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Título

The Political Economy of Fiscal Capacity Building

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Abstract: Presento una teoría sobre el desarrollo y la consolidación de la capacidad fiscal de los estados, entendida ésta como la capacidad de gravar las rentas privadas al tipo impositivo deseado. La teoría parte del uso de políticas proteccionistas como principal instrumento de recaudación tributaria cuando el estado es débil. A partir de esta regularidad empírica, evalúo las condiciones bajo las cuales los ingresos fiscales derivados de las política proteccionistas son reinvertidos en mejorar la capacidad fiscal del estado. El análisis sugiere que la reinversión depende en último término de las condiciones económicas iniciales, así como del grado de captura del sistema político. Esto es, cuál es la influencia de los sectores protegidos en el diseño de la regulación económica. La teoría se desarrolla en dos partes. En el primer bloque de la tesis, identifico las condiciones bajo las cuales se intercambian barreras proteccionistas por un mayor cumplimiento fiscal por parte de las empresas protegidas. El análisis sugiere que el stock inicial de capacidad fiscal y la competitividad de la empresa protegida deben ser simultáneamente bajos para que el intercambio de Protección por Cumplimiento Fiscal sea un equilibrio estable. Las predicciones derivadas del análisis teórico son testadas con datos industriales a dos niveles. En primer lugar, llevo a cabo un análisis comparado de 25 sectores manufactureros en 32 economías emergentes en Latinoamérica y las repúblicas de la antigua Unión Soviética. En segundo lugar, estudio en detalle la incidencia de la hipótesis de trabajo explotando datos a nivel de empresa en dos economías con niveles de capacidad fiscal opuestos dentro de la misma región económica: Chile y Bolivia. En su conjunto, los resultados indican que en contextos de baja capacidad fiscal, la protección frente a competidores superiores puede estimular el cumplimiento fiscal de los sectores protegidos. La segunda parte de la investigación evalúa las condiciones bajo las cuales los ingresos fiscales derivados del intercambio de Protección por Cumplimiento Fiscal son reinvertidos en la expansión del stock de capacidad fiscal de la economía, así como los efectos sobre la utilidad social de dicho intercambio. Los resultados apuntan que la Protección a cambio de Cumplimiento Fiscal es subóptimo en el largo plazo para estados cuyo stock inicial de capacidad fiscal es muy bajo o muy alto, y óptimo para estadios intermedios. Sólo para estos últimos, podemos esperar que las economías transiten

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THE POLITICAL ECONOMY OF FISCAL CAPACITY BUILDING

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Esta obra se presentó como tesis doctoral en el Departamento de Ciencias Políticas de la New York University (NYU) el 4 de septiembre de 2012. El Tribunal estuvo compuesto por los profesores doctores Adam Przeworski (chair), Nathaniel Beck, Isabela Mares, Shanker Satynath y David Stasavage.

Dídac Queralt es licenciado en Ciencias Políticas por la Universitat Pompeu Fabra (UPF). Formó parte de la decimoctava promoción de estudiantes del Centro de Estudios Avanzados en Ciencias Sociales del Instituto Juan March de Estudios e Investigaciones, donde obtuvo el título de Máster en 2007. Realizó su tesis doctoral en el Centro y en la New York University bajo la dirección del Prof. Adam Przeworski.

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ABSTRACT

I present a theory of the development and consolidation of fiscal capacity, defined as the state's capacity to tax private income. The theory acknowledges the use of protectionist policy as a means to raise tax revenue when fiscal capacity is weak. From this starting point, I evaluate the conditions under which tax revenue derived from protectionist policy is re-invested in enhancing the fiscal capacity of the state. The analysis suggests that re-investment ultimately depends on the initial conditions of the economy and the extent of policy capture in the political system.

The theory is developed in two steps. In the first part of the dissertation, I identify the conditions under which protectionist policy is granted in exchange for higher tax abidance by domestic industry. The analysis suggests that the initial endowment of fiscal capacity as well as the productivity of domestic industry must be simultaneously low for this institutional solution to be an equilibrium. The predictions derived from the theoretical analysis are tested twofold, using cross-national and country-specific data.

The second part of the dissertation evaluates the conditions under which the additional tax revenue derived from Protection-for-Tax- Compliance is reinvested in extending the fiscal capacity endowment of the economy. The results suggest that Protection-for-Tax-Compliance is detrimental for states whose state capacity is too weak or too strong to begin with but optimal for intermediate levels. For intermediate values only, economies endogenously switch from a protectionist equilibrium with low fiscal capacity and obsolete industry to a free-trade equilibrium with high fiscal capacity and competitive industry. On the contrary, if Protection-for-Tax-Compliance is adopted when fiscal capacity is too weak (or policy capture is pervasive), no re-investment takes place and the economy eventually falls into a poverty trap characterized by weak fiscal capacity and obsolete industry. Overall, Protection-for-Tax-Compliance is proved to maximize aggregate welfare in the short- and long-run only when the initial stock of fiscal capacity is intermediate. Ultimately, the theory presented in this dissertation emphasizes the role of political survival inter-temporal dilemmas once applied to state capacity building.

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CHAPTER 1. INTRODUCTION

This dissertation presents a theory of fiscal capacity building grounded on the strategic use of protectionist policy to encourage tax compliance by domestic producers. Specifically, I evaluate the conditions under which tax revenue collected from this strategy is reinvested in expanding the fiscal capacity of the state. Fiscal capacity refers to the capacity to tax private income. "[It] involves the administrative capacity to monitor and enforce tax payments and the institutions necessary to implement income-tax withholding by firms" (Besley and Persson, 2011).

This dissertation seeks to bridge two strands in the literature of fiscal capacity: one which evaluates the strategies to maximize tax revenue in the short-run (Congleton and Lee, 2009; Desai and Olofsgård, 2011; Gehlbach, 2008; Hibbs and Piculescu, 2010); and another which studies the expansion of fiscal capacity in absence of war and external threats (Acemoglu, 2005; Acemoglu et al., 2011; Arias, 2009; Battaglini and Coate, 2008; Besley and Persson, 2009, 2010, 2011).[1] Building on these works, I evaluate how strategies intended to maxi-

[1]There exists a third strand in the research on fiscal capacity organized around the *Tilly-hypothesis*, by which war ignites state building (Centeno, 2002; Herbst, 2000; Thies, 2005; Tilly, 1990).

mize taxation in the short-term might affect decisions over long-term institutional investment in fiscal capacity. As far as I know, this is the first work that analyzes the short- and long-term approaches of fiscal capacity simultaneously.

Until World War I, many developed economies resorted to protectionist policy as a means to raise revenue from foreign producers penetrating the national market (Congleton and Lee, 2009; Irwin, 2002; Tanzi, 2007); still today, some developing economies make use of this institutional solution as a source of government revenue (Baunsgaard and Keen, 2010). This dissertation acknowledges the revenue potential of protectionist policy but identifies a complementary mechanism by which revenue might be generated. Specifically, I claim that protectionist policy (and more generally, entry barriers) can be strategically allocated by government to induce tax compliance by uncompetitive *domestic* producers which would not survive competition in the open market.[2] In addition, as long as the stock of fiscal capacity is sufficiently low, this exchange is proved to be socially optimal. This result implies: First, that the standard dichotomy between *revenue* and *protectionist* tariffs does not always apply.[3] Protectionist tariffs (or any other protectionist instrument) might produce revenue too, but from *domestic* producers instead. Second, results imply also that protection to domestic producers is not necessarily for *sale* (Grossman and Helpman, 1994) but might result from tax compliance. Certainly, political giving is proved to relax the effective tax rate implemented under protection but does not necessarily

[2] The consideration of open market competition, later formalized as *Schumpeterian competition*, distinguishes my theory from classic work on mercantilism (Ekelund and Tollison, 1981).

[3] See Irwin (2002) for a review of both types.

prevent protected firms from paying higher tax rates than those implementable by coercive means only.[4] Altogether, *Protection-for-Tax-Compliance*, as I refer to this exchange, is proved to be an effective strategy to raise tax revenue from domestic industry in absence of rent-seeking by government or costly investment in fiscal capacity.

The Protection-for-Tax-Compliance hypothesis is tested with cross-national data and two single-country analyses, Chile and Bolivia, which vary in their stock of fiscal capacity. The results, based on observational data, seem consistent with the hypothesis, both when I exploit variation in fiscal capacity across countries or within them.

Once the research hypothesis is backed by empirical evidence, I evaluate the incentives to reinvest the proceeds stemming from this *revenue generating policy* (Levi, 1988). The additional proceeds can be funneled by the political authority to self-consumption, public spending or institutional investment. I assess when each possibility takes place and how this decision structures the incentives of protected industry to catch up with superior competitors. Specifically, the dynamic analysis of Protection-for-Tax-Compliance claims that fiscal capacity investment takes place under very restrictive conditions: not only must the institutional investment cost be low, as one would presume, but induced-innovation costs assumed by protected producers must be mild too. Indeed, the dynamic analysis suggests that fiscal capacity expansion itself depends on the technological distance between the domestic firms and foreign competitors. When

[4] See Paper 1 for exact details.

the technological distance is large, the negative impact of innovation costs on short-term labor consumption might be too big for fiscal capacity investment to pay off. Here lies, in essence, the source of the inter-temporal trade-off of institutional investment. Both investment and innovation costs must be simultaneously low for rulers to invest in long-term fiscal capacity building. If these two conditions are not simultaneously satisfied, not even a welfare utility-maximizing ruler would expand the fiscal capacity of the state. In that case, the economy would eventually fall into a poverty trap characterized by weak-fiscal capacity and a low-income level. If, on the contrary, both conditions are met, the ruler invests in fiscal capacity and the producer assumes the cost of innovation. Eventually, the economy switches endogenously from a low-fiscal capacity, low-productivity scenario to a high-fiscal capacity, high-productivity equilibrium. Altogether, I claim that the expansion of state capacity and economic growth (propelled by firm technology adoption) go hand-in-hand due to the incentives that the former sets onto the latter and the way domestic productivity growth modifies over time the maintenance of protectionism as a means to raise revenue. Basically, the theory I present in this dissertation is one of endogenous institutions, where institutional investment depends on firm productivity growth and *vice versa*, much in line with Acemoglu et al. (2006).

This dissertation builds on the work of Gehlbach (2008), Congleton and Lee (2009), and Besley and Persson (2011). As Gehlbach (2008) and Congleton and Lee (2009) do, I also study *entry barriers* as a policy stimulus to induce tax compliance. However, the similarities end here. First, I identify the effect of

protectionist policy on wages, emphasizing the trade-off underlying this institutional solution: the growth of tax revenue is followed by a decline in real wages. Both cannot grow simultaneously if a Protection-for-Tax-Compliance strategy is pursued. This trade-off is precisely what allows me to find a cut-off in the stock of fiscal capacity which defines when Protection-for-Tax-Compliance is desirable and whet it is not. The theory can travel now, as I identify the conditions under which entry barriers might be traded for tax compliance. Second, unlike previous contributions, I find that protection does not necessarily derive from rent-seeking by government. I prove that even welfare utility-maximizing rulers might use protection to stimulate tax abidance by uncompetitive producers. Protection, I argue, might not necessarily be for sale, but tax compliance.

Besley and Persson (2009, 2010, 2011) are pioneers in treating fiscal capacity as a explicit investment problem. Indeed, I follow their reduced-form modeling technology to a large extent. However, I claim that we can find underinvestment in fiscal capacity *even in absence of* social divisions or political instability, which are their main hypotheses. The reason lies in the effect of institutional investment on the tax rate and wages. I prove the two of them decrease in the short-run as a consequence of the adoption of newer technology by protected firms. To compensate this fall, a welfare-utility maximizing ruler needs to reduce the current tax rate -yes, when it is most needed- for wages to recover part of their purchasing power. I find that whenever the investment or innovation costs are too large, such compensation is unfeasible. Hence, under these circumstances, even a benevolent ruler would prefer not to invest in fiscal

capacity and stick to the *status quo*. Investing in fiscal capacity in such circumstances would be too damaging in the short-run. Besley and Persson (2011) omit this inter-temporal dilemma since they separate investment decisions from tax policy. The tax rate in their set up does not increase/decrease when institutional investment takes place. That simplifying assumption allows them to explore a myriad of interesting scenarios (such as the role of political instability and social divisions in shaping fiscal capacity) but might overlook the mere inter-temporal dilemmas of institutional investment that derive from maximizing short-term political survival even in a frictionless society. In a nutshell, the set up presented in this dissertation does not require any source of social conflict to produce underinvestment in fiscal capacity and an eventual fall into a low-fiscal capacity, low-income equilibrium.

Throughout this dissertation I emphasize that fiscal capacity building is intrinsically political in as much as redistributive. It does not only transform current income distribution but might modify future market and political advantage of those today in power. From every point of view, fiscal capacity is political economy at its best. But the study of fiscal capacity is also interesting because it might improve our understanding of other key phenomena studied in Political Economy. Fiscal capacity might lie behind the feasibility of power-sharing institutions between the poor and the rich (Acemoglu and Robinson, 2006; Przeworski, 2005), or between the aristocracy and the king (North and Weingast, 1989; Stasavage, 2003). We should expect these institutional solutions to success in solving conflict peacefully as long as the equilibrium tax rate

that satisfies both parts in conflict is feasible given the stock of fiscal capacity. Weak state capacity can only exacerbate the credibility issues behind such power-sharing agreements.

The co-determination of political survival and fiscal capacity investment decisions in this paper also speaks to the literature on barriers to technology adoption. The lack of technology adoption that characterizes poor countries might not be driven only by vested-interests in the *status quo* (Comin and Hobijn, 2009; Krusell and Rios-Rull, 1996; Mokyr, 1991; Parente and Prescott, 2000) or aversion to lose political power (Acemoglu, 2005; Acemoglu and Robinson, 2000). The mere inter-temporal dilemmas of institutional investment faced by a ruler seeking to maximize political survival might be responsible for the stickiness of protectionist solutions as the one proposed in this dissertation -even if she happens to be a benevolent *type*.

Finally, the analysis speaks to the *infant industry* literature (Edwards, 1993; Harrison and Rodríguez-Clare, 2010) in suggesting the conditions under which domestic producers would innovate while protected from foreign competition. Technology adoption, it is argued, would only happen if domestic producers anticipate the ruler will not open the economy in the future, what is itself a function of the evolution of fiscal capacity. The analysis suggests that innovating-while-protected would only happen when the technological distance between the domestic and foreign producers is moderate-to-low and fiscal capacity is not extremely low. Otherwise, the ruler would not invest in fiscal capacity and the opening threat would not bind any more. In these circumstances, infant

industry should not be expected to grow.

The dissertation is organized in three papers. Paper 1 introduces the static version of Protection-for-Tax-Compliance, emphasizing the trade-off between wages and tax revenue. Paper 1 claims that protection is not always for sale, but might be for tax compliance. The main prediction of the static model is tested with cross-national data (32 developing economies). Paper 2 tests the research hypotheses with two country-specific analyses. These are intended to minimize any omitted-variable bias in the cross-national analysis carried out in Paper 1. Specifically, the incidence of Protection-for-Tax-Compliance is tested with industrial surveys for Chile and Bolivia, and two types of protectionist policy: tariff and Non-Tariff-Barriers (NTB). Paper 3 analyzes the dynamics of Protection-for-Tax-Compliance. In particular, I evaluate the conditions under which the tax proceeds derived from the proposed protectionist solution are reinvested in the expansion of fiscal capacity. Paper 3 starts with a simplification of the set up in Paper 1 -necessary to add dynamics to it. The predictions of this model are illustrated with two historical cases: late-XVIIIc. Britain and mid-XXc. Bolivia. A brief conclusion follows.

CHAPTER 2. PROTECTION NOT FOR SALE, BUT FOR TAX COMPLIANCE

Chapter Abstract

This paper proposes a new theory of tax revenue extraction under low fiscal capacity and in the absence of external threats. In particular, it is argued that there are some conditions under which offering protection to inefficient firms is the constrained best policy. Specifically, when the state is unable to collect sufficient revenue by taxation, utilitarian welfare maximizing rulers may offer protection in exchange for tax compliance. This institutional solution does not only confer a short-cut to high fiscal capacity, but implies that protection does not always result from rent-seeking by government. A cross-national statistical analysis illustrates the incidence of the proposed mechanism, to which we refer as *Protection-for-Tax-Compliance*. [1]

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2.1. Introduction

This paper examines how rulers manage to collect enough tax revenue when fiscal capacity is weak and political survival depends on public spending.[2] Historical accounts suggest that war is a strong catalyst to reduce the resistance to taxation among the wealthiest constituents (Tilly, 1990; Scheve and Stasavage, 2010). Still, major wars are rare events. In peaceful times, rulers may invest in expanding fiscal capacity (Besley and Persson, 2010) but this strategy is expensive and politically costly. By improving the technology to tax private income, the wealthy empower the state with an extractive mechanism which, eventually, might be used against their best interest. The resistance towards expanding fiscal capacity can be particularly intense when wealth accumulates in the hands of a reduced elite. An improvement of fiscal capacity not only reduces the elite's current income but also its future market advantage. Anticipating this resistance, fiscal capacity investment usually involves a long, gradual process with setbacks and uncertain outcomes.[3] By its mere nature, it involves a joint process of pure investment in coercive tax administration (*i.e.*, improve its physical and human endowments), and political recognition by the elite (which might itself require some form of power-sharing agreement (North and Weingast, 1989;

[2]Political survival depends on public spending regardless of regime type. Certainly, democratic order, and in particular, electoral accountability is associated to larger levels of redistributive public spending (Brown and Hunter, 1999; Deacon, 2009; Lake and Baum, 2001; Stasavage, 2005). But autocrats are also proved to utilize public spending to "buy-off" loyalty and appease opponents (Cheibub, 1998; Dal Bó and Powell, 2009; Magaloni, 2006; de Mesquita et al., 2002; Pepinksy, 2007).

[3]Brautigam et al. (2008); Gillis (1989); Thirsk (1997) for extensive historical accounts.

Stasavage, 2003)). All things considered, investment in fiscal capacity would hardly yield high returns in the short-run.[4]

Time might be a luxury for rulers, though. Political survival often depends on satisfying short-term consumption demands. Rushed by fiscal disequilibrium, rulers may devise an incentive system of carrots-and-sticks in order to induce tax abidance by domestic producers, the so-called *quasi-voluntary compliance* (Levi, 1988). This paper proposes one of these institutional solutions, and identifies the micro-foundations for it to arise. In particular, I argue that under some conditions, offering protection to inefficient firms might be the constrained best policy. Specifically, when the state is unable to collect enough revenue by taxation, utilitarian welfare maximizing rulers might offer protection in exchange for tax compliance. This institutional solution not only offers a short-cut to high fiscal capacity, but also implies that protection does not always result from rent-seeking by government (Grossman and Helpman, 1994).

We refer to this variety of quasi-voluntary compliance as *Protection-for-Tax-Compliance*. This is a mechanism of institutional extortion, in which the ruler takes advantage of *Schumpeterian market competition* to set effective tax rates above the *fiscal capacity endowment*. Schumpeterian competition is a form of market competition in which *only* the most competitive firm stays in the market. All others succumb.[5] Fiscal capacity endowment refers to the max-

[4]For instance, the ability to impose an effective excise system in eighteenth century England required of investments in administrative endowments for over a century and continuous political bargaining with tax subjects (Brewer, 1988).

[5]See Aghion and Howitt (2009) for micro foundations.

imum share of private income that can be taxed by coercive means only. Fiscal capacity endowment reflects the marginal cost of tax enforcement. When this cost is small, fiscal capacity is high; when this cost is high, fiscal capacity is low.

Aware of the logic of Schumpeterian competition, the ruler may offer uncompetitive incumbent producers protection from superior competitors in exchange for higher tax abidance -in particular, above the fiscal capacity endowment. The obsolete firm then must choose between paying higher taxes if protected, or extinguishing in case of entry of a superior competitor. As long as the extinction payoffs are sufficiently low, the incumbent producer abides by a higher (effective) tax rate than that feasible by the initial fiscal capacity endowment.

