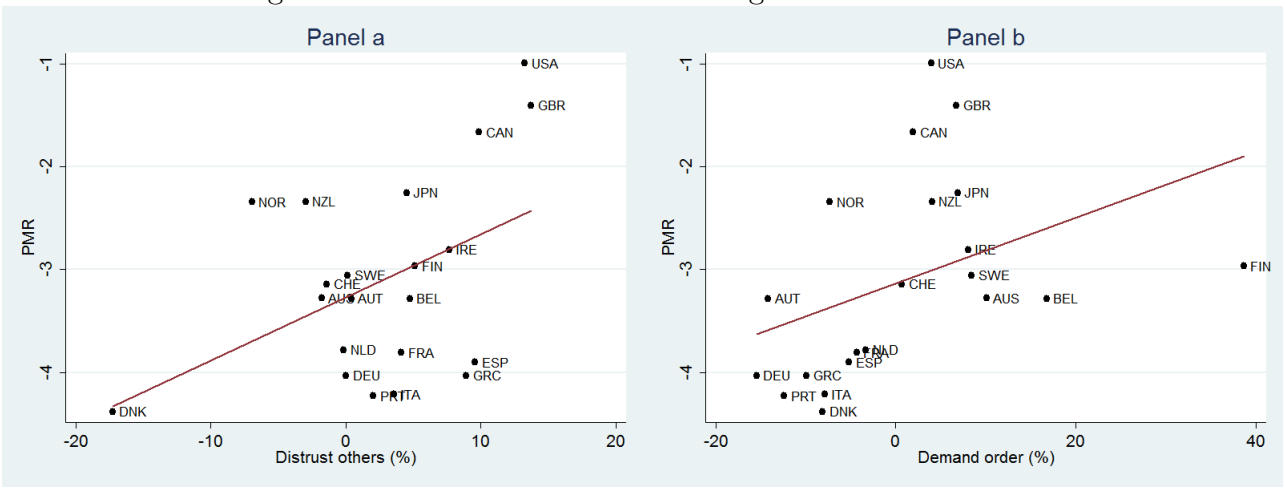
We now describe the variables we use as instruments. To instrument $CTAX_{-i}$ in equation (20), we exploit the variation associated with the introduction of a VAT system in trade partner countries. We construct a dummy variable equal to 1 if a VAT system is at work in country i at time t and zero otherwise. We then apply the weights ω_{ij} and construct a weighted average VAT_{-i}, which includes both cross-section and time variations (see table B-1 in On Line Appendix B). Figure 2 plots $CTAX_{-i}$ against VAT_{-i}, taking variables in differences between the averages in the 2004-2008 and 1990-1994 periods. The figure shows that VAT_{-i} is positively correlated with $CTAX_{-i}$. This suggests that the introduction of a VAT system in each trade partner country induces an increase in their commodity tax rates. This is consistent with the view that VAT systems are more efficient than general sales tax or consumption-based tax systems (Kato [26]).

To instrument PMR in equation (20) and PMR_{-i} in equation (21), we construct two measures for the demand for regulation in each country using the last four waves of the *World Value Survey* (WVS) and the last three waves of the *European Value Study* (EVS). The first measure is the percentage of respondents who answer '*Can't be too careful*' to the

question: '*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?*'. The second measure is the percentage of individuals who respond '*maintaining order in nation*' to the question: '*There is a lot of talk these days about what the aims of this country should be for the next ten years, ... If you had to choose, which of the things on this card would you say is most important?*' We take the averages by country over the 1990-1994, 1995-1999, 2000-2004 and 2005-2008 periods and obtain two time-varying measures of demand for regulation.[16]

Figure 3 plots PMR against the indicators of distrust (Panel a) and demand for order (Panel b). Again, the variables are taken in differences between their averages in the 2004-2008 and 1990-1994 periods. The two figures confirm a positive correlation between PMR and our measures of demand for regulation, as suggested by Aghion *et al.*, and Inglehart [25]. The two correlations are significant at the 1% level.