There exists extensive historical evidence suggesting that rulers have exchanged entry barriers (licenses, tariffs, price markups) for tax abidance by incumbent producers. Nye (2007) documents how eighteenth century British brewers accepted to pay higher taxes in exchange for the adoption of entry barriers to international competitors (French wine, mainly) and fringe producers.[6] The Mercantilist era in France (Ekelund and Tollison, 1981) or the municipal taxes in nineteenth century Prussia (Spoerer, 2008) followed the same logic: Entry barriers (operating licenses, mainly) were exchanged for higher (effec-

[6]More importantly, tax abidance only grew when protectionist policy was adopted simultaneously. Some decades earlier, a *unilateral* tax rate increase by the British Parliament had outrightly failed. This case also suggests that the Schumpeterian logic is only a subset of possible situations in which domestic producers might be interested in protection. Cheaper close substitute products might be sufficient to induce higher tax compliance by incumbent producers.

tive) tax rates. Similar agreements took place among nitrate producers in 1880s Chile (Gallo, 2008), tin producers in 1930s Bolivia (Gallo, 1988), and local businesses in pre-communist China (Wang, 2001). Radical implementations of Protection-for-Tax-Compliance are documented by Gehlbach (2008) in post-communist Russia, Bastable (1891) in nineteenth century English trade, and Arias (2009) under the Spanish rule in Mexico: In all these settings, artificial monopolies were created to guarantee *ex ante* tax compliance by the protected firms. More recently, Desai and Olofsgård (2011) have offered cross-national evidence showing that those firms paying higher taxes are also those subject to fewer regulatory constraints.

All this evidence suggests that protection, and more generally, entry barriers, might be adopted in exchange for higher tax abidance by incumbent producers.[7] This paper seeks to identify the necessary conditions for this protectionist solution to arise, and assess its welfare implications too. The theoretical model identifies an intrinsic trade-off in pursuing Protection-for-Tax-Compliance strategies, which has been overlooked by previous work studying the relationship between protection and tax compliance: Gehlbach (2008) and Desai and Olofsgård (2011). In particular, Protection-for-Tax-Compliance increases tax revenue, but decreases wages systematically too, both in nominal and real terms. Understanding this trade-off is proved to be essential to identifying the conditions under which Protection-for-Tax-Compliance is socially

[7] Notice that protectionist policy would not *only* tax foreign firms penetrating the national market, as the standard argument goes (Johnson, 1951; Hiscox, 2002), but increase tax compliance by obsolete domestic producers *too*.

optimal and not pure rent-seeking by government (Grossman and Helpman, 1994). In particular, are two the necessary conditions for Protection-for-Tax-Compliance to be socially optimal: First, the incumbent producer must be sufficiently obsolete with respect to foreign competitors. Obsolescence guarantees interest for protection but also commitment on compliance.[8] Second, fiscal capacity endowment must be sufficiently low. Otherwise, the boost in tax revenue following Protection-for-Tax-Compliance does not outweigh the fall in wages.[9] When both conditions are simultaneously met, we should observe an increase of tax compliance following the adoption of entry barriers. And, most importantly, only then the adoption of entry barriers is socially optimal.

The two necessary conditions for Protection-for-Tax-Compliance are derived from a model in which the ruler is assumed to be a pure utilitarian maximizer. For a proper comparison to Grossman and Helpman (1994), the incidence of Protection-for-Tax-Compliance is also examined assuming bribe-responsive rulers. The analysis of the theoretical extension suggests that the parameter space for which a Protection-for-Tax-Compliance equilibrium holds shrinks when rulers are responsive to contributions, but political giving does not necessarily cancel it. That is, *even if* we allow inefficient incumbent producers to *buy-off* protection, for sufficiently low values of fiscal capacity, not even bribes prevent them from paying higher tax rates if protected.

[8] By the mere logic of Schumpeterian competition, defection of obsolete firms implies their own extinction.

[9] For larger values of fiscal capacity this balancing effect does not apply. In that case, protection is adopted for reasons different to tax revenue needs (*e.g.*, bribes), and is proved to be socially sub-optimal.

The main empirical prediction of the theoretical model, that is, tax compliance of obsolete sectors increases in protection conditional on low fiscal capacity, is tested against cross-national evidence. The research design exploits cross-country variation in fiscal capacity across developing economies, and cross-sector variation in tax compliance, obsolescence and protection circa 2005. The statistical evidence is consistent with the theoretical model prediction. Conditional on low fiscal capacity, obsolete sectors increase their tax compliance if protected from foreign competitors.

The remaining document is organized as follows: Section 2 introduces the set up of the theoretical model and analyzes the conditions under which a Protection-for-Tax-Compliance equilibrium arises. Section 3 briefly examines an extension of the theoretical model in which political giving (bribing) is allowed. Section 4 tests the model against cross-national evidence. Section 5 concludes.

2.2. The Model

Suppose there are four actors in the economy: The political ruler, the incumbent producer, a potential entrant, and labor.

The Ruler. The ruler decides over the tax rate $\tau \in [0, 1]$, and entry regulation. The latter consists of costless regulation allowing (banning) entry of superior competitors. Initially, she is assumed to maximize the utility of a representative

wage-earner.[10] In particular her utility is a linear combination of wages, ω, and per capita public spending $\bar{G} = G/L$

$$V = \omega + ln(\bar{G}) \tag{2.1}$$

The log-form of $\bar{G}$ implies that the marginal utility of public spending is greatest for lower levels and decreases steadily from there on.[11] Public spending is pure-consumption, and is funded by tax revenue R. Tax revenue is raised from a value-added tax (VAT), $R = \tau px$, with $\tau \in [0, 1]$, price p, and sales x.[12] The ruler does not keep any additional share of R for self-consumption. All tax proceeds are funneled to public spending. Accordingly, an identity between spending G and revenue R is assumed (*i.e.*, $G \equiv R$).

Initially, the tax rate (and hence, tax revenue R) is upper bounded by the fiscal capacity endowment, τ_o. This parameter denotes maximum share of private income that can be taxed if no extortion mechanism is implemented. It reflects the coercive power of the tax administration, and more concretely, the marginal cost of tax enforcement. As argued in the introduction, the marginal cost of tax enforcement can be reduced with costly investments in tax administration (Besley and Persson, 2010). As examined below, Protection-for-Tax-Compliance can achieve similar (or higher) levels of fiscal capacity *without*

[10] We relax this assumption later on.

[11] The results of the model hold if we consider alternative specifications of the objective function such as an interactive or an additive-weighted specification.

[12] The choice of this tax is consistent with the spread use of excise and value-added taxes in developing countries (Brautigam et al., 2008; Gillis, 1989; Thirsk, 1997).

monetary disbursements in tax administration.

Production. The economy has a fixed number L of people, who have no demand for leisure, and offer their labor inelastically.[13] All labor is hired in the final market sector. Final output is produced under perfect competition, using labor and a flow of intermediate product x of quality A:

$$Y = \frac{1}{\alpha}(AL)^{1-\alpha}x^{\alpha} \tag{2.2}$$

with constant returns (*i.e.*, $\alpha \in (0,1)$). The final good Y is the *numeráire* (*i.e.*, its unit price is one). Wage in the final sector equals the marginal productivity of labor

$$\omega = \frac{(1-\alpha)A^{1-\alpha}x^{\alpha}}{\alpha L^{\alpha}} \tag{2.3}$$

which is increasing in A, the quality of the intermediate product.

The intermediate product is produced monopolistically using a flow of final product, one for one. The monopolist seeks to maximize the flow of profit

$$\pi = (1-\tau)px - x \tag{2.4}$$

where τ denotes the add-valorem tax rate, which is imposed only on intermediate good sales.[14]

[13] The structure of the economy is borrowed from Aghion and Howitt (2009).

[14] Expression (2.4) implicitly implies that the intermediate producer does not hire any labor, and that the marginal cost of production is 1.

The quality of the intermediate product A in the final market depends on the technology vintage operated by the monopolist. Initially, the intermediate market is operated by an old firm which supplies the market with an input of *low* quality A_l.[15] A more competitive firm might enter the intermediate market. In case of entry, the new entrant supplies the final market with an intermediate product of *high* quality $A_h > A_l$.[16]

Action Set. The ruler sets entry policy and tax policy. Entry regulation consists of costless regulation allowing (banning) entry of the new, superior competitor. Licenses, technical restrictions, price markups, or credit constraints are examples of this kind of restrictive entry regulation. Tax policy consists of a value added tax τ imposed on intermediate good sales only.

As the historical examples in the *Introduction* suggested, entry barriers might be adopted conditional on higher tax abidance by the protected firms. Here, specifically, the Protection-for-Tax-Compliance bargain consists of exchanging entry regulation for higher tax compliance, $\tau_p > \tau_o$, where τ_p denotes the tax rate in the *protectionist* regime. If barriers are not raised, a new competitive firm enters with certainty. Since institutional extortion becomes ineffective with a competitive firm, the tax rate must be set from within the fiscal capacity range $\tau_e \in [0, \tau_o]$, with subscript e standing for *entry*.

Briefly, this is a one-period static game with an extensive structure:

[15] Innovation is not considered in the model.

[16] The results of the model are not responsive to the source of heterogeneity between intermediate producers. The results hold if they are assumed to produce inputs of the same quality but at different marginal costs. For details, see *Supplementary Material*.

- First, the ruler decides whether to adopt entry barriers.

- If barriers are adopted, the old producer stays in and complies with $\tau_p > \tau_o$.

- If barriers are not raised, entry takes place, intermediate good producers compete, and abide by $\tau_e \leq \tau_o$.

- Given entry and tax policy, tax revenue, wages and profit follow.

Commitment problems in a case of protection are ruled out by assumption. Repeated interaction between government and domestic producers is expected to solve any credibility issues.[17]

What follows seeks to identify the conditions under which the ruler would prefer to raise entry barriers despite keeping the unproductive firm "in".

2.2.1. Analysis

The benchmark model is solved by backwards induction. We have to analyze the ruler and producers' equilibrium payoffs in case of *free-entry* and *protection* separately, and then examine when the ruler prefers to adopt *entry barriers* instead of *free-entry*.

[17] VAT collection tends to be implemented monthly, and protectionist policy (such as licenses) can be renewed/declined at any time. Such flexibility should be sufficient to prevent any deviation by the incumbent producer.

Free-Entry Regime

Suppose free-entry is adopted. Then then a new firm enters the intermediate market and the old producer instantaneously drops.[18] Given τ_e, the new-entrant's problem is

$$\max_x \pi_h = (1-\tau_e)p_h x_h - x_h \tag{2.5}$$

where subscript h refers to prices and production associated to input of *high* quality A_h.

Since the intermediate producer supplies a competitive market, price p_h must equal the marginal productivity of input x_h. Taking this into account, the maximization problem yields equilibrium demand

$$x_h^* = A_h L(\alpha(1-\tau_e))^{1/(1-\alpha)} \tag{2.6}$$

with equilibrium price

$$p_h^* = \frac{1}{\alpha(1-\tau_e)} \tag{2.7}$$

[18] Schumpeterian market competition itself can be modeled; see Supplementary Material. In that case, we would allow the two intermediate producers to differ in the marginal cost of production (instead of the productivity of the intermediate input). The result is identical, but requires an additional parameter, the marginal cost of production of the intermediate product, and adds no further insight.

and market-clearing wage

$$\omega_h^* = \frac{1-\alpha}{\alpha} A_h (\alpha(1-\tau_e))^{\alpha/(1-\alpha)} \tag{2.8}$$

Given x_h^*, p_h^* and ω_h^*, the ruler problem reduces to

$$\begin{aligned} \underset{\tau_e}{max}\, V = \quad & \omega_h^*(\tau_e) + ln\Big(\frac{\tau_e p_h^* x_h^*}{L}\Big) \\ \text{s.t. } & \tau_e \leq \tau_o \end{aligned} \tag{2.9}$$

In words, the ruler's maximization problem is constrained by the endowment of fiscal capacity of the economy τ_o. Since x_h^* is decreasing in τ_e, concavity is assured. The solution to the *Lagrangian* depends on whether the fiscal constraint bites: If fiscal capacity endowment is sufficiently large (*i.e.*, the constraint is not binding), the ruler adopts her *ideal* tax rate, $\tau_e^*(\lambda = 0)$, implicitly characterized by

$$1 - \alpha = \tau_e \Big[1 + (1-\alpha) A_h L (\alpha(1-\tau_e))^{\frac{\alpha}{1-\alpha}}\Big] \tag{2.10}$$

which implies $0 < \tau_e^* < 1-\alpha$.[19] That is, not even a utilitarian welfare maximizing ruler with full fiscal capacity (*i.e.*, $\lambda = 0$) would extract all income from the wealthy. The reason lies in the effect that taxes exert on prices ($(\partial p/\partial \tau) > 0$) and wages ($\partial \omega/\partial \tau < 0$). Thus, in a free-entry regime, it is in the best interest of wage-earners to allow the capitalist to gain positive profit.[20]

[19] Focus on the RHS of expression (2.10). When $\tau_e = 0$, $RHS = 0 < 1-\alpha$. When $\tau_e \to 1-\alpha$, $RHS = (1-\alpha)(1+(1-\alpha)AL\alpha^{\frac{2\alpha}{(1-\alpha)}}) > 1-\alpha$. Thus, it must exist a unique $\tau_e^* \in (0, 1-\alpha)$ for which expression (2.10) is true.

[20] Cross-partial analysis suggests this relation becomes tighter the more productive the producer.

So far we have assumed that the fiscal constraint did not bind ($\lambda = 0$). This might be too much of an optimistic assumption in many economies, especially among those still developing. When the constraint in (2.9) bites, the ruler adopts the maximum tax rate that the endowment of fiscal capacity allows: That is, $\tau_e^*(\lambda > 0) = \tau_o$. This is true because the ruler utility function is a strictly increasing function in $\tau_e \in [0, \tau(\lambda = 0)]$. *Proposition* 1 summarizes this result.

Proposition 1. *Suppose free entry of a more productive firm is allowed, and that the fiscal constraint in (2.9) is binding. Then the ruler sets* $\tau_e^* = \tau_o$ *and raises revenue* $R\big(p_h^*, x_h^*, \tau_e^* | A_h\big)$*, with equilibrium price and wage given by (2.7) and (2.8), respectively, whereas the new entrant gains positive profit* $\pi_h(\tau_e^*) > 0$.

Intuitively, *Proposition 1* states that a utilitarian welfare maximizing ruler would fully utilize the whole fiscal capacity endowment if she allows for free-entry. Likewise, *Proposition 1* implies that when fiscal capacity is limited (*i.e.*, the fiscal constraint bites), the equilibrium tax rate paid by the new firm is socially sub-optimal. Wage-earners would benefit from a higher tax rate.

Protectionist Regime

In the previous scenario the ruler could not condition entry policy to higher tax compliance by the new entrant. The new firm, already competitive, was in no need of protection from superior competitors. In contrast, when the intermediate monopolist is obsolete, the ruler can induce the old firm to abide by a higher tax rate $\tau_p > \tau_o$ in exchange for protection from superior competitors.

Otherwise, barriers are not adopted and the incumbent producer is eventually phased out of the market by the new entrant. How is this form of institutional extortion implemented? And what are its disadvantages?

Suppose entry barriers to new competitors are raised. Then, the ruler maximizes the value-added tax rate anticipating its effect on the obsolete producer's profit. Since $\tau_p > \tau_o$, we do not need to add a fiscal constraint to the ruler's maximand

$$\max_{\tau_p} V = \omega_l(\tau_p) + ln\left(\frac{\tau_p\, p_l(\tau_p)\, x_l(\tau_p)}{L}\right) \tag{2.11}$$

where subscript l refers to prices and production associated to *low* quality input A_l.

This time ω_l, p_l and x_l are determined differently. It can be proved (see Supplementary Material) that the ruler is better-off imposing a *zero-profit condition* onto the obsolete producer than allowing the latter to maximize its profit for a given τ_p. That is, in exchange for allowing the obsolete producer to survive, the ruler extracts all surplus from the firm.[21] The zero profit condition implies

$$\pi_l = (1-\tau_p)p_l x_l - x_l = 0 \tag{2.12}$$

which yields $p_l^* = 1/(1-\tau_p)$, final market demand $x_l^* = A_l L(1-\tau_p)^{1/(1-\alpha)}$, and

$$\omega_l^* = \frac{1-\alpha}{\alpha} A_l (1-\tau_p)^{\frac{\alpha}{1-\alpha}} \tag{2.13}$$

[21] It could be argued that the producer's indifference is reached for $\pi_o = \omega_h$, the wage following entry. For simplicity, we assume that the producer would prefer to live from his rents rather than becoming a wage-earner.

Given p_l^*, x_l^* and ω_l^*, the ruler's problem is maximized for the Protection-for-Tax-Compliance tax rate τ_p^* defined by

$$1 - \alpha = \tau_p \Big[1 + (1 - \alpha) A_o L (1 - \tau_p)^{\frac{\alpha}{1-\alpha}} \Big] \tag{2.14}$$

This expression is *similar* (not equal) to the optimal tax rate when fiscal capacity is not binding, as expressed in (2.10). They are not equal because the tax rate depends on the productivity of the intermediate input. In particular, the equilibrium tax rate varies inversely with the productivity of the intermediate producer, $\dfrac{\partial \tau^*}{\partial A} < 0$.[22] That is, the more productive an intermediate monopolist is, the lower the equilibrium tax rate is.[23] However, what is conceptually crucial in here is that, conditional on raising entry barriers, the ruler is able to set her *ideal* tax rate, as defined by the tax rate she would adopt if the fiscal capacity constraint ($\tau \leq \tau_o$) did *not* bind. This is precisely, the power of Protection-for-Tax-Compliance. By conditioning entry barriers on tax abidance from protected firms, the ruler is able to adopt her optimal tax rate regardless of the actual endowment of fiscal capacity. Formally,

$$\tau_p^* \equiv \tau^*(\lambda = 0) \tag{2.15}$$

where $\lambda = 0$ emphasizes the slackness of the fiscal capacity constraint.

[22] Derived from cross-partial of equilibrium condition.

[23] Expression (2.14) has an additional parameter on its RHS with respect to condition (2.10): the $\alpha^{\frac{\alpha}{1-\alpha}}$ premultiplying $(1-\tau)^{\frac{\alpha}{1-\alpha}}$. Applying the Implicit Function Theorem to expression (2.10) we observe that the effect of α on τ_e^* is negative, and hence aligns with that of productivity.

By agreeing to these terms, the domestic firm gets the necessary protection for survival though at a high cost: full surplus extraction. *Proposition 2* summarizes the results of this sub-game.

Proposition 2. *Suppose entry barriers are raised. Then the ruler sets* $\tau_p^* > \tau_o$ *similar to the optimal tax rate had the fiscal capacity constraint not bidden,* $\tau_p^* \equiv \tau^*(\lambda = 0)$. *Accordingly, the ruler raises tax revenue* $R\big(\tau_p^*\big) > R\big(\tau_o\big)$, *wages are bitten to (2.13), and the incumbent firm yields zero profit* $\Pi(\tau_p^*) = 0$.

Protection-for-Tax-Compliance Equilibrium

We now focus on the comparison between the protectionist and the free-entry regimes when the fiscal capacity constraint is binding ($\lambda > 0$ in (2.9)). If barriers are not raised, a new firm enters the market with certainty.

Given $R(\tau^*)$ and $\omega(A_j, \tau^*)$ in both sub-games (summarized in *Proposition 1* and *2*), we seek to assess whether the ruler would ever prefer raising barriers to allowing for free-entry of a superior competitor.

The answer depends on the technology distance between the new and the old producer as well as the fiscal capacity endowment (*i.e.*, how far it is from the ideal fiscal capacity, $\tau(\lambda = 0)$). Revenue and wages differ across policy regimes depending on these two parameters.

Lemma 1. *Suppose the fiscal capacity constraint bites. Then, the tax revenue*

under protection is greater than that following free-entry if

$$A_h < \frac{1-\alpha-\tau_p^*}{(1-\alpha)\tau_o(\alpha(1-\tau_o))^{\frac{\alpha}{1-\alpha}}} \tag{2.16}$$

with τ_p^* defined by (2.15).

Proof. See Appendix. □

Lemma 1 implies that tax revenue following protection can only be greater than that following entry if the technological distance between both firms is not too large. Otherwise, the increase in fiscal capacity from τ_o to τ_p^* following protection does not offset the revenue loss from blocking entry of the new, highly competitive firm. This result is consistent with Comin and Hobijn (2009) empirical evidence, where radical innovations are hardly blocked due to the high opportunity costs. True also is that radical innovation is a rare phenomenon.

Lemma 2. *Suppose the fiscal capacity constraint bites. Then, the equilibrium wage following free entry is greater than that under protection if*

$$A_h > \frac{1-\alpha-\tau_p^*}{(1-\alpha)\tau_p^*(\alpha(1-\tau_o))^{\frac{\alpha}{1-\alpha}}} \tag{2.17}$$

with τ_p^* defined by (2.15).

Proof. See Appendix. □

Lemma 2 states the equilibrium wage following free-entry is greater than

that following protection only if A_h is *sufficiently* large. This result is not immediately intuitive. We saw that wages increased in the productivity of the intermediate producer, and $A_h > A_l$; and that they also decreased in the equilibrium tax rate, and $\tau_e^* < \tau_p^*$. Hence, we might expect wages to increase following entry. However, wages also depend on how the intermediate producer behaves: Monopolistically, if entry is permitted, or competitively, if Protection-for-Tax-Compliance is pursued. If entry is permitted, the new producer reduces production to maximize profit, which negatively affects equilibrium prices. Instead, if entry is blocked, the *zero-profit condition* imposed on the incumbent producers forces him to increase production up to the point in which the equilibrium price equals the marginal cost of production (tax-markup included). Due to the increase in equilibrium production, wages under protection grow too (but only moderately, since input quality remains low). For this very reason, the effect of protection on wages is not immediately detrimental (as long as the *zero-profit condition* applies). But it will be, for sure, in comparison to the wage following free entry as long as A_h, the productivity of the new competitor, is sufficiently high. In that case, despite the reduction of equilibrium production following entry, the associated productivity boost in wages predominates, and these, overall, increase.

Lemma 1 and *Lemma 2* define the conditions under which the ruler will opt for protection or free-entry.

i. If *Lemma 1* is satisfied, but *Lemma 2* is not, protection is always opti-

mal. In this case, the technological distance between the new and old producer, $A_h - A_l$, is so low that both revenue and wages are greater pursuing Protection-for-Tax-Compliance. That is, the boost of productivity on revenue and wages following entry does not compensate the increase of the tax rate from τ_o to τ_p^* (and wages too, but moderately) following protection.

ii. If *Lemma 1* is not satisfied (and hence, *Lemma 2* either), free-entry is always preferred to raising barriers. In this scenario, the technological distance between the new and old producer is too large to be compensated by higher tax compliance by the old producer upon protection.

iii. If *Lemma 1* and *Lemma 2* are simultaneously satisfied, it is not evident what entry policy is most convenient for the ruler. Protection increases tax revenue but decreases wages; free-entry increases wages but decreases tax revenue. *Proposition 3* identifies the conditions under which protection is preferred.

Proposition 3. *(Protection-for-Tax-Compliance) Suppose the fiscal capacity constraint in (2.9) bites, and that Lemma 1 and 2 are simultaneously satisfied. Then, for a sufficiently low fiscal capacity endowment* $\tau_o \in [0, \hat{\tau}]$*, where* $\hat{\tau} < \tau(\lambda = 0)$ *as defined by (2.15), a unique SPNE exists in which the ruler prefers to adopt entry-barriers to free-entry. Accordingly, the ruler sets* $\tau_p^* = \tau(\lambda = 0)$*, tax revenue grows* $R(\tau_p^*) > R(\tau_e^*)$ *but wages decrease* $\omega(\tau_p^*) < \omega(\tau_e^*)$*; the incumbent firm stays "in" and yields zero-profit* $\Pi(\tau_p^*) = 0$*; and the would-be*

entrant remains "out".

Proof. Denote $V_e(\cdot)$ and $V_p(\cdot)$ the ruler utility under *entry* and *protection*, respectively. $V_e(\tau_o)$ is an increasing monotone concave function in $\tau_o \in [0, \tau(\lambda = 0)]$, with $\tau(\lambda = 0)$ being the unconstrained tax rate. Given A_o, $V_p(\tau_p^* = \tau(\lambda = 0))$ defines a horizontal line in the $V - \tau$ space. When $\tau_o \to 0$, by expression (2.1), $V_e(\tau_e^*) = -\infty$, and hence, $V_e(\tau_e^*) < V_p(\tau_p^*)$. When $\tau_o \to \tau(\lambda = 0)$, by *Proposition 1*, $\tau_e^* = \tau(\lambda = 0)$; since $A_h > A_l$, then $V_e(\tau_e^*) > V_p(\tau_p^*)$. Thus, by the Intermediate Value Theorem, it must be true that there exists a unique $\hat{\tau},\ 0 < \hat{\tau} < \tau(\lambda = 0)$ such that $\forall \tau_o \leq \hat{\tau}$, $V_p(\tau_p^*) > V_e(\tau_e^*)$. □

Proposition 3 states that a utilitarian welfare maximizing ruler finds Protection-for-Tax-Compliance preferable to free-entry when fiscal capacity endowment is sufficiently low, despite that protection blocks entry of superior technology and pushes equilibrium wages down. That is, the ultimate combination of lower wages but higher tax compliance by the obsolete incumbent producer is preferred to the alternative scenario with higher wages but lower tax compliance by the new producer. But this is only true as long as fiscal capacity endowment τ_o is sufficiently low (*i.e.*, $\tau_o \leq \hat{\tau}$), and the productivity differential between the old and new producer is sufficiently large (*Lemma 2*) but not extremely large (*Lemma 1*). In that case, the ruler's marginal gain of a unit increase in per capita public spending $\bar{G}(\tau_p^*)$ is greater than the marginal loss in equilibrium wages $\omega(\tau_p^*)$. By the same token, when fiscal capacity endowment is sufficiently large (*i.e.*, $\tau_o > \hat{\tau}$), the relative magnitude of these marginal effects flip,

and free-entry is preferred. This result has immediate implications: When fiscal capacity is high, protection is granted for reasons other than inducing tax compliance (*e.g.*, rent-seeking by non-utilitarian maximizer rulers).

Figure 2.1 depicts the SPNE defined in *Proposition 3*. The horizontal axis represents the fiscal capacity endowment τ_o (or, if preferred, the tax rate at the beginning of the game). Recall, this parameter denotes the maximum share of fiscal capacity that can be taxed without extortion. The vertical axis represents the equilibrium tax rate (or, if preferred, the final tax rate).

Figure 2.1 depicts three distinct segments (solid line. Two of them are horizontal; and these are separated by a diagonal line. When fiscal capacity endowment falls to the right of $\tau(\lambda = 0)$, the unconstrained fiscal capacity, the equilibrium tax rate is $\tau(\lambda = 0)$ itself. That is precisely why it can be interpreted as the *ideal* tax rate of the ruler.[24] From *Proposition 1*, moreover, we know that the ideal tax rate is smaller than 1. When the fiscal capacity endowment is above this ideal value, *free-entry* is always adopted, since tax compliance by the old producer under protection does not outweigh the boost in wages following entry of the new firm. However, the interesting scenario is limited to the interval of fiscal capacity endowment between 0 and $\tau(\lambda = 0)$. For these states of the world, the fiscal capacity constraint bites. Here, we can distinguish two sub-intervals: By *Proposition 3*, for $\tau_o \leq \hat{\tau}$ the ruler prefers to raise entry barriers and, in exchange, set τ_p^* equal to her ideal value, $\tau(\lambda = 0)$. That is

[24] Since the tax administration is costly, we should observe no economy with a fiscal capacity endowment above this ideal point. But this segment is plotted for completeness.

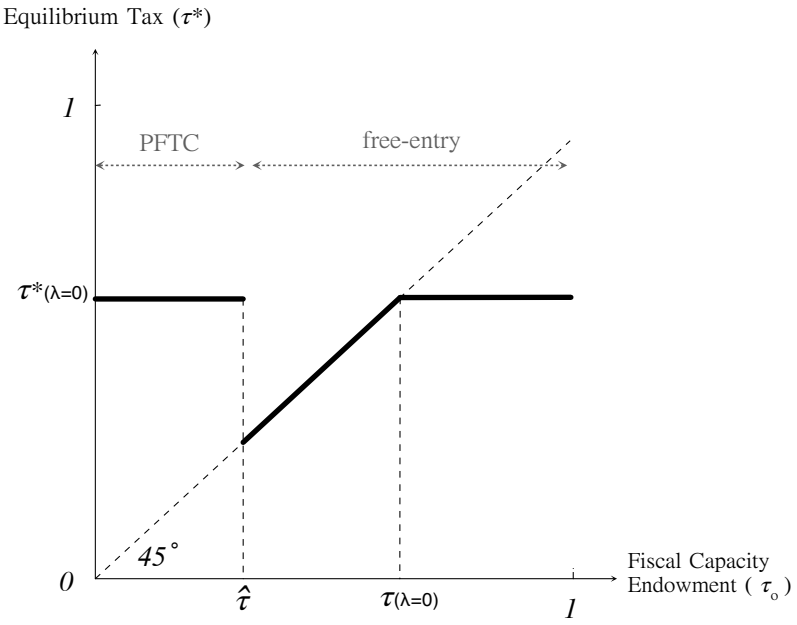


Figure 2.1: Equilibrium Tax Rate and ruler's Optimal Strategy along Fiscal Capacity Endowment (provided *Lemma 1 and 2* are satisfied).

why we observe a horizontal line at $\tau^* = \tau(\lambda = 0)$ for $\tau_o \in [0, \hat{\tau}]$. Instead, for $\tau_o \in (\hat{\tau}, \tau(\lambda = 0)]$, the ruler allows for *free-entry*. By *Proposition 1* she sets $\tau_e^* = \tau_o$ (*i.e.*, she fully utilizes the fiscal capacity endowment). This explains why the equilibrium tax rate for this range of fiscal capacity endowment falls along the 45° line.

Altogether, *Proposition 3*, as exemplified in Figure 2.1, states that optimal entry regulation depends on the fiscal capacity endowment. This result conveys the power of regulation once combined with the logic of Schumpeterian market competition: Protection-for-Tax-Compliance offers a unique mechanism of institutional extortion of obsolete producers. When domestic producers are uncompetitive, rulers can devise this system of carrots-and-sticks in order to induce tax compliance by protected firms. In particular, protection is granted in exchange for abidance by the ideal tax rate of a utilitarian welfare maximizing ruler. Moreover, *Proposition 3* offers an alternative explanation for protectionist policy in which entry barriers do not result from rent-seeking by government (Grossman and Helpman, 1994). Quite the contrary, *Proposition 3* states that, under some conditions, utilitarian welfare maximizing rulers might offer protection in exchange for tax compliance only. That is why, when policy is constrained, offering protection to inefficient firms might be the best constrained policy.

2.3. Protection-for-Tax-Compliance *vs.* Contributions

In the previous section we concluded that protection was not necessary for sale; instead, protection might be offered in exchange for tax compliance. However, this mechanism should not necessarily preclude domestic firms from trying to *buy-off* protection through political giving. In particular, they might give the ruler a contribution as to gain protection and keep taxes low. This section analyzes whether Protection-for-Tax-Compliance can arise even if rulers are responsive to bribes or contributions. The analysis proves that contributions do push tax rates down with respect to the welfare maximizing tax rate, $\tau_p^* = \tau(\lambda = 0)$; however, for sufficiently low values of fiscal capacity the new tax rate is still above the fiscal capacity endowment of the economy. That is to say, when fiscal capacity is sufficiently low, not even contributions prevent inefficient firms from being more tax compliant if protection is adopted.

In order to prove this point, we allow for political giving and let contributions to be determined endogenously. The analysis proceeds stepwise: First we prove that a *Contribution-Induced Protection* equilibrium exists. Second, we examine whether such equilibrium ever leads to tax rates above the fiscal capacity endowment.

Extended Set Up

So far we assumed a benevolent ruler who maximized social welfare. Now we relax this assumption. In particular, we allow the ruler to be responsive to

bribes or contributions. These are a form of rent-seeking and are assumed to be a private transfer. As such, contributions enter the utility function of the ruler only. Specifically, the ruler objective function becomes

$$V = \omega_c + ln(\bar{G}_c) + c \tag{2.18}$$

where contributions c enter linearly, and ω_c and $\bar{G}_c$ denote the new wages and per capita public spending, respectively.[25]

All else constant, deviating from the Protection-for-Tax-Compliance equilibrium implies an utility loss for the ruler. From *Proposition 1* we know that her utility is strictly increasing in $\tau \in [0, \tau(\lambda = 0)]$. Hence, the producer must compensate her for any deviation from $\tau_p^* = \tau(\lambda = 0)$, the Protection-for-Tax-Compliance equilibrium tax rate. This compensation is exerted through contributions. These are endogenous: We define the total cost of the contribution by its price, m, times the magnitude of the deviation from the ideal tax rate in the Protection-for-Tax-Compliance equilibrium, $(\tau_p^* - \tau_c)$, where τ_c denotes the tax rate when contributions are allowed. Since the contribution must offset the ruler's loss of utility, the price of the contribution must equal the unit marginal gain of taxation in the Protection-for-Tax-Compliance scenario. That is,

$$m = \frac{\partial V_{pftc}}{\partial \tau} \tag{2.19}$$

with V_{pftc} defined in (2.1). Given (2.19), we fully specify the total cost (gain)

[25] Wage-earner's utility is still given by (2.1).

of the contribution as

$$c = m \times (\tau_p^* - \tau_c) \tag{2.20}$$

Notice that expression (2.20) is a strictly decreasing monotone function in τ_c. Intuitively, the closer τ_c gets to τ_p^*, the smaller the contribution the producer gives the ruler.[26]

Contribution-Induced Protection

In the Protection-for-Tax-Compliance agreement it was optimal for the ruler to extract all surplus from the protected producer (*i.e.*, $\Pi = 0$). That we called the *zero-profit condition* of Protection-for-Tax-Compliance. This condition impeded the producer to optimally choose its production level (*i.e.*, $\max_x \Pi$). But if profit is to be positive, as it should in a Contribution-Induced Protection (CIP) scenario, the old producer must be able to optimally choose his output. That is,

$$\max_x (1 - \tau_c) p_c x_c - x_c \tag{2.21}$$

This maximization problem yields a *gross* profit

$$\left[\frac{1}{\alpha} - 1\right] A_l L (\alpha(1 - \tau_c))^{\frac{\alpha}{1-\alpha}} \tag{2.22}$$

which is decreasing in τ_c. Expression (2.22) defines what the profit of the old producer would be if no contribution had to be paid to deviate from the

[26] By the same argument, c is greatest for $\tau_c = 0$.

Protection-for-Tax-Compliance tax rate. But contributions are required to deviate from that equilibrium. Hence, we must add this cost to (2.22) in order to achieve *net* profit

$$\pi_c = \Big[\frac{1}{\alpha} - 1\Big] A_l L(\alpha(1-\tau_c))^{\frac{\alpha}{1-\alpha}} - c \tag{2.23}$$

with contribution cost c given by (2.20). Given (2.23), the producer must choose how much he wants to deviate from $\tau_p^* = \tau(\lambda = 0)$, the Protection-for-Tax-Compliance equilibrium tax rate. For that, the old producer maximizes his net profit with respect to τ_c.

Lemma 3. ***(Optimal Bribe)*** *For Protection-for-Tax-Compliance equilibrium tax, τ_p^*, given by (2.15) and contribution cost function, c, given by (2.20), $\alpha < 1/2$ is a sufficient condition for the existence of a unique interior tax rate, $0 < \tau_c^* < \tau_p^*$, for which (i) $c(\tau_c^*) > 0$; (ii) the domestic producer makes positive net profit $\pi(\tau_c^*, c^*) > 0$; and (iii) the ruler gains utility $V_{cip}(\tau_c^*, c^* > 0) = V_{pftc}(\tau_p^*, c = 0)$.*

Proof. See Appendix. □

Intuitively, *Lemma 3* states that the old producer gives the ruler a positive contribution that brings equilibrium tax rate below the Protection-for-Tax-Compliance tax rate. More importantly, thanks to this positive contribution the domestic producer is not fully extracted. Quite the opposite, despite the contribution cost $c^* > 0$, the new equilibrium tax τ_c^* is low enough as to allow the

producer to make positive profit. Second, *Lemma 3* states that the contribution-induced tax rate, τ_c^*, is greater than 0. In particular, $\tau_c^* \in (0, \tau_p^*)$ is such that the marginal cost of bribing equals the marginal gain in net profit. Third, *Lemma 3* states that the optimal strategy of the incumbent producer consists of making the ruler indifferent between two baskets: One characterized by a high tax rate and no contributions (*i.e.*, the original Protection-for-Tax-Compliance payoff); the other characterized by a lower tax rate $\tau_c^* < \tau_p^*$ and positive contributions, $c^* > 0$. Accordingly, her utility in both scenarios is similar. That is, $c(\tau_c^*)$ just offsets the ruler's utility loss when she is induced to depart from the Protection-for-Tax-Compliance equilibrium. For this same reason, it must be the case that a unique Contribution-Induced Protectionist equilibrium in the whole game exists.

Proposition 4. *(**Contribution-Induced Protection**) Suppose that the fiscal capacity constraint is binding, Lemma 1 and 2 are simultaneously satisfied, and an uncompetitive domestic producer is allowed to bribe the ruler in exchange for protection and low taxes. In case the ruler allows for free entry, she receives utility V_e as defined in Proposition 1. In case barriers are adopted, the ruler utility is defined by (2.18), with contribution gain given by (2.20).*

Then, for a sufficiently low fiscal capacity endowment $\tau_o \in [0, \hat{\tau}]$, where $\hat{\tau} < \tau(\lambda = 0)$ as defined by (2.15), a unique SPNE exists in which the producer gives the ruler a contribution $c(\tau_c)^* > 0$ (as defined in Lemma 3) in exchange for which she raises entry barriers and sets $0 < \tau_c^* < \tau_p^*$, with Protection-For-Tax-Compliance equilibrium tax $\tau_p^* = \tau(\lambda = 0)$. Accordingly, tax revenue

is $R(\tau_c^*)$*, wages are set to* $\omega(\tau_c^*|A_l)$*, the obsolete incumbent producer stays "in", yields positive profit* $\pi(\tau_c^*, c^*, x_c^*) > 0$*, and the would-be entrant remains "out".*

Proof. Lemma 3 defined the optimal contribution c^* for which $V_{cip}(\tau_c^*, c^* > 0) = V_{pftc}(\tau_p^*, c = 0)$. Existence of $\hat{\tau} \in (0, \tau(\lambda = 0))$ such that $\hat{\tau}_{cip} = \hat{\tau}_{pftc}$ follows directly from the *Proof* of *Proposition 3*. □

Proposition 4 states that for sufficiently low fiscal capacity endowment, the ruler still prefers *entry barriers* to *free-entry*. However, this time she sets a lower tax rate upon raising barriers (with respect to that of the Protection-for-Tax-Compliance equilibrium) and receives positive contributions to fully compensate for the utility loss. *Proposition 4* also states that parameter space for which Protection-for-Tax-Compliance and Contribution-Induced Protection equilibria exist is the same: $\tau_o \leq \hat{\tau}$. This implies that contributions might affect the magnitude of the tax rate under protection but will not delay *free-entry* in case fiscal capacity endowment eventually expands.

Protection-for-Tax-Compliance *despite* Contributions

Protection-for-Tax-Compliance characterizes an equilibrium in which labor benefits from the protection of obsolete producers. In that equilibrium, old producers pay lower wages but abide by a tax rate above the fiscal capacity endowment of the economy. In particular, the equilibrium tax rate is equal to the welfare maximizing tax rate, $\tau(\lambda = 0)$ (*Proposition 3*). When we allow for

contributions, the equilibrium tax rate under protection falls below the welfare maximizing rate, $\tau_c^* < \tau(\lambda = 0)$ (*Proposition 4*). Since labor utility is strictly increasing in $\tau \in [0, \tau(\lambda = 0)]$ (*Proposition 1*), wage-earners are strictly worse-off when bribing takes place than otherwise.

If it is true that, given protection, labor is better-off without bribes, it is not necessarily true that they are better-off with free-entry than Contribution-Induced Protectionist equilibrium. That ultimately depends on the technology distance between the new and the old producer as well as the fiscal capacity endowment. Revenue and wages differ across policy regimes depending on these two parameters.

Lemma 4. *Supposed the fiscal capacity constraint is binding. Then, tax revenue under Contribution-Induced protection is greater than that following free-entry if*

$$\frac{A_l}{A_h} > \frac{\tau_e^*(1-\tau_e^*)^{\frac{\alpha}{1-\alpha}}}{\tau_c^*(1-\tau_c^*)^{\frac{\alpha}{1-\alpha}}} \tag{2.24}$$

with τ_c^* and τ_e^* defined in *Proposition 4 and 1*, respectively.

If *Lemma 4* is not satisfied, the technological distance between the new and old producers is large enough that tax revenue following free-entry is *always* greater than that upon protection.