Figure 3: Indicators of demand for regulation and PMR.

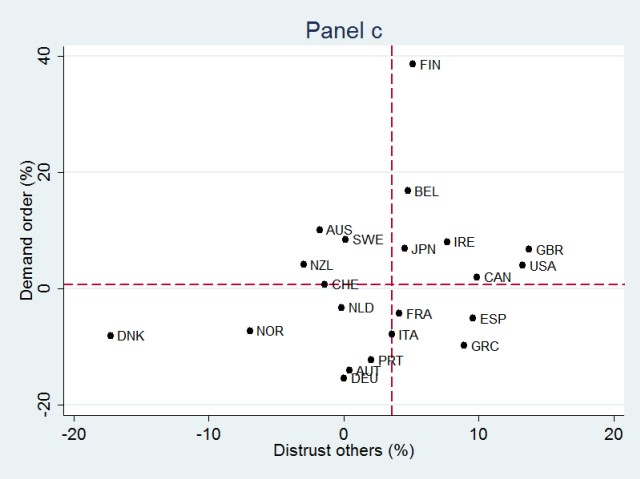


Notes: Differences between country averages over the periods 2004-2008 and 1990-1994. Authors' calculation on EVS/WVS data.

Finally, figure 4 plots the percentages of individuals who demand order and those who do not trust other people, in differences between the final and initial period averages. The dashed lines denote the sample medians of the changes in the two measures between 1990 and 2008. Figure 4 shows that country observations are dispersed across the four quadrants of the graph. This highlights heterogeneity in country behaviors and the absence of common

[16]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. (See On Line Appendix A for details).

Figure 4: Distrust versus demand for order.



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

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),[17] and in other countries there was 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).[18] The bottom left panel includes countries that experienced successful welfare and workfare reforms inspired by the "flexicurity" principle in the 1990s (e.g. Denmark, Norway and Germany). Finally, the bottom right panel includes

[17] 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.

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

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).[19]

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

4.3 Baseline Results

Table 1 reports our baseline estimates of the commodity tax response function (20) in Panel *a* and the regulation response function (21) in Panel *b*. In each panel, we present a first set of estimates in Columns [1]-[3], based on number of days to start up a business as a measure of product market regulation, and a second set of estimates in Columns [4]-[6], where we use the ETCR measure. Each set of estimates includes a simple OLS model (Columns [1] and [4]), an OLS model with fixed effects (Columns [2] and [5]), and a two stage least squares (2SLS) model with fixed effects (Columns [3] and [6]).

We start by commenting on the coefficient of $CTAX_{-i}$ in the commodity tax response function in Panel *a*. The OLS estimates in Columns [1] and [4] show a positive coefficient, significant at the 1% level, which provides prima facie evidence in favor of commodity taxes being strategic complement policies. However, this evidence disappears when we add the country fixed effects (Columns [2] and [5]). This suggests that the coefficient of $CTAX_{-i}$ in the OLS estimates reflects time-invariant characteristics determining commodity taxes in both the domestic country and its trade partners, which are controlled for through the inclusion of the country fixed effects.[20] In Columns [3] and [6], we present the 2SLS esti-

[19]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.

[20]The negative significant coefficient of $CTAX_{-i}$ in Column [5] is driven by omitted variables associated with the economic turmoil during 1990-1997, which followed the reunification of Germany, the European Monetary System crisis, and the systemic banking crises in Finland, Sweden and France (Kovzanadze,

mates.[21] Econometric tests confirm that the instruments are sufficiently correlated with the endogenous regressors in the first stage and provide valid exclusion restrictions in the second stage.[22] The coefficient of $CTAX_{-i}$ in Columns [4] and [6] remains not significantly different from zero. This allows us to conclude the absence of strategic interactions in commodity taxation.