Lemma 5. *Supposed the fiscal capacity constraint is binding. Then, equilibrium wage following free-entry is greater than that under protection if*

$$\frac{(1-\tau_e^*)^{\frac{\alpha}{1-\alpha}}}{(1-\tau_c^*)^{\frac{\alpha}{1-\alpha}}} < \frac{A_h}{A_l} \tag{2.25}$$

If *Lemma 5* is not satisfied, the technological distance between the new and old producers is that small that wages under free-entry are lower than those following protection (an elaborate explanation for a similar result is offered for *Lemma 2*).[27]

When *Lemma 4 and 5* are simultaneously satisfied,[28] the equilibrium wage under free entry is above that of a Contribution-Induced Equilibrium, but the equilibrium tax rate is greater under the latter. Hence, it is not evident which combination of wages and tax revenue would make labor better-off. *Proposition 5* states that labor prefers protection *despite contribution* to free-entry when fiscal capacity is sufficiently low:

Proposition 5. ***(Protection-for-Tax-Compliance despite Contributions)*** *Proposition 4 identified a unique $\hat{\tau} < \tau(\lambda = 0)$ such that, $\forall \tau_o \in [0, \hat{\tau}]$, a bribe-responsive ruler prefers protection to free-entry. Now, for Lemma 3 to 5 and labor utility function given by (2.1), there exists a unique $\tilde{\tau} \in (0, \hat{\tau})$ such that, for $\tau_o \leq \tilde{\tau}$, Contribution-Induced Protection yields $\tau_c^* \geq \tau_o$ and labor is better-off under protection (despite contributions) than free-entry of a superior competitor. On the contrary, if $\tau_o > \tilde{\tau}$, then $\tau_c^* < \tau_o$, and labor is better-off if free-entry is allowed.*

Proof. Denote V_{labor}^j the utility of labor, as given by (2.1), with $j \in \{e, p\}$, for *entry* and *protection* respectively. From *Proposition 1* we know that V_{labor}^j

[27] Condition 5 identifies the minimum requirement for this exercise to yield interesting policy trade-offs. These do not exist if the potential entrant's productivity is virtually identical to that of the incumbent producer.

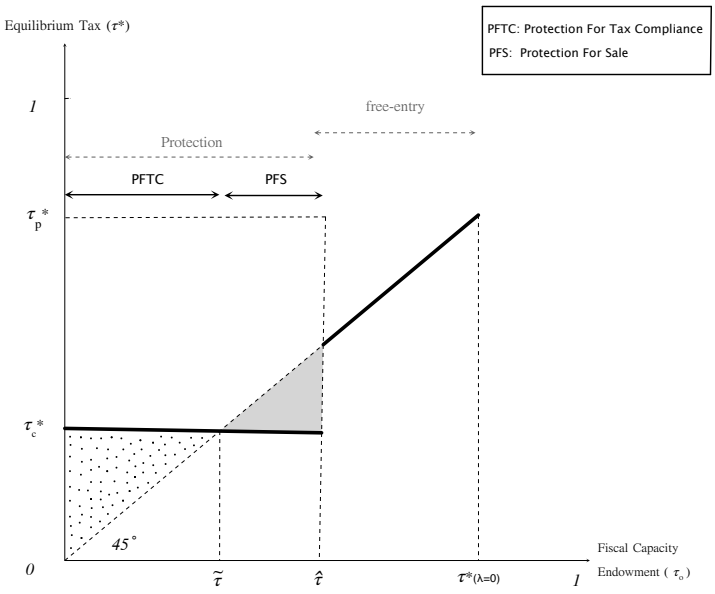
[28] They are if and only if $\tau_c^* > \tau_e^*$.

is strictly increasing in $\tau_o \in [0, \tau(\lambda = 0)]$, and by *Lemma 3* we know that $0 < \tau_c^* < \tau_p^*$. Hence, $0 < V_{labor}^p(\tau_c^*) < V_{labor}^p(\tau_p^*)$. By *Proposition 1*, upon entry, $\tau_e^* = \tau_o$. When $\tau_o \to 0$, $V_{labor}^e(\tau_e^*) = -\infty < V_{labor}^p(\tau_c^*)$; when $\tau_o \to \tau(\lambda = 0)$, $V_{labor}^e(\tau_e^*) > V_{labor}^p(\tau_c^*)$. Then, for $\hat{\tau}$ defined as in *Proposition 3*, by the Intermediate Value Theorem it necessarily exists a unique $\tilde{\tau} \in (0, \hat{\tau})$ such that for all $\tau_o \in [0, \tilde{\tau}]$, $V_{labor}^p(\tau_c^*) \geq V_{labor}^e(\tau_e^*)$; and for all $\tau_o \in (\tilde{\tau}, \hat{\tau}]$, $V_{labor}^p(\tau_c^*) < V_{labor}^e(\tau_e^*)$. □

Intuitively, *Proposition 5* states that for sufficiently low fiscal capacity endowment $\tau_o \leq \tilde{\tau}$, the equilibrium tax rate under a Contribution-Induced equilibrium, although lower than the welfare maximizing rate, is still above the fiscal capacity endowment τ_o. As such, provided *Lemmas 4 and 5* are satisfied, labor is better-off if protection is allowed than upon free entry. This result is consistent with the notion of Protection-for-Tax-Compliance, by which labor benefits from protection of inefficient firms because these, in exchange, abide by higher taxes.

The parameter space for this *win-win* scenario, in which the incumbent producer, the ruler and labor are all better-off (in comparison to *free-entry*) is smaller than that of the original Protection-for-Tax-Compliance equilibrium, characterized by *Proposition 3*. This is illustrated in Figure 2.2, which plots the ruler's equilibrium strategy as a function of the fiscal capacity endowment. For $\tau_o \leq \hat{\tau}$ protection is optimal for the ruler (*Proposition 4*). Along this interval she receives positive contributions. However, the ultimate equilibrium tax she

Figure 2.2: Equilibrium Tax Rate and ruler's Optimal Strategy when Contributions are allowed. The dotted area identifies the values of fiscal capacity endowment for which equilibrium tax rate is above the fiscal capacity endowment. The grey area identifies the values of fiscal capacity endowment for which equilibrium tax rate is below the fiscal capacity endowment.



sets depends on the fiscal capacity endowment. In particular, only a subset of this interval, $\tau_o \leq \tilde{\tau}$, is consistent with Protection-for-Tax-Compliance. For this interval only, the equilibrium tax rate is above the fiscal capacity endowment. Accordingly, in Figure 2.2 the equilibrium tax rate (solid line) for $\tau_o \leq \tilde{\tau}$ falls above the 45° line.

On the contrary, when fiscal capacity reaches intermediate levels, $\tau_o \in$

$(\tilde{\tau}, \hat{\tau}]$, the Protection-for-Tax-Compliance equilibrium unravels. For this parameter space, the equilibrium tax falls below the fiscal capacity endowment. Graphically, this implies that the equilibrium tax rate is below the 45° line. In this case, protectionist policy benefits the ruler and the old producer only, and makes wage-earners worse off. The latter would improve from entry of a superior firm.[29] Instead, for $\tau_o \in (\tilde{\tau}, \hat{\tau}]$ they are paid lower wages (due to the low productivity of the incumbent firms) *and* receive lower public spending, since $\tau_c^* < \tau_o$. In fact, the equilibrium policy for this subset of fiscal capacity endowment is consistent with the standard *Protection for Sale* hypothesis (Grossman and Helpman, 1994): That is, protection is *bought-off* through contributions whereas tax rate remains low (here, even lower than the fiscal capacity endowment of the state).[30]

For completeness, Figure 2.2 also plots the ruler equilibrium strategy for higher values of fiscal capacity endowment, $\tau_o > \hat{\tau}$. Here, by *Proposition 4* free-entry is preferred, and the ruler utilizes the full fiscal capacity, $\tau_e^* = \tau_o$. Graphically, the equilibrium tax rate falls along the 45° line).

To sum up, when fiscal capacity is sufficiently low, $\tau_o \leq \tilde{\tau}$, not even contributions prevent incumbent inefficient producers from paying higher effective tax rates following the adoption of entry barriers.[31] Contributions do reduce the parameter space for which we jointly observe protection and equilibrium

[29] Notice that for this same parameter space, in absence of bribes, labor would prefer protection. See *Proposition 3* if necessary.

[30] See Sonin (2010) for an example of protection with low taxation as a result of political giving.

[31] This result, in fact, is consistent with Desai and Olofsgård (2011), who find that influential firms are subject to lower regulatory constraints but still pay higher taxes on average.

tax rates above the fiscal capacity endowment, but they do not cancel it. More importantly, for such low endowments of fiscal capacity, labor is better-off if inefficient firms are protected than otherwise.

2.4. Empirical Design

The theoretical section of the paper identifies two conditions for Protection-for-Tax-Compliance to hold: (i) The incumbent producer must be obsolete (otherwise he would not be interested in protection); and (ii), fiscal capacity must be sufficiently low. Both conditions must hold simultaneously for protection to induce higher tax abidance. Combined, the main empirical implications of the theoretical model is: *Tax compliance of obsolete industries increases in protection conditional on low fiscal capacity*.

This section seeks to test this research hypothesis against cross-national evidence. In particular, the empirical analysis exploits variation in fiscal capacity across Latin America and Eastern Europe to assess the incidence of Protection-for-Tax-Compliance. However, instead of treating each country as a homogeneous unit, the research design exploits sector-variation in key magnitudes: taxation, protection and obsolescence. In particular, the empirical design includes all two-digit extractive and manufacturing industries (as classified by the International Standard Industry Classification (ISIC Rev. 3)) for which data on sector magnitudes *and* national values of fiscal capacity exist. The ultimate sample includes a total of 25 two-digit sectors, which are themselves nested within the 32

Latin-American and Eastern European economies.[32] The data structure is of an unbalanced panel in which sectors nest within countries. Altogether, it includes 322 sector-country units.[33]

Given the data structure, we seek to examine whether "obsolete" sectors in "low fiscal capacity" economies are more "tax compliant" (*i.e.*, evade less) once they are granted "protection". That is, three conditions must be simultaneously met for tax compliance to increase: fiscal capacity must be low, incumbent sectors uncompetitive, and protection positive. In order to test this prediction a three-way interaction is in order. Specifically, given two-digit sector i in country j we seek to fit

$$\begin{aligned} tax_compliance_{ij} \quad &= \beta_0 + \beta_1 Low_Fiscal_Capacity_j + \beta_2 Protection_{ij} \\ &+ \beta_3 Obsolescence_{ij} \\ &+ \beta_4 \big(Obsolescence_{ij} \times Protection_{ij}\big) \\ &+ \beta_5 \big(Low_Fiscal_Capacity_j \times Protection_{ij}\big) \\ &+ \beta_6 \big(Obsolescence_{ij} \times Low_Fiscal_Capacity_j\big) \\ &+ \beta_7 \big(Obsolescence_{ij} \times Low_Fiscal_Capacity_j \times Protection_{ij}\big) \\ &+ \mathbf{Z}_{ij}\beta_8 + \delta_i + \eta_j + \epsilon_{ij} \end{aligned} \tag{2.26}$$

where Z_{ij} denotes a vector of controls, the δ_i's denote a full set of two-digit sector effects, the η_j's denote a full set of country fixed effects, and ϵ is a disturbance term. The main coefficient of interest is β_7. This coefficient should be positive if, conditional on low fiscal capacity, obsolete sectors are more tax

[32] The final sample includes sectors from: Albania (AL), Argentina (AR), Armenia (AM), Belarus (BY), Bolivia (BO), Bulgaria (BG), Chile (CL), Colombia (CO), Croatia (HR), Czech Republic (CZ), Ecuador (EC), El Salvador (SV), Estonia (EE), Georgia (GE), Guatemala (GT), Hungary (HN), Kazakhstan (KZ), Latvia (LV), Lithuania (LT), FYR Macedonia (MK), Mexico (MX), Moldova (MD), Nicaragua (NI), Peru (PE), Poland (PL), Romania (RO), Russian Federation (RU), Slovak Republic (SK), Slovenia (SI), Turkey (TR), Ukraine (UA), Uruguay (UY).

[33] Further details can be found in the Appendix.

abiding once protected. Indeed, β_7 might be compared to β_6, the observational counterfactual. Particularly, β_6 captures the taxes paid by an obsolete sector in a low fiscal capacity economy when it is not protected. According to the theoretical model, we should expect these sectors to pay lower taxes, or at least not to differ significantly from the sample average. In other words, we expect $\beta_6 \leq 0$.[34]

Measurement

Next, we review how the four key magnitudes in the research hypothesis are measured.

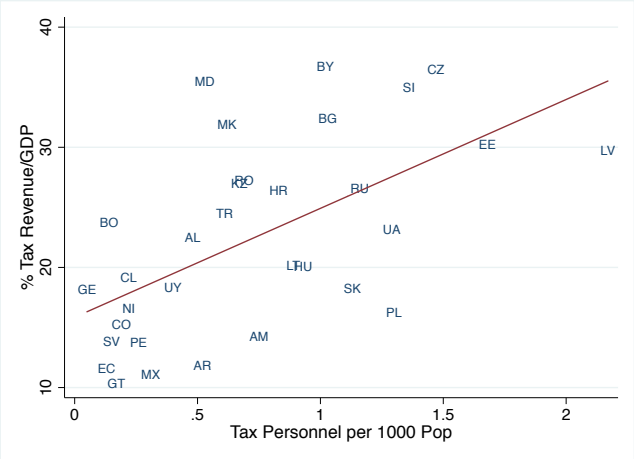
Fiscal capacity. This variable varies by country, not sector. It is approximated by the total number of staff of the tax administration for every 1,000 people in the country. This variable is produced by the USAID's *Fiscal Reform and Economic Governance Project* (FREGP).[35] The values of fiscal capacity this analysis are recorded circa 2007.[36] Figure 2.3 shows that this measure is strongly correlated to the share of tax revenue over GDP, the usual proxy for fiscal capacity (Besley and Persson, 2010; Hendrix, 2010)). However, contrarily to the latter variable, tax personnel is a lumpy magnitude that the ruler cannot

[34]Notice that β_4 represents an off-the-equilibrium path outcome: obsolete sectors in high fiscal capacity economies being protected. The same applies to β_5: competitive sectors being protected when fiscal capacity is low. The theoretical mode offers no *aprioristic* expectation for these two estimates.

[35]The FREGP data is not subject to copyright protection, is in the public domain, and can be accessed at http://www.fiscalreform.net/.

[36]All values refer to 2007 except for Armenia (2008), Belarus (2008), Colombia (2004), Ecuador (2004), Georgia (2004), Guatemala (2004), Kazakhstan (2009) and Nicaragua (2004).

Figure 2.3: Share of Tax Revenue over GDP vs. Personnel Working for Tax Administration per 1,000 of the national Population. $R^2 = .58$. Data source: USAID's Fiscal Reform and Economic Governance Project.



endogenously modify in the short-run. In other words, it genuinely reflects the structural capacity of the state to tax private income.

Tax Compliance. The World Bank *Business Survey* does not request for tax payments but tax compliance. This is methodologically convenient because responses systematically incorporate varying tax treatments across sectors. Information on tax compliance is sensitive for obvious reasons. The *Business Survey* questionnaire retrieves this information in the following terms:

> *Recognizing the difficulties that many firms face in fully complying with taxes and regulations, what percentage of total annual sales would you estimate the typical firm in your area of business reports*

for tax purposes?

This wording is purposively chosen to elicit more candid responses than if respondents were asked directly (Knack, 2007). Still, this variable might present two sources of noise: On the one hand, strategic-considerations might be in place. On the other, we can never be sufficiently sure that respondents take themselves as reference. Sector averages, as the ones used in the upcoming analysis, should minimize both sources of noise. Nevertheless, the reliability of these data has already been confirmed by Gehlbach (2006) and Desai and Olofsgård (2011). In particular, their work confirms that the distribution of this variable satisfies the main predictions of taxation theory: That is, self-reported tax compliance is greater for larger firms, monopolies, state-owned and resource-extractive enterprises.[37] This variable, in short, seems to capture genuine trends in tax compliance.

For the sake of representativeness, only a weighted average of sector tax compliance is considered in the analysis. Under this premise, the responses of big firms weigh more than those of smaller competitors. *Firm labor* acts as weighting factor.[38] The descriptive statistics of this and remaining variables are reported in Table 2.1.

[37] Knack (2007) specifically analyzes the reliability of the World Bank *Business Survey* for corruption-related variables, including "bribe taxes". He finds that the respondents answers correlate highly with experts assessments. Moreover, pairwise correlation between average national tax compliance and the share of tax revenue over GDP for the 32 economies considered in the analysis is .51.

[38] An example: Suppose two firms operate sector j. One hires 70% of labor in sector j and complies with 20% of taxes. The other firm hires 30% of labor in that same sector and complies with 90% of taxes. The weighted tax compliance value for sector j is $.2 \times .7 + .9 \times .3 = .41$.

Table 2.1: Summary statistics (N=322)

Variable	Mean	(Std. Dev.)	Min.	Max.
Weighted Tax Compliance	0.89	(0.14)	0.2	1
Fiscal Capacity	0.85	(0.49)	0.05	2.17
Obsolescence	0.79	(0.26)	0	1
Tariff Protection	5.69	(5.49)	0	28.97
log(1+Export Share)	2.47	(1.35)	0	4.60
Market Structure	2.35	(0.59)	0	3
log(Capital)	14.99	(2.26)	8.85	20.36

Obsolescence. Foreign firms and foreign products are major competitors for domestic industry, especially in developing economies. Here we seek to obtain an indicator of the technological distance between domestic and foreign firms. This measure would indicate how exposed domestic firms are to foreign competitors and how interested they are likely to be in the adoption of entry barriers. The World Bank *Enterprise Survey* includes a variable indicating whether the firm has *recently* obtained a new internationally-recognized quality accreditation (ISO 9000, 9002 or 14,000, AGCCP, etc). Besides being a reasonable proxy for the technological distance with foreign competitors, this item establishes an objective, international standard of quality across countries.[39] Moreover, this variable correlates positively with other practices that are generally associated with competitive firms: recent adoption of a new technology (.17 Pearson) or engagement in costly R&D activity (.23 Pearson).[40]

The proportion of firms holding one of these accreditations is computed for

[39] All industries in the sample are entitled for such international accreditations.

[40] Unfortunately, these other proxies of competitiveness lack the crucial reference to technological distance with respect to foreign competitors required to test the theory at play.

all sectors. A sector is considered obsolete the closer this proportion is to 0, and competitive when this proportion approaches 1.

Protection. Entry barriers are proxied by sector-level import tariff protection. Two coding decisions are required here: First, since statutory tariff lines can be meaningless, attention is restricted to *effective* tariff measures only. This implies that when a similar product has different tariffs (they might vary across exporters), only the lowest value enters the dataset. Second, within each two-digit sector there are multiple tariff lines. To cope with within-sector variation, each tariff line is weighed by its trade volume. Altogether, the tariff measure used in the analysis is effective (not statutory) and representative (weighted average). The data source for tariff protection is UNCTAD's TRAINS system.[41]

Besides they four key magnitudes, regression models control for *export activity*, *market structure*, and *sector capital*. These variables are sought to affect both the left and right-hand side of the regression model. Export oriented sector are said to be technologically advanced (Melitz, 2003). But at the same time, they are also easier to tax (Musgrave, 1969).[42] *Market structure* (*i.e.*, the extent to which a given market is oligopolistic) is proven to be strongly correlated with sector taxability (Gehlbach, 2006). But oligopolistic sectors might have a higher capacity to lobby (Drope and Hansen, 2009; Olson, 1965), specifi-

[41] These data is publicly available at http://wits.worldbank.org/wits/.

[42] *Export share* captures the average proportion of sales that are exported in a given sector. The raw variable goes from 0 to 98% (data source: World Bank *Business Survey*).

cally for lower taxes (Richter et al., 2009) and higher protection (Grossman and Helpman, 1994).[43] *Sector capital* is also a strong proxy for sector taxability (Gupta and Newberry, 1997), but capital-intensive sectors tend to be oligopolistic too.[44] In case these three controls were not enough to control for sector- and country-heterogeneity, all models are adjusted by two full sets of sector- and country-fixed effects. Their inclusion should minimize the risk of omitted variable bias.[45]

The two-digit sector-level averages for *tax compliance*, *obsolescence* and control regressors are all computed for a sample of 7,954 firms distributed across Latin America and Eastern Europe. Observations with missing data for *tax compliance* and *labor* are dropped from that matrix.[46] Moreover, the *labor* and *capital* variables are winsorized at 1- and 99-percentile.[47] This strategy reduces the risk of results being driven by outliers.

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[43] Each respondent in the sample declares the number of competitors they have. Respondents must chose among different categories: from category 0 (no competitor) to category 3 (more than 5 competitors). For each two-digit sector the average is computed (data source: World Bank *Business Survey*).

[44] *Sector capital* aggregates the monetary value of all fixed capital of a given sector. A log-transformation is used in the analysis to cope with the skewness of this variable's distribution (data source: World Bank *Business Survey*).

[45] Firm labor is a strong predictor of tax compliance too (Gehlbach, 2006; Desai and Olofsgård, 2011). But *sector labor* and *sector capital* are highly correlated: .82 (Pearson). To avoid multicollinearity problems, one should drop one from the equation. Since *labor* is used as the weighting factor to compute average tax compliance, we prefer to keep *sector capital* in the vector of regressors. Otherwise, part of the correlation between tax compliance and the regressors would stem from the weighting factor.

[46] Recall, together these two variables conform the dependent variable.

[47] Winsorization of the *capital* variable is executed after deflating capital costs in the Latin American sample to Dec 31, 2005 values.

Correlates

In order to fit regression model as stated in (2.26) one last change is required. The *fiscal capacity* variable is reversed so that higher values now denote *lower fiscal capacity*.[48] Table 2.2 reports the estimate of the three-way interaction, β_7 in (2.26), for three selected models: OLS, tobit and multilevel.

Model 1 fits expression (2.26) for the entire sample (N=322). The OLS estimates for β_6 and β_7 move in the expected direction. That is, conditional on low fiscal capacity, obsolete sectors, if protected, tend to be more tax compliant ($\hat{\beta}_7 > 0$); but that is not the case when they do not receive protection ($\hat{\beta}_6 \leq 0$). Model 1 includes a full vector of two-digit sector fixed effects that control for unobserved confounders across sectors. It also adjusts for country fixed-effects, which might capture, among other things, information about the tax administration (effectiveness, expertise, computerization, corrupt practices, etc) other than the number of personnel that might be affecting not only observed tax compliance but also the willingness/necessity to engage in Protection-for-Tax-Compliance practices.

The distributions of the dependent variable, *obsolescence* and *protection* are skewed. Hence, Model 1 estimates might be driven by influential outliers. Figure 2.4 plots the distribution of Model 1 residuals against their leverage scores. Here, we observe four influential outliers: cases no.321 (ISIC = 31, Russian

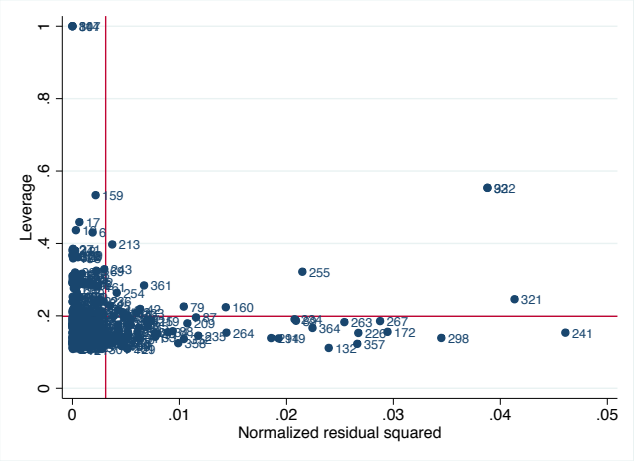
[48] The reversion is done premultiplying the original value of *fiscal capacity* by -1. This change eases the interpretation of the analysis in as much as aligns the three variables in the three-way interaction.

Table 2.2: Cross-National Test of Protection-For-Tax-Compliance. Dependent Variable: Average Tax Compliance at Two-digit Sector Level.

	(1) OLS	(2) OLS	(3) OLS	(4) Tobit	(5) Hierarch.
$\hat{\beta}_1$: Low Fiscal Capacity	.05	.04	.02	.06	.08
	(.07)	(.07)	(.07)	(.09)	(.08)
$\hat{\beta}_2$: Tariff	-.03**	-.03*	-.03**	-.04***	-.03**
	(.01)	(.01)	(.01)	(.01)	(.02)
$\hat{\beta}_3$: Obsolescence	-.18	-.15	-.14	-.25*	-.16
	(.12)	(.12)	(.12)	(.14)	(.10)
$\hat{\beta}_4$: Obsolescence $\times$ Tariff	.03*	.02*	.02*	.04***	.03*
	(.01)	(.01)	(.01)	(.01)	(.02)
$\hat{\beta}_5$: Low Fiscal Capacity $\times$ Tariff	-.03**	-.02***	-.03***	-.04***	-.03**
	(.01)	(.01)	(.01)	(.01)	(.01)
$\hat{\beta}_6$: Obsolescence $\times$ Low Fiscal Capacity	-.13	-.13	-.12	-.20**	-.13
	(.08)	(.08)	(.07)	(.09)	(.09)
$\hat{\beta}_7$: Obsolescence $\times$ Low Fiscal Capacity $\times$ Tariff	.02*	.02**	.02**	.03***	.02*
	(.01)	(.01)	(.01)	(.01)	(.01)
$\hat{Z}_1$: ln(1+Export Share)	.00	-.00	.00	.00	.00
	(.01)	(.01)	(.01)	(.01)	(.01)
$\hat{Z}_2$: Market Structure	-.02	-.02	-.03**	-.04***	-.03**
	(.01)	(.01)	(.01)	(.01)	(.01)
$\hat{Z}_3$: ln(Sector Capital)	.01*	.01	.01**	.01	.01*
	(.01)	(.01)	(.00)	(.01)	(.00)
$\hat{\beta}_0$: Constant	.91***	.89***	.85***	.98***	1.07***
	(.15)	(.16)	(.13)	(.15)	(.13)
Sector FE	Yes	Yes	No	No	No
SuperSector FE	No	No	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	No
Region FE	Yes	Yes	Yes	Yes	Yes
Observations	322	318	318	318	318
R-squared	.45	.48	.46	.	.

Standard errors in Models 1 to 4 are robust, clustered at country level.
*** p<.01, ** p<.05, * p<.1

Figure 2.4: Influential Outliers in Model 1 of Table 2.2. Standardized Residuals vs. Leverage.



Federation), 322 (ISIC = 32, Russian Federation), 93 (ISIC = 32, Bulgaria), and 255 (ISIC = 21, Moldova).

On the one hand, cases no.321, 255 and 93 have extreme values in tax compliance, in one or other way: Case no.321 has the lowest tax compliance value in Russia. Case no.255 has the lowest value of tax compliance for two-digit sector ISIC 21. And case no.93 has the lowest tax compliance value in the entire sample. On the other hand, case no.322 is special because of its uncommon tariff protection value: it has the highest tariff value for two-digit sector ISIC 32. Model 2 re-runs the same specification in Model 1 once these four outliers are dropped. The results suggest that the presence of the four influential cases far from driving the results impede them from being more favorable to the

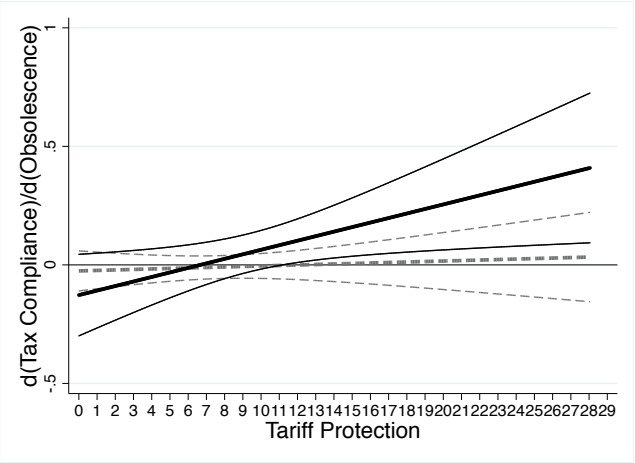
Protection-for-Tax-Compliance hypothesis.

Model 3 modifies the vector of sector fixed-effects. Tax policy (or negotiations) might take place at higher levels of aggregation than the two-digit level. To allow for this possibility, we collapse the 25 two-digit ISIC sectors into 8 categories, or *supersectors*.[49] The magnitudes of $\hat{\beta}_7$ and $\hat{\beta}_6$ once we adjust for the new set of sector fixed-effects is virtually identical to those in Model 1 and 2. However, the estimates are more efficient now -most likely because the model consumes fewer degrees of freedom.

Figure 2.5 plots the marginal effect of obsolescence on tax compliance as derived from Model 3. To examine the effect of obsolescence on tax compliance we fix fiscal capacity to two representative values (mid-low and mid-high), and allow tariff protection to vary along its observational range. When fiscal capacity is high (dashed grey curve), tariff protection seems to yield no effect on tax compliance among obsolete sectors. The marginal effect falls over 0 along the entire range of tariff protection. Indeed, granting protection for such high levels of fiscal capacity is an off-the-equilibrium path under the Protection-for-Tax-Compliance model. In other words, protection in that state of the world (*i.e.*, high fiscal capacity) is given for reasons other than tax compliance. In consequence, the null effect of protection among obsolete sectors that we observe in Figure 2.5 is to be expected by the theoretical model. On the contrary, when fiscal capacity is low (solid black curve), tax compliance among obsolete

[49] (i) Mining and quarrying; (ii) Food processing, beverages and tobacco; (iii) textiles; (iv) wood processing; (v) pulp and printing; (vi) chemicals, petroleum, rubber and plastics; (vii) non-metal minerals and basic metals; and (viii) metal products and machinery equipments.

Figure 2.5: Marginal Effect of Obsolescence on Average Tax Compliance by Tariff Protection and two values of Fiscal Capacity (90% Confidence Interval). Prediction run with Model 3 estimates in Table 2.2. High fiscal capacity (1/1,000) in dashed grey line. Only 30% of sector has values above $1/1,000$. Low Fiscal capacity (19/10,000) in solid black line. Only 20% of sector has values below $19/10,000$.



sectors should increase in protection. And that is precisely what we observe in Figure 2.5.

Model 4 in Table 2.2 acknowledges the censured nature of the dependent variable. Tax compliance responses are constrained between 0 and 1. A tobit model is run to cope with this nuisance. The magnitude of the two coefficients of interest, $\hat{\beta}_7$ and $\hat{\beta}_6$, increases in the expected direction as do their statistical significance. Finally, in order to fully respect the hierarchical structure in the data (*i.e.*, sectors are nested within countries), Model 5 reports the multilevel estimates of the three-way interaction (see Appendix for the model specifica-

tion).[50] Once again, we observe that protection increases tax compliance among obsolete sectors conditional on low fiscal capacity: that is, $\hat{\beta}_7 > 0$. Figure 2.6 plots the estimate of the three-way interaction coefficient by the level of fiscal capacity. We can observe that the effect of protection among obsolete sectors is positive only for sufficiently low values of fiscal capacity, as predicted by the theoretical model.

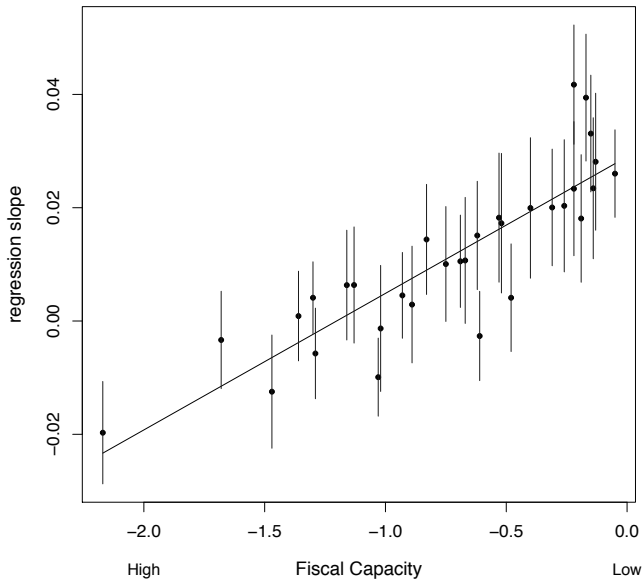
2.5. Conclusion

This papers examines a very particular way through which rulers can raise tax revenue without actually investing in fiscal capacity: Protection-for-Tax-Compliance. It has been claimed, first with a theoretical model, later empirically, that rulers might grant protection to domestic firms in order to induce the latter to comply with their tax obligations. The theoretical model suggests that for low enough levels of fiscal capacity, a Protection-for-Tax-Compliance agreement can provide the ruler with her ideal tax rate, defined as the one she would adopt in absence of any fiscal capacity constraint. Most importantly, this kind of protectionist agreement is proved to be socially optimal.

This result offers an alternative explanation for protectionist policy to Grossman and Helpman's (1994) -one in which protection to inefficient firms arise without rent-seeking by government. In effect, we argued that under some conditions protection to inefficient firms may be granted *even if* rulers are welfare

[50] Although theoretically convenient, we should not base our conclusions on the hierarchical model only. This model is forced to estimate four random errors with only 318 observations.

Figure 2.6: Three-way cross-level interaction coefficient $\hat{\beta}_7$ by level of fiscal capacity. Estimates drawn from Model 5 in Table 2.2. Horizontal Axis is reversed: Highest values of Fiscal Capacity are on the left; lowest values on the right.



maximizers and unresponsive to political giving. When such conditions are met (*i.e.*, the fiscal capacity of the state is weak and incumbent producers are uncompetitive), protectionist policy delivers higher tax abidance. This exchange is self-enforcing as long as Schumpeterian market competition abides. The threat of extinction prevents defection by inefficient firms.

Protection-for-Tax-Compliance is robust to the intermediation of bribes.

The parameter space shrinks when incumbent producers can *buy-off* protection but does not cancel it. In other words, Protection-for-Tax-Compliance can coexist with some degree of political giving. Coexistence is, however, less likely the stronger the fiscal capacity. When strong states adopt protectionist policy, they do so for reasons other than tax compliance (*e.g.*, rent-seeking).

The main empirical implication of the theoretical model has been tested against cross-national data. Despite the research design is observational, all evidence seems consistent the model prediction: that is, conditional on low fiscal capacity, tax compliance of obsolete industries increases in protection from superior competitors.

An obvious extension of the model should consider the dynamic consequences of this kind of protectionist agreement: Despite the beneficial effects that protection might bring in the short-run (*i.e.*, increase effective taxation and labor welfare), it might endogenously empower incumbent producers as to eventually block entry of superior technologies (Mokyr, 1991). Paper 3 explores this possibility.

2.6. Appendix

2.6.1. Proof of Lemma 1

Lemma 1 examines when tax revenue under protection is greater than tax revenue following free-entry. Suppose the fiscal capacity constraint is binding. The revenue following protection is

$$R_p = \tau_p^* A_l L (1 - \tau_p^*)^{\frac{\alpha}{1-\alpha}} \tag{2.27}$$

with $\tau_p^* = \tau(\lambda = 0)$, the unconstrained tax rate. The revenue following entry is

$$R_e = \tau_e^* A_h L (\alpha (1 - \tau_e^*)^{\frac{\alpha}{1-\alpha}} \tag{2.28}$$

with $\tau_e^* = \tau_o$, the fiscal capacity endowment. For an easier comparison, from the equilibrium condition in (2.14), we get

$$(1 - \tau_p)^{\frac{\alpha}{1-\alpha}} = \frac{1 - \alpha - \tau_p}{\tau_p (1 - \alpha) A_l} \tag{2.29}$$

which we plug back into R_p. That leaves

$$\frac{1 - \alpha - \tau_p^*}{1 - \alpha} > \tau_p A_h (\alpha (1 - \tau_o)^{\frac{\alpha}{1-\alpha}} \tag{2.30}$$

which, once rearranged, yields *Lemma 1* condition.

2.6.2. Proof of Lemma 2

Lemma 2 examines when wages following free-entry are greater than wages under protection. Suppose the fiscal capacity constraint is binding. Wages following protection are

$$\omega_o^* = \frac{1-\alpha}{\alpha} A_l (1-\tau_p^*)^{\frac{\alpha}{1-\alpha}} \tag{2.31}$$

with $\tau_p^* = \tau(\lambda = 0)$, the unconstrained tax rate. Wages following entry are

$$\omega_e^* = \frac{1-\alpha}{\alpha} A_h (\alpha(1-\tau_e^*)^{\frac{\alpha}{1-\alpha}} \tag{2.32}$$

with $\tau_e^* = \tau_o$, the fiscal capacity endowment. From the equilibrium tax rate condition in (2.10), we get

$$(1-\tau_e)^{\frac{\alpha}{1-\alpha}} = \frac{1-\alpha-\tau_e}{\tau_p(1-\alpha)A_l \alpha^{\frac{\alpha}{1-\alpha}}} \tag{2.33}$$

Substitute this expression in ω_e^*, and (2.29) into ω_o^*. This leaves

$$\frac{1-\alpha-\tau_p^*}{\tau_p^*(1-\alpha)} < A_h \alpha^{\frac{\alpha}{1-\alpha}} (1-\tau_o)^{\frac{\alpha}{1-\alpha}} \tag{2.34}$$

which is equivalent to *Lemma 2* condition.

Moreover, there is a range of A_h for which *Lemma 1 and 2* are simultane-

ously satisfied

$$\frac{1-\alpha-\tau_p^*}{(1-\alpha)\tau_p^*(\alpha(1-\tau_o))^{\frac{\alpha}{1-\alpha}}} < A_h < \frac{1-\alpha-\tau_p^*}{(1-\alpha)\tau_o(\alpha(1-\tau_o))^{\frac{\alpha}{1-\alpha}}} \tag{2.35}$$

since $\tau_o \leq \tau_p^*$.

2.6.3. Proof of Lemma 3

Lemma 3 examines what is the optimal contribution when the incumbent producer is allowed to align the ruler's interest with his through contributions.

Proof. Let $\tilde{\pi}_c$ the gross profit of the incumbent producer. The maximization of $\tilde{\pi}_c$ with respect to x_c yields $x_c^* = AL(\alpha(1-\tau_p))^{\frac{1}{1-\alpha}}$ and $p_c^* = 1/(\alpha(1-\tau_p))$. We substitute these values into the net profit expression of the incumbent producer, who decides over the tax rate he wants to pay (and hence, the magnitude of the bribe).

$$\begin{aligned}\max_{\tau_c} \pi = \quad & \Big(\frac{1}{\alpha}-1\Big)AL(\alpha(1-\tau_c))^{\frac{1}{1-\alpha}} \\ & -\Big\{\big[1-\alpha-\tau_c(1+A(1-\alpha))(1-\tau)^{\frac{\alpha}{1-\alpha}}\big](\tau_p^*-\tau_c)\Big\}\end{aligned} \tag{2.36}$$

with the element in keys being the cost of the contribution. The FOC of this

maximization problem yields

$$\begin{aligned} -\alpha A_l L(\alpha(1-\tau_c))^{\frac{\alpha}{1-\alpha}} = \quad & -1+\alpha-\tau_p+2\tau_c \\ & +A_l(1-\tau_c)^{\frac{2\alpha-1}{1-\alpha}}((2+\alpha(-2+\tau_c)-2\tau_c)\tau_c \\ & +\tau_p(-1+\alpha+\tau_c)) \end{aligned} \tag{2.37}$$

This equality implies that the optimal tax rate is one for which the marginal cost of bribing (RHS) is equal to the marginal cost of taxation in the new protectionist regime (LHS). For simplicity, we can rearrange expression (2.37) as follows

$$\begin{aligned} \alpha(1-\alpha+\tau_p-2\tau_c) = \quad & \alpha(1-\tau_c)^{\frac{2\alpha-1}{1-\alpha}} A_l \Big[L\alpha^{\frac{1}{1-\alpha}}(1-\tau_c) \\ & +\alpha((2+\alpha(-2+\tau_c)-2\tau_c)\tau_c \\ & +\tau_p(-1+\alpha+\tau_c)\Big] \end{aligned} \tag{2.38}$$

The LHS in expression (2.38) is a linear function of τ_c with negative slope. The RHS of (2.38) is a concave function in τ_c. To guarantee that both curves cut in the $(0, \tau_p)$ interval (*i.e.*, interior solution) and only once, we have to analyze that the $LHS > RHS$ of (2.38) when $\tau_c \to 0$ and $RHS > LHS$ of (2.38) when $\tau_c \to \tau_p^*$.

On the one hand, when $\tau_c \to 0$,

$$\tau_p^* > \frac{\alpha^{\frac{\alpha}{1-\alpha}} + \alpha - 1}{2-\alpha} \tag{2.39}$$

Since $\tau_p^* > 0$, $\alpha < 1/2$ is sufficient for $LHS > RHS$ in (2.38).