We next discuss the coefficient of PMR in the commodity tax response function in Panel *a*. The OLS estimates show a non-significant coefficient in Column [1], and a negative coefficient, significant at the 1% level in Column [4]. Results remain stable in Columns [2] and [5] where we include the country fixed effects. 2SLS estimates in Columns [3] and [6] show that in both specifications the coefficient of PMR is negative and significant at the 1% level. This evidence suggests that high product market regulation in a country induces lower commodity taxes in that country.[23] In relation to the controls, note the positive significant coefficient of VAT in Columns [4]-[6]. This is consistent with the view that the introduction of a value-added system of commodity taxation increases the efficiency of commodity taxation, raising the effective tax rate on consumption by about 0.7 percentage points after the inclusion of country fixed effects (See table B-2 in On Line Appendix for the full set of controls).

Panel *b* reports the estimates of the regulation policy response function (21). As in Panel *a*, Columns [1]-[3] report the estimates of PMR based on the number of days to start up,

[29]). Governments hit by these shocks simultaneously increased their spending without increasing their tax revenues. This is reflected by a spatially correlated decrease in effective tax rates which provides false evidence of strategic interaction. The results of the robustness checks are available from the authors upon request.

[21] As mentioned above, due to lack of VAT reforms during 2002-2008, for 2SLS estimates in column [3] we use trade partners' average population and government expenditure on final consumption as instruments for $CTAX_{-i}$ (see Lockwood and Migali [32]).

[22] The K-P weak identification statistics approach the critical values associated with a maximum size distortion of the Wald test of 25% (Stock and Yogo [46]). These distortions imply that we may be too quick to conclude that the endogenous tax regressors are statistically significant in instrumental variables estimates. In the robustness checks we discuss how this apparently large distortion is due to the large number of controls reducing the power of the instruments in the baseline specification: More parsimonious specifications reduce the size of the maximum distortion to reassuring levels (e.g. to 10%. compare Stock and Yogo [46], Table 5.2), without affecting our main results.

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

while Columns [4]-[6] display those based on ETCR. OLS estimates in Columns [1] and [3] show a positive coefficient of PMR_{-i}, significant at the 1% level which suggests strategic complementarity in product market regulation policies. However, the positive effect of PMR_{-i} vanishes in Column [2], and becomes smaller in Column [4], once we account for the country fixed effects. This suggests that evidence of strategic complementarity in regulation policies in the OLS estimates partly reflects time-invariant unobserved characteristics which determine product market regulations in trade partners (e.g. common legal origins). Columns [3] and [6] present the 2SLS estimates. Econometric tests confirm that the instruments are strongly correlated with the endogenous regressors in the first stage and provide valid exclusion restrictions in the second stage. The coefficient of PMR_{-i} is now positive, large, and significant at the conventional levels in both Columns [3] and [6]. The coefficient in Column [6] is below 1, which ensures stationarity in the spatial lag model. Among the controls, the shares of people who distrust others and demand order are significant and take a positive sign, in line with Aghion et al. [1] and Inglehart [25] (see table B-2 in On Line Appendix for the full set of controls).

It is instructive to discuss the economic magnitude of the effects of both local regulation on local commodity tax and of trade partners' regulation on local regulation. For this purpose, we use the 2SLS estimates in Column [6] as a benchmark, and interpret the coefficient of PMR in terms of the days to start up a business, which is a more intuitive dimension of product market regulation. Over the 2002-2008 period, for which the ETCR and days to start up measures are both available, the two measures are strongly correlated and have standard deviations of 0.56 (on a scale of 0 to 6) and 20 (days), respectively. Thus, the number of days to start up a business corresponding to the standard deviation of ETCR over the 1990-2008 period (i.e., 1.49) can be approximated by $1.49 * 20/0.56 \approx 53$ (days). This is about one-third of the decrease in the days to start up a business achieved during the 1990s' EU deregulation waves. Taken at face value, the 2SLS estimate in Panel *a* suggests that a deregulation wave that cuts 53 days to start up a business raises the effective commodity tax rate by $(-0.47 * -1.49 =)$ 0.70 percentage points. The 2SLS estimate in Panel *b* also implies that a country will cut its days to start up a new business by $(53 * 0.46/1.49 \approx)$ 16 days in response to a deregulation wave in trade partner countries which cuts their days to start up by 53 days.