On the other hand, when $\tau_c \to \tau_p^*$,

$$1 - \alpha < \tau_p(1 + (1-\alpha)A_l(1-\tau_p)^{\frac{\alpha}{1-\alpha}}) + A_l L(\alpha(1-\tau_p))^{\frac{\alpha}{1-\alpha}} \qquad (2.40)$$

From *Proposition 2* we know that in equilibrium $(1-\alpha)$ equals the first element in the RHS of expression (2.40). Since the second element in the RHS of expression (2.40) is strictly positive, $RHS > LHS$ of (2.38) is always true when $\tau_c \to \tau_p$. Hence, $\alpha < 1/2$ is sufficient for the existence of a unique interior solution $\tau_c^* \in (0, \tau_p^*)$, and $c(\tau_c^*) > 0$. Indeed, as long as $\alpha < 1/2$, this is τ_c^* global maximum in $\tau_c \in [-1, 1]$, what guarantees $\pi(\tau_c^*, c^*) > 0$. □

2.6.4. Data Sources and Structure

Except for the tariff values, all sector-level data is taken from the World Bank *Business Survey* of 2005 (Eastern Europe) and 2006 (Latin America). These surveys are representative of the industrial population in the countries considered. In addition to the measures of tax compliance and obsolescence, all controls (capital, market structure and export shares) are constructed from this dataset. Sector-level measures at the ISIC Rev.3.1 two-digit level for all these variables are first computed and then merged with the tariff protection data available at the *United Nations Conference on Trade and Development's TRAINS* system. Once the ISIC Rev.3.1 two-digit sector-level database is armed, all sectors are assigned the fiscal capacity value corresponding to their their

home country, proxied by the number of personnel working for the tax administration per 1000 inhabitants. This variable as well as the % taxes/GDP used in Figure 2.3, is produced by the USAID's *Fiscal Reform and Economic Governance Project* (FREGP). The FREGP data is not subject to copyright protection, is in the public domain, and can be accessed at http://www.fiscalreform.net/.

2.6.5. Multilevel Specification

Let *Low Fiscal Capacity (LFC)* $= -1 \times Fiscal\ Capacity$, Z_{ij} vector of controls, and δ_i battery of sector FE. The multilevel/hierarchical model to estimate is

$$\begin{aligned} tax_compliance_i = \quad & \alpha_{j[i]} + \beta^1_{j[i]} obsolescence_i + \beta^2_{j[i]} protection_i \\ & + \beta^3_{j[i]} (obsolecence_i \times protection_i) \\ & + Z_i + \delta_i + \epsilon_i \end{aligned}$$

with

$$\begin{aligned} \alpha_j = \quad & \gamma^\alpha_0 + \gamma^\alpha_1 LFC_j + \epsilon^\alpha_j, \\ \beta^k_j = \quad & \gamma^\beta_0 + \gamma^\beta_1 LFC_j + \epsilon^\beta_j,\ for\ k = 1, 2, 3. \end{aligned}$$

and $\epsilon^\alpha_j \sim \mathcal{N}(0, \sigma_\alpha)$, $\epsilon^\beta_j \sim \mathcal{N}(0, \sigma_\beta)$ with error correlation ρ, all estimated from the data. With a little algebra, expression 2.6.5 can be expressed as a three-way interaction model similar to expression 2.26. We just have to plug α_j and β^k_j

into 2.6.5. Then, we reach expression:

$$\begin{aligned} tax_compliance_i &= \gamma_0^{\alpha} + \gamma_1^{\alpha} LFC + \gamma_0^{\beta^1} Obsolescence + \gamma_0^{\beta^2} Protection \\ &+ \gamma_1^{\beta^2} (LFC \times Protection) \\ &+ \gamma_0^{\beta^3} (Obsolescence \times Protection) \\ &+ \gamma_1^{\beta^1} (Obsolescence \times LFC) \\ &+ \gamma_1^{\beta_3} (Obsolescence \times LFC \times Protection) \\ &+ Z_i + \delta_i \\ &+ \epsilon_j^{\alpha} + \epsilon_j^{\beta_1} Obsolescence + \epsilon_j^{\beta^2} Protection \\ &+ \epsilon_j^{\beta_3} (Obsolescence \times Protection) \end{aligned}$$

which corresponds to Model 5 in Table 2.2. The Protection-for-Tax-Compliance expectations remain in 2.6.5 stand: $\gamma_1^{\beta_3} > 0$ and $\gamma_1^{\beta^1} \leq 0$. The estimates for these coefficients are reported in Table 2.2. There we deliberately omitted the estimated standard deviation of the random errors: $\hat{\sigma}_{\alpha} = .092$, $\hat{\sigma}_{tariff} = .017$, $\hat{\sigma}_{obsolescence} = .054$, $\hat{\sigma}_{obsolescence \times tariff} = .013$.

2.7. Supplementary Material

2.7.1. Zero-Profit Condition

This section shows why imposing the *zero-profit condition* condition onto the protected industry is optimal following barriers. To test for optimality, we have to compare the utility with the *zero-profit condition*, V_z to those without this condition, V_w.

Recall, when the *zero-profit condition* applies, the ruler utility is defined as

$$V_z = \frac{1-\alpha}{\alpha} A_l (1-\tau_z)^{\frac{\alpha}{1-\alpha}} + ln\Big[\tau_z \frac{1}{(1-\tau_z)} AL(1-\tau_z)^{\frac{1}{1-\alpha}}\Big] \tag{2.41}$$

This expression is maximized for τ_z^* defined by

$$1-\alpha = \tau\Big[1+(1-\alpha)A_l L(1-\tau)^{\frac{\alpha}{1-\alpha}}\Big] \tag{2.42}$$

If the ruler does not impose a zero profit condition, the producer maximizes its profit. This yields x_w^*, ω_w^*, and p_w^*. Plugging this values into the ruler utility function yields

$$V_w = \frac{1-\alpha}{\alpha} A_l (\alpha(1-\tau_w))^{\frac{\alpha}{1-\alpha}} + ln\Big[\tau_w \frac{1}{\alpha(1-\tau_w)} AL(\alpha(1-\tau_w))^{\frac{1}{1-\alpha}}\Big] \tag{2.43}$$

Expression (2.43) is similar to the one under entry, with the sole difference of A_l instead of A_h. For this same reason, expression (2.43) expression is maximized

for τ_w^* defined by

$$1-\alpha = \tau\Big[1+(1-\alpha)A_l L(\alpha(1-\tau))^{\frac{\alpha}{1-\alpha}}\Big] \tag{2.44}$$

Now we compare τ_w^* to τ_z^*. The LHS of both expressions is similar, $1-\alpha$. Both RHS are concave function starting in 0. They cut the LHS at different point. In particular, the RHS of expression cuts it later because the same $\alpha^{(\alpha/1-\alpha)}$ in expression (2.44) that is absent in expression 2.42. Thus, $\tau_z^* < \tau_w^*$.

Knowing $\tau_z^* < \tau_w^*$, next we seek to prove that wages with the *zero-profit condition* are greater than without. The LHS of expression 2.45 reflects the equilibrium wage for the *zero-profit condition*, whereas the RHS represents the one without this condition.

$$\frac{1-\alpha}{\alpha}A_l(1-\tau_z^*)^{\frac{\alpha}{1-\alpha}} \;>\; \frac{1-\alpha}{\alpha}A_l\alpha^{\frac{\alpha}{1-\alpha}}(1-\tau_n^*)^{\frac{\alpha}{1-\alpha}} \tag{2.45}$$

This simplifies to

$$(\frac{1-\tau_z}{1-\tau_n})^{\frac{\alpha}{1-\alpha}} \;>\; \alpha^{\frac{\alpha}{1-\alpha}}$$

which is always true for $\tau_z^* < \tau_w^*$. Thus, $\omega_z > \omega_w$.

Next, we seek to prove that tax revenue (per capita public spending) with the *zero-profit condition* is greater than without. The LHS of expression 2.46 reflects the equilibrium wage for the *zero-profit condition*, whereas the RHS represents the one without this condition.

$$ln\Big[\tau_z^* \frac{1}{(1-\tau_z^*)} AL(1-\tau_z^*)^{\frac{1}{1-\alpha}}\Big] \; > \; ln\Big[\tau_w^* \frac{1}{\alpha(1-\tau_w^*)} AL(\alpha(1-\tau_w^*))^{\frac{1}{1-\alpha}}\Big] \tag{2.46}$$

A little algebra simplifies this expression into

$$\frac{1-\tau_z^*}{1-\tau_w^*} \; > \; \frac{\tau_w^*}{\tau_z^*} \alpha^{\frac{\alpha}{1-\alpha}} \tag{2.47}$$

From equilibrium conditions (2.42) and (2.44) we can retrieve

$$(1-\tau_z)^{\frac{\alpha}{1-\alpha}} = \quad \frac{1-\alpha-\tau_z}{\tau_z(1-\alpha)A_l}$$

and

$$(1-\tau_w)^{\frac{\alpha}{1-\alpha}} = \quad \frac{1-\alpha-\tau_w}{\tau_w(1-\alpha)A_l\alpha^{\frac{\alpha}{1-\alpha}}}$$

Plugging these expressions back into (2.47), and simplifying yields

$$\frac{1-\alpha-\tau_z}{1-\alpha-\tau_w} > 1$$

which is always true for $\tau_z^* < \tau_w^*$. Thus, $R_z > R_w$.

Since both wages and tax revenue (public spending) are greater with the *zero-profit condition* than without, it is optimal for the ruler to impose this con-

dition onto the protected producer.

2.7.2. Schumpeterian Competition

If we seek to model Schumpeterian Competition appropriately, we can allow the firms to differ on the marginal cost of producing the intermediate product χ (instead of the quality of intermediate input A). Initially, we assumed that the marginal cost of producing the intermediate good was 1 for both firms. Now, we relax this assumption. Denote the old producer marginal cost χ_o, and the new producers' χ_n. Assume, $\chi_o > \chi_n$, thus the new producer is more efficient.

Suppose now that the fiscal constraint in (2.9) is binding. In that case, from *Proposition 1* we know that $\tau_e^* = \tau_o$. Given τ_e^*, equilibrium prices of the competing firms are

$$p_n^* = \frac{\chi_n}{\alpha(1-\tau_o)} < p_o^* = \frac{\chi_o}{\alpha(1-\tau_o)} \tag{2.48}$$

In words, the old producer cannot undercut the new producer's price. All input is bought from the new firm, and the old one is dropped from the market. Notice, as well, that once *free-entry* is allowed, the *zero-profit condition* does not apply. That explains the similarity of the price functions between producers, differing only in χ.

Suppose now that the fiscal capacity in (2.9) does not bind. In that case, the ruler optimizes her utility function for tax rate $(\tau_j^e)^*$ different for each firm

$j \in \{old, new\}$ and implicitly defined by

$$1-\alpha = \tau_j^e \left[1 + (1-\alpha) \Big(\frac{\alpha}{\chi} \Big)^{\frac{\alpha}{1-\alpha}} (1-\tau_j^e)^{\frac{\alpha}{1-\alpha}} \right] \tag{2.49}$$

which depends on χ_j. Applying the Implicit Function Theorem to the FOC of the ruler's problem, we see that $\partial \tau^* / \partial \chi > 0$. That is, the tax rate following entry of the old producer is greater than the one for the new entrant. This implies that

$$p_n^* = \frac{\chi_n}{\alpha\big(1-(\tau_n^e)^*\big)} \; < \; p_o^* = \frac{\chi_o}{\alpha\big(1-(\tau_o^e)^*\big)} \tag{2.50}$$

since the numerator $\chi_n < \chi_o$, and the denominator $(1-(\tau_n^e)^*) > (1-(\tau_o^e)^*)$. Hence, it is also true that the equilibrium price of the obsolete producer is greater than that of the new entrant when the fiscal capacity does not bind. If entry takes place, the obsolete producer is again phased out by Schumpeterian competition.

Even though this is a more appropriate way to model Schumpeterian competition, I have deliberately avoided this approach because it adds a new parameter χ_j but no additional insights. The mere assumption of different productivity of intermediate input $A_h > A_l$ is sufficient to illustrate the effects of entry of a superior competitor: the obsolete firm's disappearance.

CHAPTER 3. EMPIRICAL EVIDENCE OF PROTECTION-FOR-TAX-COMPLIANCE

Chapter Abstract

Paper 2 evaluates the incidence of Protection-for-Tax-Compliance in Bolivia and Chile, countries with low and medium fiscal capacity, respectively. The analysis exploits within country variation in the four key magnitudes of the research hypothesis: *fiscal capacity*, proxied by sector taxability, *competitiveness*, *effective taxation*, and *protection*. The analysis suggests that Protection-for-Tax-Compliance is fully operative in Bolivia. Both tariff and Non-Tariff Barrier (NTB) protection seem to induce higher tax compliance by uncompetitive hard-to-tax sectors. The incidence of Protection-for-Tax-Compliance in Chile is limited to the weaker leg of the tax structure: profit taxation. Non-Tariff Barriers are proved to induce higher effective profit tax rates among obsolete, hard-to-tax sectors. Overall, the results for Bolivia and Chile are consistent with the theoretical predictions derived in Paper 1.[1]

[1] I am grateful to Ana Fernandes and Caroline Paunov, and Eric Verhoogen for their help with Total Factor Productivity estimation. I want to express my sincere gratitude to Jenny Nuñez, from the Chilean Statistics Office, and López Valerio, from the Bolivian Statistics Office, for their help with the industrial surveys.

3.1. Introduction

The first paper of the dissertation identifies the conditions under which *Protection-for-Tax-Compliance* is preferred to *free-entry*. Mainly, Protection-for-Tax-Compliance introduces a trade-off between wages and tax revenue. The latter increases as a result of protecting declining industry, but real wages decrease as a direct consequence. I prove that Protection-for-Tax-Compliance is preferred by a ruler seeking to maximize political survival as long as the stock of fiscal capacity is sufficiently low. Only when this condition is satisfied, the marginal gain in tax revenue derived from Protection-for-Tax-Compliance outweighs the marginal loss in wages. Protection-for-Tax-Compliance is proved to be theoretically robust to the intermediation of bribes (intended to buy protection without taxation). Although the equilibrium payoffs are more favorable to the domestic producer when these channels of influence are operative, Protection-for-Tax-Compliance is still feasible when fiscal capacity endowment is sufficiently low. In other words, when fiscal capacity is weak, protection might not be granted for sale but tax compliance.

The Protection-for-Tax-Compliance hypothesis is tested in Paper 1 with cross-national data. The sample includes 32 developing economies in Latin America and Eastern Europe. The research design exploits cross-national variation in fiscal capacity and within-country variation in sector competitiveness, tariff protection and tax compliance. The results of the cross-national test are consistent with the Protection-for-Tax-Compliance hypothesis: uncompetitive

sectors in countries with low fiscal capacity tend to be more tax abiding when they are granted protection from foreign competition.

Paper 2 tests once more the Protection-for-Tax-Compliance hypothesis. This time, however, I fulfill two single-country analyses: one for Bolivia 2006-7, another for Chile 1996-2007. The single-country analyses should minimize omitted variable bias in the cross-national results, if any.[2] Specifically, in Paper 2 I exploit within country variation in all key magnitudes, including fiscal capacity.

Bolivia and Chile represent starkly different realities within Latin America: Chile is the richest country in Latin America, with a GDP per capita of $13,794 (PPP) in 2007. Bolivia is one of the poorest countries in the region, with a GDP per capita of $3,995 (PPP), only above Haiti's ($1051), Nicaragua's ($2458) and Honduras' ($3563).[3] Income level is all but independent from state capacity (Besley and Persson, 2011). Not surprisingly, the *2008 Index of State Weakness in the Developing World* ranked Bolivia fifth in *state weakness* in the Western Hemisphere. Chile, on the contrary, ranked 139 out of 141, that is, closer to the average developed economy than the average developing country. These two starkly different positions are exemplified by the magnitude and source of tax revenue. Tax revenue as a percentage of GDP in 2007 was 16.9% in Bolivia, and 21.4% in Chile (Source: World Bank Indicators). Taxes on income, profit and capital gains represented 9.64% of total revenue in Bolivia but 39.99% in Chile.

[2] Omitted variable bias in the cross-national analysis is already minimized in presence of country fixed effects.

[3] Both GDP PPP per capita figures are given in constant 2005 international dollars. Source: World Bank Indicators.

Contrarily, taxes on international trade were three times bigger in Bolivia than in Chile (3.34% of total revenue vs 1.27%) and taxes from hydrocarbon in Bolivia accounted for over 37% of total revenue. These figures are consistent with the prototypical depictions of low and high fiscal capacity. When the capacity to tax private income is low, taxation focuses on a narrow, easy-to-tax base, which usually involves extractive industry and exports.

The empirical analysis in Paper 2 evaluates the incidence of Protection-for-Tax-Compliance in these two economies. The unit of analysis in both analyses are manufacturing sectors. In order to allow for within-country variation in fiscal capacity, I exploit *cross-sector taxability*. Following the *tax handles* literature, I proxy sector taxability by its market structure (Musgrave, 1969; Cheibub, 1998; Gehlbach, 2008). Keeping everything constant, concentrated markets minimize enforcement costs and maximize marginal revenue. On top of market concentration, I introduce a novel proxy of sector taxability: the spatial distribution of the sector across the geography. I claim that sectors that are concentrated in a single region are easier to tax than those that are scattered all over the territory. First, coordination issues might arise between the regional delegations of the tax administration, as documented in Easter (2006). Second, information spillovers from auditing that could improve tax monitoring decrease in distance. Input prices, transportation costs, labor supply, even demand might change from region to region and thus benchmarks for avoidance and evasion.

Using both measures of within-country fiscal capacity variation, Paper 2

tests whether *hard-to-tax sectors* pay higher effective taxes whenever they are protected from superior competitors. The micro-analyses also benefit from the higher quality of taxation data, especially for Chile, where firms must enclose their tax documents to the industrial survey. Protection data also improve: besides the use of effective tariff protection, the single-country analyses exploit variation in Non-Tariff Barrier (NTB) protection. NTB are subtle forms of industry protection, harder to denounce international (Ray, 1987) and easier to hide domestically (Kono, 2006).

Results suggest that both tariff and NTB protection induce higher tax payments among uncompetitive hard-to-tax sectors in Bolivia. In Chile, tariffs have no effect on taxation but NTBs seem to induce higher effective profit tax rates among uncompetitive hard-to-tax sectors. The analysis is organized in two main blocks: first, I test the working hypothesis for Bolivia, where I proxy sector taxability by market concentration; then I test the hypothesis for Chile, where sector taxability is proxied by spatial sector concentration. For each country, a brief contextualization is provided.

3.2. Bolivia

The current tax system in Bolivia was introduced in 1986, after a historical collapse of the public finances. By the late 70s, the fiscal deficit became unmanageable. Tax revenue could not cope with spending needs and the international financial market demanded higher and higher interest. The government

printed money to honor debts and pay wages but this solution turned out to be even more damaging for the economy: inflation sky-rocketed, reaching growth rates over 20,000% in 1985 (Mann and Wolfson, 1989). Per capita income fell too by 27% from 1980 to 1986 (Whitehead, 1991). The financial crisis was a direct consequence of a deficient tax structure. Myriad of tax loopholes, pervasive corruption, and tax deductions granted to public enterprises drained the national coffers. In the worst year of the crisis, tax revenue accounted for only .88% of GDP (Silvani and Radano, 1992).[4] The acuteness of the crisis called for major reforms.[5]

In 1985 President Paz Estenssoro approved a radical stabilization plan or *New Economic Plan*. The tax reform was the cornerstone of the plan. The new tax system introduced a brand new set of taxes and collection rules. Aware of the very limitations of the fiscal system, the reformers focused on easy to administer taxes. Direct taxation, individual- and firm-based, was eliminated. The goal of the reform was to reduce the reliance on foreign trade taxes (both import and export taxes), and increase the weight of indirect taxation (Thirsk, 1997). In order to improve tax collection, non-compliance penalties were strengthened and actually implemented; a special office on large contributors was launched in la Paz; and commercial banks assumed responsibility of tax collection to minimize contact between tax officers and taxpayers. The initial performance

[4] In the 1970 decade, tax revenue represented 9% of GDP (Mann and Wolfson, 1989).

[5] The huge political turnover, which reduces the incentives to invest in fiscal capacity (Besley and Persson, 2011), and the inter-temporal dilemmas identified in the third paper of the dissertation are likely causes of the weak fiscal capacity of Bolivia by the early 80s.

of these reforms was positive (Mann and Wolfson, 1989; Bird, 1992; Thirsk, 1997). Indeed, tax revenue increased from .88% of GDP in 1984 to 7.40% in 1990 (Silvani and Radano, 1992). However, it soon became evident that he tax administration was not receiving sufficient resources to cope with the reactivated economy (Mann and Wolfson, 1989; Bird, 1992). The VAT did convey richer information to tax authorities but this information was never collected as systematically as by the Chilean authorities, who had initiated a similar reform 10 years earlier (Bird 1992, Footnote 21). Fiscal deficit returned and foreign debt accumulated again in the early 1990s. In order to cope with fiscal imbalance, the profit tax (or *impuesto de utilidades*) was reintroduced. The new tax increased revenue, but only moderately (12% of all domestic taxes in 1996). In early 2000s, the discovery of new natural gas deposits combined with a new hike in sovereign debt motivated the adoption of a new tax on hydrocarbon production (*i.e.*, oil and gas). The new tax, operative since 2004, significantly boosted government revenue. Nevertheless, two years later hydrocarbons were nationalized. In 2007, the special tax on hydrocarbons only accounted for 37.4% of domestic tax revenue. No doubt, the hydrocarbon tax did reduce fiscal deficit. However, its adoption brought Bolivia closer to the 1970s, when one third of tax revenue stemmed from export taxes on mineral resources (Thirsk, 1997).

Bolivia's efforts to improve its fiscal capacity over the last 30 years are undeniable. However, the return to old-style tax collection, based on mineral exports, reveals the very limitations of the stock of fiscal capacity. In fact, the tax administration is still poorly endowed. Bolivia has only .11 tax staff

employees per 1000 inhabitants, compared to .23 in Chile or .54 in Argentina (Source: USAID's Fiscal Reform & Economic Governance Project). Bolivia ranks last in the VAT gross compliance ratio in Latin America despite the tax structure being based on indirect taxation (Gallagher, 2005).[6] The weakness of the fiscal capacity is also exemplified by the size of the shadow economy. In 1993, Bolivia ranked first in the world in the size of the shadow economy (Schneider and Enste, 2000); in 2007 Bolivia still led the rank, with a shadow economy sized in 67,7% of the GDP (Schneider et al., 2010). By definition, firms operating in the informal economy do not pay taxes. The perpetuation of this problem indicates a structural incapacity to avoid tax evasion in Bolivia.

Altogether, despite all effort exerted since 1985, Bolivia's fiscal capacity in the late 2000s was still precarious. It raised low tax revenue, was focused on a small tax base, and relied strongly on export taxes (Peres Cajías, 2010).

3.2.1. Protection-for-Tax-Compliance in Bolivia

The incidence of Protection-for-Tax-Compliance in Bolivia is tested at the sector-level due to data availability. In particular, data on protection is available at the sector level only. The analysis focuses on all manufacturing sectors for which protection data is available. Sectors are classified according to the International Standard of Industrial Concentration (ISIC), Revision 4. The ISIC consists of a nested industrial classification structured in four levels (or digits):

[6] Gross compliance ration is measured as the actual VAT collection as percentage to total (potential) VAT collection.

the first digit indicates the field of production (agriculture, mining, manufacturing, etc); the second digit indicates the major group of production (food, textiles, basic metal, etc); the third digit indicates the industry group (for instance, within two-digit "food group", it differentiates between meat or fish production); the fourth and last digit indicates the sub-industry of production, which captures within-variation in the industry group (for instance, types of "meat production"). In order to maximize the size of the sample, the analysis exploits variation in the four key magnitudes across four-digit manufacturing sectors: sector taxability, sector taxation, sector competitiveness and sector protection.

The analysis draws from two data sources: the UNCTAD TRAINS dataset provides the protection data; all other magnitudes, including sector controls, are derived from the 2007 *Encuesta Anual a la Industria Manufacturera* (EAIM), or Manufacturing Industry Annual Survey. The 2007 EAIM was conducted by the Bolivian National Institute of Statistics, and it is a retrospective survey for 2006 and 2007. The survey was resumed after five years on hold. So far, it is not possible to match the firms in the 2007 survey to the pre-2002 sample. Nevertheless, the Survey consists of the *universe* of firms registered in the Bolivian Tax Ministry (*Impuestos Nacionales*). This implies the sample includes only formalized firms in Bolivia. The sample size is 1,090 (excluding unclassified firms). The 350 larger firms in the survey account for 85% of all manufacturing tax revenue in Bolivia.

Taxation. All firms in Bolivia pay direct and indirect taxes. Direct taxation consists of profit taxes.[7] Indirect taxation consists of VAT, excises and sales taxes. The ultimate magnitudes of direct and indirect taxation depend on the type of sector. For that same reason, I work with total taxation, defined as the sum of direct and indirect tax payments. For each four-digit manufacturing sector, I compute total taxation.[8]

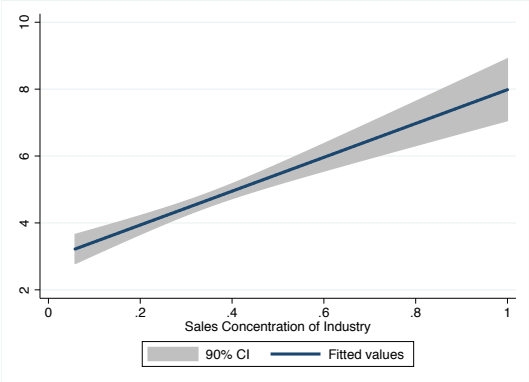
Sector Taxability. Overall fiscal capacity in Bolivia is still low. However, even within countries it is claimed that some sectors are easier to tax than others (Cheibub, 1998; Gehlbach, 2008; Musgrave, 1969). Market concentration and export activity are the two of the main sector characteristics that facilitate tax collection. The more concentrated a sector is, the easier it is to monitor tax compliance. At the extreme, monopolies are thought to be particularly easy to monitor. Accordingly, ease-to-tax is approximated by a Herfindahl Index of market concentration, computed for each of the four-digit manufacturing sectors. The higher the Herfindahl Index, the easier should be to monitor the sector. Market concentration is computed using sales values for 2007.

In order to test the validity of the Herfindahl Index as a proxy for sector taxability, I evaluate the relationship between both variables. To account for the systematic relation between the number of firms and total taxation, I divide the

[7] Profit is assessed as the difference between revenue and costs for larger firms. Smaller firms can choose the presumptive profit system.

[8] Alternatively, I could estimate the average tax rate, defined as the share of taxes paid over pre-tax profit. However, the "net profit" item in the survey is not precise enough. Since this item is not preceded by any instruction, "net profit" might refer to pre- or post-taxes, pre- or post-interests and amortizations.

Figure 3.1: Bivariate robust regression between the Sales Herfindahl Index and Average Taxation.



latter by the former. As a result, I get an approximate average tax payment by sector.[9] If more concentrated sectors are easier to tax, we should expect average tax payments to correlate positively with the Herfindahl Index of industry concentration. That is precisely what we observe in Figure 3.1. Indeed, what we see in Figure 3.1 reproduces the tax habits of countries with very low fiscal capacity: the burden of taxation falls on concentrated sectors precisely because these are easier to tax.

Export activity is also considered a tax handle. Exports cross the borders through a limited number of geographical points, increasing the expected costs of evading taxation. Still, export activity is theoretically problematic. It tends to be correlated to the sector's productivity too (Melitz, 2003). Thus, it confounds two different effects of the theoretical model. For this reason, I do not use it

[9] Specifically, I divide the log of Total Taxation by the log of number of firms in the sector.

as a proxy of sector taxability. Instead, it is included as an additional control (specifically, the export variable measures the average share of export sales over total sales for each sectors). This variable also adjusts for export taxation.

Protection. The *New Economic Plan* implemented by Paz Estenssoro in 1986 also involved a renewed approach to trade. Before the reform, Bolivia had a cacophony of tariffs, varying from sector to sector. Such flexibility was itself conducive of rent-seeking (Mann and Wolfson, 1989). The 1986 reform replaced all tariffs for a uniform tariff rate of 20%. In 1991, the uniform tariff was reduced to 10%. Despite these unilateral reductions, tariff protection in 2007 was slightly higher in Bolivia than other Latin American economies (World Trade Organization, 2011). High tariffs are in fact convenient for the analysis, since they provide us with variation in the key stimulus variable for tax compliance: protection from competition.

The tariff data is drawn from the UNCTAD TRAINS database.[10]
The tariff measure used in the analysis satisfies three properties: First, when a tariff involves quantities rather than prices, ad-valorem equivalent are provided. Second, tariffs refer to *effective* protection, not statutory. This implies that among all tariff lines for a given product, only the lowest (most favored nation) is considered.[11] Third, tariffs are weighed according to the importance

[10]The data is publicly available at http://wits.worldbank.org/wits/.

[11]"Three types of tariffs may exist for the same commodity line. In general, the bound rate is the highest tariff, the preferential the lowest one, and the MFN applied is generally somewhere in between the other two." (UNCTAD TRAINS). The "Effectively Applied Rate" is defined as the lowest available tariff. If a preferential tariff exists, it is used as the effectively applied tariff. Otherwise, the MFN applied tariff is be used.

(in terms of import value) of each product. Altogether, the weighted, effective (ad-valorem equivalent) import tariff variable used in the analysis provides us with a meaningful and comparable measure of tariff protection across sectors.

The UNCTAD TRAINS tariff data is classified following Revision 3 of the International Standard Industry Classification (ISIC). However, the EAIM survey sector classification follows ISIC Revision 4. This one is very recent. To this date, no official correspondence between both revisions exists, at least that is publicly available. In order to solve this issue, I made the correspondence myself. It can be checked in the Appendix of this paper.

On top of tariff protection, the analysis considers Non-Tariff Barriers (NTB). Tariff protection is increasingly difficult under the GATT provisions. For this very reason, the reduction in tariff protection has been replaced by NTB both in developed and developing economies (Drope, 2007; Rodrik, 1995). NTBs are subtle protectionist instruments, whose effects on prices and welfare are much harder to ascertain than tariff's -which also reduces the chances of international sanctions. For that very reason, NTBs are said to be politically useful (Ray, 1987). Since their effect on national prices is opaque, rulers and interest groups find them particularly convenient to protect national industry to their own benefit (Kono, 2006; Mansfield and Busch, 1995). Finally, NTB, unlike tariffs, are also useful for collective action purposes. Unlike tariffs, NTB such as trade licenses can be really effective to discipline all firms within an industry subject to any non-competitive agreement (Ray, 1987).

NTB data is also drawn from the UNCTAD TRAINS database. In particular,

I consider all NTB information available at this source. This involves quantity controls, monopolistic, automatic licenses and technical measures. The values considered in this analysis correspond to 2006.[12] In order to assess the incidence of NTB protection at the sector level, I follow the simplest option: computing coverage ratios (Deardorff and Stern, 1997; Gawande, 1997; Kono, 2006; Mansfield and Busch, 1995). This ratio captures the share of imports within a given sector subject to NTB. There is also a weighted version of this measure (Goldberg and Maggi, 1999). This other version weighs the incidence of NTB for those products by its import value. This measure, however, excludes all protected products for which there are no imports at all. I claim this might introduce a selection problem. Products with zero-import value might be precisely those most affected by NTB protection. For this reason, I prefer to stick to the unweighed version. For each four-digit manufacturing sector in EAIM, I compute the NTB cover ratio.

Competitiveness Total Factor Productivity scores, the usual measurement of sector productivity, cannot be estimated with the available data.[13] It requires a longitudinal panel of firms. Unfortunately, the EAIM was resumed in 2007 and it is not possible to match it to the pre-2002 sample. Instead, I make use of a supplementary questionnaire in the 2007 EAIM, relative to Information Technology. This supplementary questionnaire was voluntary but was still filled by 87% of firms. One of the questions in this questionnaire requests for recent

[12] NTB data for 2007 is unavailable.

[13] Total Factor Productivity requires long firm panels.

Research and Development (R&D) activity (dummy variable). In order to proxy sector uncompetitiveness, for each sector I compute the proportion of firms *not* involved in this kind of productivity enhancing activity:

$$\textit{uncompetitive} \equiv 1 - \text{proportion(R\&D)}$$

For robustness, I also use the growth rate of sales between 2006 and 2007 as a proxy for sector competitiveness. Once again, I compute the average growth rate for each sector. Both averages, R&D and sales growth, are weighted by the firm size (proxied by the number of employees) in order to generate a more representative measure of sector productivity.

3.2.2. Model Specification

I seek to test whether hard-to-tax, uncompetitive sectors pay higher taxes whenever they are protected from foreign competitors. That is, three conditions must be met simultaneously for tax payments to increase: the domestic sector must be uncompetitive, hard-to-tax, and had been granted protection. In order to test this implication, a three-way interaction is required. Given the j four-digit

sector in industry i, I fit

$$\begin{aligned} tax_payments_{ij} &= \beta_0 + \beta_1 Hard_to_tax_{ij} + \beta_2 Protection_{ij} \\ &+ \beta_3 Uncompetitive_{ij} \\ &+ \beta_4 \big(Uncompetitive_{ij} \times Protection_{ij}\big) \\ &+ \beta_5 \big(Hard_to_tax_{ij} \times Protection_{ij}\big) \\ &+ \beta_6 \big(Uncompetitive_{ij} \times Hard_to_tax_{ij}\big) \\ &+ \beta_7 \big(Hard_to_tax_{ij} \times Uncompetitive_{ij} \times Protection_{ij}\big) \\ &+ \mathbf{Z}_{ij}\beta_8 + \delta_i + \epsilon_{ij} \end{aligned} \tag{3.1}$$

where

$$\text{Hard to tax}_j \equiv (1 - \text{Concentration index}).$$

I am particularly interested in the three-way interaction coefficient β_7 in (3.1). It should be positive if obsolete, hard-to-tax sectors pay higher taxes only if protected. β_7 might be compared to β_6, the observational counterfactual. Particularly, β_6 captures the effect of zero protection on a hard-to-tax, obsolete sectors (*i.e.*, "had it not been protected"). According to the theoretical model, we should expect these sectors to pay lower taxes or, at least, do not differentiate from the sample mean. In other words, we expect $\beta_6 \leq 0$.[14]

In order to minimize omitted variable biases (*i.e.*, the presence of unconfounded factors affecting both sides of the expression (3.1)), I include a battery of manufacturing industry fixed effect, δ_i. I identify 9 of them: (i) Manufacture

[14]Notice that β_4 represents an off-the-equilibrium path outcome: easy-to-tax, obsolete sectors being protected. The same applies to β_5: hard-to-tax, competitive sectors being protected. The theoretical mode yields no *aprioristic* expectation for these two estimates.

of Food, Beverages and Tobacco; (ii) Textile, Wearing Apparel and Leather Industries; (iii)Wood and Wood Products, Including Furniture; (iv) Paper and Paper Products, Printing and Publishing; (v) Chemicals and Chemical, Petroleum, Coal, Rubber and Plastic Products; (vi) Non-Metallic Mineral Products, except Products of Petroleum and Coal; (vii) Basic Metal Industries; (viii) Fabricated Metal Products, Machinery and Equipment; (ix) Other Manufacturing Industries. Notice that four-digit level manufacturing sectors are nested within this larger *industry* classifications.[15]

The empirical models include a vector of Controls $\mathbf{Z}_{ij}$. The ultimate tax proceeds stemming from a given sector depend to a large degree on the number of firms in the sector. However, controlling the model for this variable is problematic. The number of firms per sector strongly correlates with the proxy of sector taxability, that is, the Herfindahl concentration index. The correlation increases the more concentrated the sector. At some point (monopolies), both variables are indistinguishable. To minimize the identification problems derived from such strong correlation, I replace the number of firms in each sector by total employment. These two measures are highly correlated (Pearson coef. = .83).[16]

Public intervention in Bolivia is not trivial. Public firms by law have to pay the same tax rates than private firms. However, they might collaborate

[15]The *industry* classification is inspired in the older Revision 2 of the ISIC.

[16]Moreover, employment has been said to be another way to pay for protection among obsolete sectors (Desai and Olofsgård, 2011). Including total employment thus controls for this potential effect too.

with tax authorities to a larger degree. If the presence of public firms produce information spill-overs about the production costs of an average firm in the sector, the higher the share of public firms in a given sector, the harder should be for all firms in that sector to hide production. All other things constant, taxation should grow. To control for this effect, I include the variable *Public Share*, which measures the proportion of public capital over total capital in the sector.

Four sectors within the *Manufacture of Food, Beverages and Tobacco* industry are subject to a special tax, the so-called *ICE* (the specific consumption tax): tobacco, alcoholic and non-alcoholic beverages. In order to account for this additional tax the models I include an indicator variable. I exclude two sectors from the sample: beer manufacturing and manufacture of refined petroleum. Both sectors are strong outliers in tax payments. I also drop from the original sample all firms whose sales value for 2007 is missing or equal to 0. Likewise, I drop all firms with missing information for total labor, or those whose taxation values for both 2006 and 2007 are missing.

The distributions for sector taxation and sector labor have long tails on their right. To avoid estimates to be influenced by the few outlier sectors, I apply a logarithmic transformation to both variables. Altogether, the final sample is made of 837 firms, distributed across 78 four-digit sectors. This filtered sample represents almost the entire universe of firms listed in the Bolivian Tax Ministry. Table 3.1 report the distribution of sector-level measures for all variables.

Table 3.1: Summary statistics of the Bolivian Sample . Data Source for Tariff and NTB protection: UNCTAD TRAINS. For all other covariates, 2007 EAIM.

Variable	Mean	Std. Dev.	Min.	Max.
ln(total taxation)	9.271	2.976	3.121	14.278
R&D share	0.334	0.341	0	1
Sales Growth	40.286	67.105	-67.889	404.58
ln(labor)	5.005	2.089	0.693	8.585
NTB cover	0.321	0.408	0	1
Tariff	4.335	2.258	0	9.33
Public Share	0.005	0.037	0	0.325
Exports	0.538	0.502	0	1
N		78		

A Note on Omitted Variable Bias. The theoretical model in Paper 1 showed that lobbying, and in particular, political contributions, is expected to reduce the parameter space for which Protection-for-Tax-Compliance is feasible. If the previous variables do not capture cross-sector variation in lobbying capacity, we might face two sources of endogeneity bias: one through the protection measure; the other through the hard-to-tax proxy. On the one hand, if lobbying reduces effective tax rates (Richter et al., 2009), the relation between protection and taxation might be confounded. This source of endogeneity bias is not extremely problematic. Since *lobbying* and *protection* hold opposite signs with *sector taxation*, the omission of the *lobbying variable* introduces a downward bias in the latter's coefficient.

On the other hand, it has been argued that lobbying is less intense in decentralized (*i.e.*, hard-to-tax sectors) sectors (Drope and Hansen, 2009). If this is true, the negative relation between hard-to-tax sectors and effective taxation

might be confounded with lobbying activity. This potential endogeneity problem is more problematic. In particular, *lobbying* and *hard-to-tax* share the same sign with *sector taxation* (*i.e.*, negative). Thus, if we do not properly account for *lobbying* activity, the coefficient for *hard-to-tax* might be upwardly biased. As long as we assume that lobbying takes place at the industry level, the inclusion of the nine industry fixed effect battery should suffice to cope with this source of endogeneity bias.

3.2.3. Analysis

The models in Table 3.2 evaluate the effect of effective tariff protection on tax compliance among hard-to-tax uncompetitive sectors. In these models, uncompetitiveness captures the proportion of firms in each sector that do not carry out research and development activities. Model 1 reports the estimates without industry fixed effects. Coefficient $\hat{\beta}_7$ is positive and significant, suggesting that hard-to-tax obsolete sectors pay higher taxes once they received effective tariff protection. Coefficient $\hat{\beta}_6$ is negative but not significant, implying that unprotected obsolete sectors which are hard to tax tend to pay lower taxes than the average. Model 2 adds the nine industry fixed effects. This causes an attenuation in $\hat{\beta}_7$'s magnitude. Still, the coefficient is significantly different from zero. Model 3 to 5 in Table 3.2 keep the industry fixed effects, intended to minimize omitted variable bias. Model 3 adds a dummy variable for a subgroup of sectors that have to pay special consumption tax or *ICE* (see above for details).