To sum up, the estimates in table 1 highlight three main results. First, we find no evidence of strategic interaction in commodity taxation under the destination principle. Second, we

establish a negative impact of product market regulations on the level of commodity taxes in a country. Third, we reveal strategic complementarity in regulation policies between trade partners. The first result adds to the previous work on strategic complementarity in commodity taxation under the origin principle (Lockwood and Migali [32]). In terms of our theoretical model, the second result provides indirect evidence that the demand for public goods is more sensitive to income than the demand for private goods. This is in line with Wagner's law, which implies that the development of an industrial economy is accompanied by an increased share of public expenditure in the gross national product (see Peacock and Wiseman, [44], for an application to the U.K.). The third result can be interpreted in terms of our theoretical model as indirect evidence of a weak taste for variety. This is consistent with empirical findings in Hummels and Klenow [24] and Ardelean [5].

5 Sensitivity Analysis

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

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

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

Lockwood and Migali [32]). Finally, the use of placebo weights eliminates the strategic interactions we found in the baseline estimates. This confirms that complementarities in regulation, and absence of interaction in commodity taxes stem directly from the matrix based on bilateral trade relationships.

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

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

Finally, we performed an additional battery of robustness checks. We run a more parsimonious specification, which includes only country and time fixed effects. This increases the correlation of the instruments in the first stage to reassuringly high levels (i.e. to a maximum distortion of the 2SLS size below 10% (see Stock and Yogo [46])) but also introduces some omitted variables in the estimates. We control for any unobserved heterogeneity associated with asymmetric shocks and changes in social preferences (i.e. tax morale). We show that this is not a concern in our estimates. We also carried out some sensitivity analysis with respect to the estimated impact of product market regulation in the commodity tax response function i.e. to distinguish the effects of domestic and foreign regulation and assuming regulation is exogenous. Our results hold in both cases. Finally, we show that our baseline results hold in this medium-run perspective by running regressions on five-year periods.

6 Conclusion

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

are strategic complements as long as consumers do not value product variety too highly. Third, regulation has a negative impact on commodity tax rates if the demand for public goods is more sensitive to income than the demand for private goods. In the empirical part of the paper, we specify an empirical model to estimate the direction of the forces described by the theory using data on OECD countries. We find evidence supporting the absence of strategic tax interactions, the presence of strategic complementarity in regulation policies, and a negative impact of regulation on commodity taxes. More specifically, taken at face value, our estimates suggest that a domestic deregulation process that reduces firms' start up time by 53 days leads to a rise in the effective commodity tax rate of 0.70 percentage points and triggers a deregulation process of about 16 days for startup in trade partner countries. Overall, these magnitudes are non-negligible considering that EU countries reduced firms' start up time by an average of 160 days in the 1990s.

Finally, our results shed light on the relationship between the various policies of trading partners. First, (de)regulation policies significantly change the magnitude of the tax revenues collected through consumption taxes. This is particularly important as commodity taxation remains an important public finance instrument, particularly in the EU. Our research suggests that the deregulation of commodity markets leads to an increase in commodity tax revenues. Our findings suggest also that foreign deregulation has an indirect impact on domestic tax revenues because it leads domestic governments to deregulate, and therefore, to raise their effective tax rates and revenues.

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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Table 1: Commodity tax and regulation regulation response functions

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

Notes: Controls in all specifications are reported in table B-2. In panel a $CTAX_{-i}$ is instrumented by average government consumption, and average population in trade partners in Column [3] and VAT_{-i} Column [6]. PMR (lagged one year) is instrumented by preferences for order and distrust (lagged five years) in Column [3] and Column [6]. In panel b, PMR_{-i} is instrumented by five year lags of preferences for order and distrust in the trade partner in Columns [3] and [6], and instruments for $CTAX_{-i}$ in Panel a are included in the vector of controls. Robust standard errors are in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

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Appendix A Demand under delivery uncertainties.

In this appendix we suppose that delivery uncertainty symmetrically affects the varieties so that the probabilities of home and foreign varieties (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

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

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

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

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

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

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

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

Under the assumption of symmetric delivery uncertainty, the probability of the variety ω to be delivered is the same for all varieties 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 varieties $n\theta$. 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 varieties $\omega \in (n, n+n^*]$. 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

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

Now, since varieties 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

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

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 variety

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

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

Appendix B Sign of $\frac{\partial C_0}{\partial n}$ and Proposition 3

Since the utility function of a consumer V is an increasing function of C, to investigate the sign of $\frac{\partial C_0}{\partial n}$ is equivalent to study when $\frac{\partial \ln C_0}{\partial \ln n} > 0$ is true. We compute

$$\frac{\partial \ln C_0}{\partial \ln n} = \frac{1}{(\sigma-1)}\left(1 - \frac{1}{\sigma}\frac{1}{1+\frac{\theta}{\theta^*}\left(\frac{n}{n^*}\right)^{\frac{1}{\sigma}}}\right) + \xi\frac{1}{1+\left(\frac{n}{n^*}\right)^{-1}}.$$

Whenever the number of domestic firms n does not depart far from the number of foreign firms n^* we have that

$$\frac{\partial \ln C_0}{\partial \ln n} = \frac{1}{(\sigma - 1)} \left(1 - \frac{1}{2\sigma}\right) + \frac{1}{2}\xi = \frac{1}{2\sigma} > 0.$$

Proof Proposition 3:

Finally, for the optimal regulation decision, we need to check

$$\frac{\partial \ln C_0}{\partial \ln n} + \frac{\partial \ln C_0}{\partial \ln \theta} \frac{\mathrm{d} \ln \theta}{\mathrm{d} \ln n} = 0$$

We compute

$$\frac{\mathrm{d} \ln \theta}{\mathrm{d} \ln n} = \frac{-\varphi n}{1 - \varphi n} < 0$$

and

$$\frac{\partial \ln C_0}{\partial \ln \theta} = \frac{\sigma}{\sigma - 1} \left(1 - \frac{1}{\sigma} \frac{1}{1 + \frac{\theta}{\theta^*} \left(\frac{n}{n^*}\right)^{\frac{1}{\sigma}}}\right)$$

At the symmetric equilibrium this yields

$$\frac{\partial \ln C_0}{\partial \ln \theta} = \frac{\sigma}{\sigma - 1} \left(1 - \frac{1}{2\sigma}\right) > 0$$

Thus,

$$\frac{\partial \ln C_0}{\partial \ln n} \Big/ \frac{\partial \ln C_0}{\partial \ln \theta} = \frac{1}{\sigma} \frac{\sigma - 1}{2\sigma - 1} > 0$$

Those values can be used to get (17).

Appendix C 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.[24]

[24]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 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.

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 [23] for details):

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

Results of the OLS estimates are reported in table C-1. From the estimated coefficients, we reconstruct the predicted imports' flows $\widehat{Imp_{ij}}$[25] and construct from it the exogenous weight as $\omega_{ij} = \frac{\widehat{Imp_{ij}}}{\sum_{i \neq j} \widehat{Imp_{ij}}}$. Table C-2 displays the weighting matrix.

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

Table C-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 C-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 C-1.

Appendix D Sensitivity analysis

Table D-1: Alternative weighting schemes

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

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

Table D-2: Simultaneous equations models - domestic equations

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

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

Table D-3: Statutory VAT rates

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

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

Table D-4: Alternative timing

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

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

Table D-5: Alternative specifications

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

Notes: 2SLS estimates with robust standard errors in parentheses. PMR are measured in seven non-manufacturing industries (ETCR). Most specifications in panel a,b include the same set of controls as in Table 1. Exceptions are: Column [1] where we use only country and time dummies; Column [2] where we use country specific time trends instead of country fixed effects; Column [3] where we include the output gap; Columns [4] where we add a control for trade openness; Column [5], where we include a control for tax morale; Column [6], panel a, where we replace $CTAX_{-i}$ by $ETCR_{-i}$ and instrument it by the five years lags of $OrderNation_{-i}$ and $DisTrust_{-i}$. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

On Line Appendix of "Commodity Taxation and Regulatory Competition"

(Not for publication)

A Data

The main variables of interest are drawn from the OECD International Regulation Database; the OECD National Accounts and Revenue Statistics; the World Value Survey and the European Value Study. The other variables used in the analysis as controls or for robustness checks come from multiple sources: the OECD Economic Outlook; the World Bank's Database on Political Institutions (DPI), World Development Indicators (WDI) and Doing Business (DOBUS); the International Monetary Fund's Direction of Trade Statistics (DOTS); and the CEPII Gravity Dataset (CEPII). The reader can find a precise description of the variables below.

ETCR: we restrict our attention on the 'low level' ETCR indicator which measures the barriers to entry of new firms in seven non-manufacturing industries: electricity, gas, air passenger transport, rail transport, road freight, and postal services. In the *energy sector* indicators for entry regulation focus on terms and conditions for third party access (TPA) and the extent of the supplier's choice of consumers. Entry regulation in *rail transport services* distinguishes i) free entry (with access fees to the rail network infrastructure), ii) franchising to several firms, and iii) franchising to a single firm. Entry regulation in *passenger air transport services* covers, on the domestic side, the liberalization of internal routes and, on the international side, participation in an agreement liberalizing access to routes within a region. Entry regulation in *road freight* looks at more subtle ways in which entry can be thwarted in this eminently competitive sector: Through a restrictive or discretionary licensing system, and through the intervention of incumbents in decisions concerning entry or price setting. In the *communication sector*, indicators for entry regulation are based on legal limitations on the number of competitors allowed in each of the post and telecommunications markets covered by the analysis (see Conway and Nicoletti [14] for further details).

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

CTAX: We followed the methodology in Carey and Rabesona [11] who compute effective

tax rates relating the tax revenues to the relative tax base. We thus apply the following formula

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

where:

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

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

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

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

Notice that (A-1) is different from the definition proposed by Carey and Rabesona [11] in that it excludes those revenues which are most likely not to depend on value added taxation, and to reflect the application of the origin principle to consumers' transactions. So the definition of $CTAX$ excludes excise taxes, profits of fiscal monopolies, customs and import duties and taxes on specific services.

Demand for order, Distrust others: *Demand for order* is constructed as the percentage of respondents who answered 1 (i.e., 'maintaining order in nation') to questions E003 in WVS1-5, V201 in EVS4, V190 in EVS3, Q532A in EVS2, V460 in EVS1. *Distrust others* is constructed as the percentage of respondents who answered 2 (i.e., 'Can't be too careful') to questions A165 in WVS1-5, V62 in EVS4, V66 in EVS3, Q241 in EVS2, V208 in EVS1. We assigned country observations for the available years to five periods, each corresponding broadly to the intended coverage of a EVS/WVS wave. Alternative measures of Distrust are the percentage of respondents who indicated 4 (i.e., 'none at all') to questions $E069\_8$ in WVS1-5, V212 in EVS4, V207 in EVS3, q553i in EVS2, v546 in EVS1 (how much confidence in civil service) and the percentage of respondents who indicated 4 (i.e., 'none at all') to questions $E069\_13$ in WVS1-5, v219 in EVS4, 027 in EVS3, q554K in EVS2, v547 in EVS1 (how much confidence in major companies). The period is as follows:

1980-89: coverage by EVS1/WVS1 but for CHE, CZR and SLK covered by EVS2. Surveys carried in 1981 for AUS, BEL, DEU, DNK, ESP, FIN, FRA, GBR, IRE, JPN, NLD; 1982 for CAN, HUN, NOR, KOR, NOR, SWE, USA; 1984 for ICE and 1989 for CHE, CZR, POL, SLK.[26]

[26]Data for former Czechoslovakia actually refer to 1990 but we decided to assign them to this period as 1990 in these countries is still representative of pre-transition (transition in former Czechoslovakia began in

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

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

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

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

Observations were averaged by country and period resulting in an unbalanced panel of (up to) 27 countries for the period 1990-2008 in five year averages. Missing observations were obtained by linear interpolation. The initial observation covering the period 1980-89, was not used in the empirical analysis but allows to obtain the observation of the period 1990-94 through linear interpolation rather than extrapolation for countries with missing observations for this period.

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

Other variables used in the analysis:

Euro: Dummy variable equal to 1 if the country enters the European Monetary Union.

1991).

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

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

GDP: GDP, current US dollars (World Bank's WDI).

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

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

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

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

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

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

Tax Morale: percentage of respondents indicating 8-10 (i.e. 'always') to the question 'do you think it is justifiable to cheat on taxes' (WVS/EVS).

Variables used for the construction of the weights

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

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

smctry: dummy equal to 1 if countries were the same country in the past (e.g. result of political secession) (CEPII gravity dataset).

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

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

legorig: dummy equal to 1 if countries have a common legal origin.

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

distwces: distance between the most important cities/agglomerations (in terms of population) of the two countries weighted by the share of the city in the overall country's

population, with sensitivity of trade flows to bilateral distance equal to -1 (CEPII gravity dataset).

B Ancillary tables

Table B-1: Means and standard deviation of VAT_{-i}

Trade partners of:	**mean**	**sd**
Australia	0.59	0.02
Austria	0.90	0.05
Belgium	0.94	0.02
Canada	0.29	0.01
Switzerland	0.94	0.00
Germany	0.87	0.06
Denmark	0.89	0.02
Spain	0.77	0.02
Finland	0.86	0.02
France	0.85	0.04
UK	0.70	0.03
Greece	0.85	0.02
Ireland	0.82	0.02
Italy	0.87	0.05
Japan	0.68	0.04
Netherlands	0.93	0.02
Norway	0.86	0.03
New Zealand	0.54	0.06
Portugal	0.85	0.02
Sweden	0.85	0.05
USA	0.97	0.07
Total	0.80	0.16

Notes: Average of the VAT dummy across each country's trade partner, weighted by the predicted import shares reported in Table C-2.

	[1] OLS	[2] OLS FE	[3] 2SLS FE	[4] OLS	[5] OLS FE	[6] 2SLS FE
Panel a: Commodity tax response						
Total population	–0.03***	–0.07**	–0.05	–0.02***	–0.04***	–0.02**
	(0.00)	(0.03)	(0.07)	(0.00)	(0.01)	(0.01)
GDP per capita	0.09***	0.17**	0.91***	0.01	0.23***	0.25***
	(0.02)	(0.09)	(0.26)	(0.03)	(0.02)	(0.04)
Rightwing government in office	–0.69*	–0.04	0.26	–0.63***	0.02	0.01
	(0.37)	(0.11)	(0.23)	(0.22)	(0.08)	(0.09)
Government consumption	0.40***	–0.17**	–0.08	0.45***	0.12***	0.13***
	(0.06)	(0.08)	(0.13)	(0.04)	(0.03)	(0.03)
Real interest rate	1.04***	–0.04	–0.08	0.18***	–0.21***	–0.21***
	(0.19)	(0.14)	(0.20)	(0.07)	(0.03)	(0.03)
Real exchange rate	0.01	–0.01	–0.00	–0.05***	0.00	0.00
	(0.04)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Member of European Union				–0.64	0.19	–0.21
				(0.53)	(0.28)	(0.34)
Member of EURO area				0.14	–0.33***	–0.53***
				(0.32)	(0.12)	(0.14)
Applies European VAT with hybrid DP/OP				0.35	–0.47***	–0.54***
				(0.40)	(0.17)	(0.19)
Panel b: Regulation response						
Total population	0.04	1.63***	0.39	–0.00***	0.03***	0.03***
	(0.03)	(0.60)	(0.64)	(0.00)	(0.00)	(0.00)
GDP per capita	–1.76***	8.98***	5.74**	–0.01	0.09***	0.10***
	(0.40)	(2.19)	(2.30)	(0.01)	(0.02)	(0.02)
Rightwing government in office	3.05	8.09**	8.76***	–0.11*	–0.12**	–0.12**
	(3.09)	(3.16)	(3.26)	(0.07)	(0.05)	(0.05)
Government consumption	–1.59***	–1.82	–0.50	–0.06***	0.05*	0.04
	(0.50)	(1.70)	(1.59)	(0.01)	(0.03)	(0.02)
Real interest rate	–8.13***	1.55	0.08	–0.02	0.01	0.01
	(1.24)	(2.47)	(2.29)	(0.02)	(0.02)	(0.02)
Real exchange rate	–0.41**	0.04	–0.18	–0.00	–0.01**	–0.01**
	(0.18)	(0.17)	(0.20)	(0.00)	(0.00)	(0.00)
Member of European Union				0.02	0.19	0.17
				(0.18)	(0.19)	(0.18)
Member of EURO area				–0.06	–0.50***	–0.53***
				(0.11)	(0.11)	(0.10)
Applies a VAT system				–0.01	–0.39**	–0.38**
				(0.14)	(0.16)	(0.15)
Applies European VAT with hybrid DP/OP				–0.28	–0.31**	–0.32**
				(0.18)	(0.14)	(0.13)

Notes: These are the coefficients of the control variables in the estimates reported in table 1. Estimates in

Table B-3: Simultaneous equations models - trade partners' equations

	[1] **SUR**		[2] **SUR, FE**		[3] **3SLS, FE**	
	$CTAX_{-i}$	PMR_{-i}	$CTAX_{-i}$	PMR_{-i}	$CTAX_{-i}$	PMR_{-i}
CTAX	0.03***		–0.04***		–0.01	
	(0.00)		(0.01)		(0.01)	
PMR_{-i}	0.36***		–0.16***		–0.49***	
	(0.06)		(0.05)		(0.09)	
VAT_{-i}	–0.65		0.51**		0.90**	
	(0.50)		(0.21)		(0.21)	
PMR		0.25***		0.08***		0.13***
		(0.02)		(0.01)		(0.01)
Demand order (%) $-i$		0.02***		0.02***		0.02***
		(0.01)		(0.00)		(0.00)
Distrust others (%) $-i$		–0.05***		0.06***		0.05***
		(0.01)		(0.00)		(0.00)
N	389	389	389	389	389	389

Notes: Foreign counterparts of SUR and 3SLS estimates of the four equations system with four endogenous variables ($CTAX$, PMR, PMR_{-i}, PMR_{-i}). estimates for the domestic country are reported in table D-2. Robust standard errors in parentheses. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Table B-4: Additional controls for the estimates with alternative specifications

	[1]economic cycle	[2]trade openness	[3]tax morale	[4]regulation competition
Panel a: Commodity tax response				
Output gap	0.01			
	(0.03)			
Trade-to-GDP ratio		0.01		
		(0.01)		
Tax morale			–0.01**	
			(0.00)	
PMR_{-i}				-0.00
				(0.23)
Panel b: Regulation response				
Output gap	–0.05***			
	(0.02)			
Trade-to-GDP ratio		0.00		
		(0.00)		
Tax morale			0.01**	
			(0.00)	

Notes: 2SLS estimates with robust standard errors in parentheses. Column [1] in the present table completes the estimates presented in table D-5, Column [3]; Column [2] in the present table completes the estimates presented in table D-5, Column [4]. Column [3] in the present table completes the estimates presented in table D-5, Column [5]. Column [4] in the present table completes the estimates presented in table D-5, Column [7] Significance levels: $*$: 10% $**$: 5% $***$: 1%.

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