Table 3.2: Bolivia. Effect of Tariff Protection on Sector Tax Payments for two proxies of sector uncompetitiveness

	R&D				Sales Growth
	(1)	(2)	(3)	(4)	(5)
β_1: Hard to Tax (HTT)	1.375	1.061	.936	.271	-1.851*
	(1.875)	(1.733)	(1.741)	(1.793)	(.979)
β_2: Tariff	.572***	.588***	.567***	.500***	-.144
	(.204)	(.194)	(.189)	(.176)	(.111)
β_3: Uncompetitive	2.846***	2.680**	2.617**	2.271**	.004
	(1.009)	(1.043)	(1.045)	(1.055)	(.010)
β_4: Tariff $\times$ Uncompetitive	-.946***	-.888***	-.858***	-.761***	-.004
	(.224)	(.232)	(.230)	(.222)	(.002)
β_5: Tariff $\times$ HTT	-1.039**	-.813*	-.763*	-.590	.428**
	(.456)	(.412)	(.408)	(.404)	(.191)
β_6: HTT $\times$ Uncompetitive	-3.980	-3.400	-3.027	-2.273	-.021
	(2.818)	(2.807)	(2.737)	(2.715)	(.019)
β_7: HTT $\times$ Uncompetitive $\times$ Tariff	1.636**	1.380**	1.244**	1.042*	.009**
	(.641)	(.599)	(.598)	(.582)	(.005)
Z_1: ln(labor)	1.353***	1.310***	1.316***	1.319***	1.316***
	(.096)	(.096)	(.095)	(.090)	(.094)
Z_2: Public Share	4.555***	5.535***	5.338***	5.494***	4.853***
	(.870)	(1.449)	(1.431)	(1.516)	(1.380)
Z_3: Exports			.033	-.040	-.193
			(.342)	(.338)	(.354)
Z_4: ICE			1.210	1.162	1.365*
			(.818)	(.856)	(.806)
Z_5: NTB Cover				1.310*	1.699**
				(.680)	(.732)
β_0: Intercept	1.382	2.017*	1.790	.773	2.158**
	(.837)	(1.164)	(1.100)	(1.120)	(1.053)
hline					
Industry FE	No	Yes	Yes	Yes	Yes
N	78	78	78	78	78
R-squared	.846	.896	.901	.904	.902

Robust standard errors in parentheses. *** p<.01, ** p<.05, * p<.1

It also adds an indicator variable for sector export activity. Recall, export activity provides a tax handle but also identifies competitive sectors. Neither of these variables is significant. Model 4 adds Non-Tariff Barriers to the vector of controls. It is intended to capture any strategic or balancing effect in the allocation of tax burden and protection rates. $\hat{\beta}7$, the coefficient of the three-way interaction survives the inclusion of this variable.

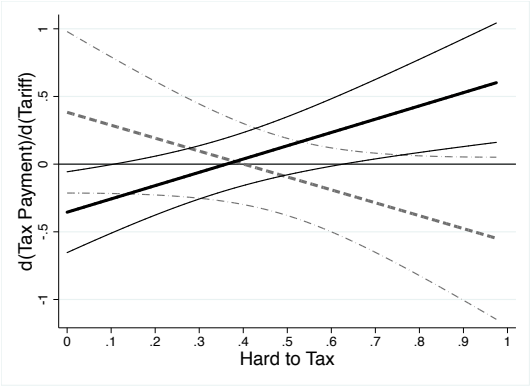
Finally, in Model 5 I replace the measure of sector uncompetitiveness in Models 1 to 4 (*i.e.*, R&D) by the *reduction* of sector sales from 2006 to 2007. That is,

$$\text{uncompetitive} \equiv -1 \times \frac{Sales_{2007} - Sales_{2006}}{Sales_{2006}} \tag{3.2}$$

weighted by the size of each firm within the sector. When I add this variable, $\hat{\beta}7$ remains negative and significantly different from 0. That is, among those hard to tax sectors that grew least from 2006 to 2007, tariff protection did stimulate tax payments. Figure 3.2 plots the marginal effect estimated in Model 5. In particular, it plots the effect of protection on total tax payments for two types of sector, one competitive, the other uncompetitive, for different values of sector taxability. When the sector is competitive (dashed grey curve), protection has a slight negative effect on tax payment, but it is not significantly different to 0. On the contrary, when the sector is uncompetitive (solid black curve), the effect of protection on tax payment becomes positive as the sector becomes sufficiently hard to tax. This is indeed the effect we should expect from the theoretical model. Fiscal capacity and competitiveness must be simultaneously low for protection to induce (and be traded for) higher tax payments.

In Table 3.3 I run models similar to those in Table 3.2. This time, however, I use Non-Tariff Barrier (NTB) as the stimulus policy to increase tax compliance among hard to tax, uncompetitive sectors. Once again, from models 1 to 4, uncompetitiveness is measured by the share of firms that are not involved in R&D activities. The most relevant estimate, $\hat{\beta}_7$, is again positive and significantly

Figure 3.2: Marginal Effect of Tariff Protection on Tax Payments by Sector Taxability, where 0 indicates high taxability and 1 low taxability. Dashed grey line: competitive sector. Solid black line: uncompetitive sector. Estimates drawn from Model 5 in Table 3.2. 90% CI.



different from 0, as the theory predicts. The estimate for $\hat{\beta}_6$ is positive, but indistinguishable from 0. Model 1 does not include industry fixed effects. Model 2 does, and $\hat{\beta}_7$ grows slightly.[17] Models 3 and 4 add potential confounders. The estimate for the three-way interaction remains almost unaltered when I control for the additional covariates. Finally, Model 5 uses the average reduction of sales from 2006 to 2007 as an alternative measure of sector uncompetitiveness. Once again, the higher this reduction, the more taxes hard-to-tax sectors pay provided they are granted NTB protection.

Figures 3.3 and 3.4 plot the predicted (log of) tax payments of an obsolete

[17] It is important to mention that the different magnitude of coefficients in Table 3.3 compared to those in Table 3.2 is due to the range of the NTB variable, which goes from 0 to 1. This short range mechanically increases the magnitude of the key coefficients. Tariff protection, instead, ranges from 0 to 10.

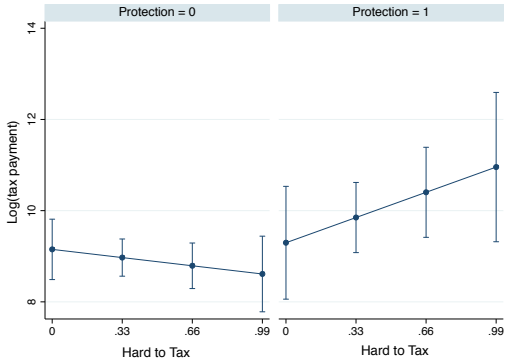
Table 3.3: Bolivia. Effect of Non-Tariff Barrier Protection on Sector Tax Payments for two proxies of sector uncompetitiveness

	R&D				Sales Growth
	(1)	(2)	(3)	(4)	(5)
β_1: Hard-to-Tax (HTT)	-.614	.015	-.112	.157	.031
	(1.153)	(.975)	(.959)	(1.055)	(.678)
β_2: NTB	7.279**	7.262***	6.779***	6.877***	.359
	(2.932)	(2.570)	(2.214)	(2.279)	(1.251)
β_3: Uncompetitive	-.514	-.099	-.116	-.093	-.004
	(.638)	(.691)	(.688)	(.703)	(.005)
β_4: NTB $\times$ Uncompetitive	-6.258*	-5.571*	-4.998*	-5.128*	-.043**
	(3.398)	(2.945)	(2.623)	(2.609)	(.018)
β_5: NTB $\times$ HTT	-11.082**	-1.243***	-9.167**	-1.105***	.359
	(4.656)	(3.731)	(3.487)	(3.698)	(1.679)
β_6: HTT $\times$ Uncompetitive	1.206	.064	.189	.041	.009
	(1.450)	(1.344)	(1.367)	(1.422)	(.009)
β_7: HTT $\times$ Uncompetitive $\times$ NTB	1.604*	11.218**	9.663*	1.411**	.051**
	(5.727)	(5.086)	(5.015)	(5.035)	(.024)
Z_1: ln(labor)	1.248***	1.268***	1.274***	1.266***	1.364***
	(.110)	(.088)	(.084)	(.084)	(.091)
Z_2: Public SHare	5.291***	4.575***	4.509***	4.251***	3.570**
	(1.166)	(1.352)	(1.340)	(1.358)	(1.345)
Z_3: ICE			1.172	1.262	1.485*
			(.865)	(.822)	(.783)
Z_4: Exports			.079	.063	-.114
			(.313)	(.313)	(.305)
Z_5: Tariff				-.063	-.017
				(.068)	(.062)
β_0: Intercept	3.037***	1.691	1.451	1.889	1.817*
	(.560)	(1.069)	(1.078)	(1.226)	(1.048)
Industry FE	No	Yes	Yes	Yes	Yes
N	78	78	78	78	78
R-squared	.835	.892	.896	.898	.905

Robust standard errors in parentheses. *** p<.01, ** p<.05, * p<.1

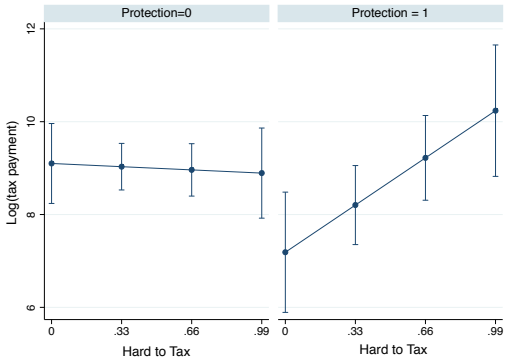
sector for different levels of sector taxability under protection and lack thereof. Figure 3.3 corresponds to Model 2 in Table 3.3, where the absence of R&D is used as a proxy for sector uncompetitiveness. Figure 3.4 corresponds to Model 5 in Table 3.3 where sector obsolescence is proxied by the average sales reduction from 2006 to 2007. For ease of exposition, the protection variable is recoded into a dummy variable. Those sectors where less than 15% of products are covered by NTB are considered *free*; all remaining are considered *protected*. This partition guarantees sufficient variation in both categories (46 sectors free, 32 protected), but the results are virtually identical if other cutoffs are chosen.

Figure 3.3: 90% CI Predicted Total Tax Payments of an Uncompetitive Sector for Two States of the World: NTB Protection vs. lack thereof. Sector uncompetitiveness is proxied by the share of firms not involved in R&D activities.



The left part in both Figure 3.3 and 3.4 represents the same state of the world in terms of NTB protection: that is, absence of it ($NTB < .15$). In both figures we observe a mild decrease of tax payments as sectors become harder to

Figure 3.4: 90% CI Predicted Total Tax Payments of an Uncompetitive Sector for Two States of the World: NTB Protection vs. lack thereof. Sector uncompetitiveness is proxied by the average reduction in sales growth.



tax, as one would expect. However, the Protection-for-Tax-Compliance theory focuses on the right-hand side of both figures. When uncompetitive sectors are protected from superior competitors, tax compliance increases as sector taxability falls. The effect is clearer when uncompetitiveness is proxied by the reduction of sector sales. In this case, the 90% CI predictions for minimum and maximum taxability never overlap. When uncompetitiveness is proxied by the lack of $R\&D$, the 90% CI do overlap but the mean of the predicted tax payment of a hard-to-tax sector is two standard deviations above the average tax payment of an easy-to-tax sector. These results, together, convey the power of Protection-for-Tax-Compliance. When fiscal capacity is low, Protection-for-Tax-Compliance might be used as an extortion tool to raise taxation to values

unfeasible by coercive means only.[18]

3.3. Chile

Chile differs in many dimensions from Bolivia, including fiscal capacity. Chile is internationally praised for developing an effective tax system over the last 40 years. Chile's current tax structure is based on the 1974 reform, implemented one year after Pinochet took power (Collier and Sater, 2004; Sanchez, 2011). However, prior to the military coup, some modern elements had been introduced in the tax system: for instance, the indexation of tax rates by inflation growth, adopted in the 1960s (Bergman, 2003); or the establishment of the General Directorate of Internal Revenue in 1972 (Cominetta, 2008), the predecessor of the *Servicio de Impuestos Internos* (SII).[19] The 1974 reform dropped the old system based on international transactions (export taxes) and established instead a modern system of consumption and income taxation, both on business and labor (Cominetta, 2008). Indexation was improved, what tackled the perverse incentives derived from tax arrears (Harberger, 1989). The tax administration was fully reformed too: the system began its computerization, auditors were rotated, and collection was externalized to commercial banks to reduce street level corruption (*ibid.*). The second major reform came with the democracy, in 1990. It

[18] Tables 3.10 and 3.11 in the Appendix two additional robustness tests are included, one for tariff protection the other for NTB. They seek to prove that the results in this section are not driven by extreme cases. In particular, in those robustness tests the complete specifications in Models 3 and 5 are re-run once I drop all observations with residuals above or below two standard deviations. The robustness results offer similar estimates to those in Tables 3.2 and 3.3.

[19] Ascher (1989) for a full account of the 1960s tax reforms.

was supported by both sides of the aisle (Boylan, 1996; Sanchez, 2011).[20] The reform left the tax instruments virtually untouched, but the mix was slightly different. The democratic government increased the corporate tax and top marginal tax rate, and funneled the new receipts to social spending (*ibid.*). From 1990 onwards, the system experienced incremental improvements. Crucial among these was the full computerization of tax collection, what improved auditing effectiveness and reduced compliance costs (Cominetta, 2008).[21]

The effort to reduce tax evasion was reinforced in 2001, when a plan against tax evasion was passed (*Plan de Lucha Contra la Evasion Tributaria*). The law enhanced the enforcement power of the SII, increased non-compliance penalties and expanded the auditor staff (Cominetta, 2008). From 2000 to 2006 alone, tax staff personnel grew my 18% (Fontaine and Vergara, 2000) and SII funds rose yearly (Servicio de Impuestos Internos, 2006). The enhanced SII improved its monitoring capacity: in 2007 alone, 10% of income tax payers and 3.4% of VAT taxpayers were audited.[22] The results of four decades of fiscal capacity investment were positive: fiscal revenue grew from 15,7% in 1990 to 18.8% in 2005 (Cominetta, 2008). More importantly, fiscal revenue became extremely stable and almost independent of export activity.

Chile's success in improving its tax administration is a mayor challenge for Protection-for-Tax-Compliance. From *Proposition I.3* in Paper 1 we know this

[20] A minor reform took place in 1984, which emphasized reliance on indirect taxation.

[21] By 2001, income taxes could be filled online.

[22] The numbers differ due to the magnitude of the denominators: in 2007, there were 2.1 million tax payers but 11 million of VAT payers.

institutional solution is pursued for low enough values of fiscal capacity. Chile might have overcome that cutoff already. In order to test for it, I take advantage of the unequal results achieved by the tax reforms of the last 40 years. If we look closer at the performance of these reforms, we we find a big divide between the income and consumption taxes. While VAT has proved to be extremely efficient, profit tax has reached only moderate result.

Since 1990 VAT yields represent over 40% of all fiscal revenue, being the main source of government revenue. Indeed, VAT performance has been internationally praised for its performance (Bergman, 2003; Pomeranz, 2011; Silvani and Radano, 1992). VAT gross compliance ratio in 2007/8, measured as the ration of actual VAT to a potential VAT collection (based on private consumption), was 76.97% (Source: USAID's Fiscal Reform & Economic Governance Project[23]). For reference, Argentina's was 21.71%, Spain's 59.71% and Sweden's 76.86%. VAT evasion has decreased over time too: from 29.6% in 1990 to 18.3% in 1999 (Barra and Jorrat, 1999). The 2001 Plan Against Evasion pushed this value down to 9% in 2006 (Servicio de Impuestos Internos, 2010). All in all, VAT performance in Chile since democratic transition is a complete success.

Corporate taxation (or *impuesto de primera caterogía*) has evolved very differently. It was adopted in 1974, under Pinochet. However, after twenty-five years of operation, profit tax evasion was estimated in 1999 in 41.7%, more

[23]The USAID's Fiscal Reform & Economic Governance data is not subject to copyright protection, is in the public domain, and can be accessed at http://www.fiscalreform.net/.

than twice the value for VAT.[24] More importantly, profit tax evasion had barely decreased since democratic transition. It was estimated in 49.6% by 1990. The gap between VAT and profit tax evasion has not shrunk after 1999 either; while the VAT evasion was estimated in 9% in 2006, that for the profit tax was as high as 48% (Jorrat, 2009).[25]

The different compliance ratio of VAT and profit tax might be due to the mere technical difficulties to monitor income taxes; or it could be induced by the political economy that motivated the current tax system. Some scholars claim that given the political constraints of the democratic transition, the tax reformed approved in 1990 by the left government was not particularly damaging for the business elite, former Pinochet allies (Boylan, 1996; Sanchez, 2011). The material power of the major business' associations was too strong to antagonize. This implicit constraint might have persisted over time. The perpetuation of low profit tax compliance is consistent with this hypothesis.[26] The regressiveness of taxation under democratic rule is too: the after-tax distribution of income does not alleviate income inequality (Engel et al., 1998); if any, it goes the other way (Cantallopts et al., 2007).

The ultimate cause of the divide between VAT and corporate taxation can-

[24]Precisely, in 1999 a uniform profit tax was adopted to ease collection.

[25]This value excludes all firms related to copper, which have a special tax treatment.

[26]The *de facto* power of business elite was manifest in the 1990 tax reform. They accepted an increase in the highest marginal tax rate and also in the profit tax. But in exchanged they (represented by *Renovación Nacional*, the rightist coalition) had the VAT increased (something that was not in the *Concertación* plans), and the target of the tax collection increment was downsized from 3% to 2% (Boylan, 1996). Since 1990, business organizations have blocked all major reforms in tax compliance except for the 2001 reform, which reduced profit taxes and increased income taxes (Sanchez, 2011).

not be not traced here. Instead, the analysis exploits this marked duality in fiscal capacity. Accordingly, the empirical exercise testes the Protection-for-Tax-Compliance for the weakest tax leg (in terms of evasion), the profit tax, and use the VAT, whose management is internationally praised, as a placebo test. Since fiscal capacity is only weak for profit taxation, Protection-for-Tax-Compliance should only be observed here.

3.3.1. Protection-for-Tax-Compliance in Chile

One of the main characteristics of Pinochet economic policy was the liberalization of international trade (Edwards and Lederman, 2002). This trend was continued after democratic transition. Currently, Chile's tariff regime is much more open than the average Latin American or upper-middle-income country (World Trade Organization, 2010). The average tariff in 2007 was 1.36, about four times lower than in Bolivia. There seems to be little margin to study the effect of tariff protection on tax compliance in Chile. For that reason, I prefer to focus on Non-Tariff (NTB) barrier only, a much more subtle instrument to restrict trade. NTB data, as for Bolivia, is publicly available at the UNCTAD TRAINS dataset, but only at the sector level.[27]

Accordingly, the incidence of Protection-for-Tax-Compliance in Chile is tested at the sector level too. The other key magnitudes required to test the hypothesis, that is, uncompetitiveness, fiscal capacity and tax compliance, are measured in a different way than in the Bolivian sample. The data for these three variable is

[27] The data is publicly available at http://wits.worldbank.org/wits/.

drawn from the *Encuesta Nacional Industrial Anual* (ENIA), or National Annual Manufacturing Industry. The survey covers all manufacturing plants employing ten or more workers. The plants included in ENIA account for 50% of total manufacturing employment in Chile (Bergoeing et al., 2003). ENIA covers all created and continuing plants, and excludes plants that ceased activities or reduced their hiring below the survey's threshold (Bergoeing et al., 2011). The unit of observation is "plants" not firms, so one cannot distinguish single-plants from multi-plant firms. The tax measurement variable will bear this into consideration. The industrial classification in ENIA follows Revision 3 of the International Standard Industrial Classification (ISIC Rev. 3), which can be directly matched to the UNCTAD TRAINS Non-Tariff Barrier protection. I consider all manufacturing sectors except tobacco (information is missing), alcoholic beverages (special excises), and copper-processing firms, which is an extreme outlier in taxation. The final sample consists of 85 four-digit ISIC Rev. 3 manufacturing sectors. For each of them, I compute sector averages for the key magnitudes and relevant controls.

Uncompetitiveness. I use the full power of the ENIA to estimate average Total Factor Productivity (TFP). TFP captures the share of production not accounted by traditional factors (capital, labor, materials). The classic OLS method to compute TFP consists of a three-step process. First, the contribution of inputs (labor, capital, materials) to output (sales or value-added) is estimated by OLS. Second, the input estimates are retrieved to predict the output variable. Third,

the predicted output is subtracted from the observed output.

The risk of using OLS TFP estimates lies in the simultaneity problem. There might be elements unobserved by the researcher but known by the firm which affect the demand for inputs and outputs simultaneously. This happens when the firm experiences an expected productivity shock (*e.g.*, programmed upgrade of the managerial skill in the firm). Such shocks are likely to expand production and also input demand. Statistically, this implies that the unobserved productivity shocks are confounded with the error component. When that is the case, Gauss Markov assumptions are violated and OLS estimates are inconsistent.

Levinsohn and Petrin (2003) (LP) offer a two-step semi-parametric estimation method in which productivity shocks are separated from iid error. Their method assumes the following Cobb-Douglass production function

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it} \tag{3.3}$$

where i identifies the firm and t the period, y denotes the output variable (sales or value-added), l labor, k capital, and m materials. Notice that the error term has two components: ω_t, the transmitted productivity component, and η_t, the iid error. The ω_t error is assumed to be a state variable, transmitted over time, observed by the firm, but not for the researcher. Levinsohn and Petrin (2003) propose proxying productivity shocks by changes in input materials. These are claimed to adapt rapidly to short-term productivity shocks, unlike capital or labor.

The two-step estimation method proposed by these two scholars is grounded on two identification assumptions: First, they assume monotonicity in the material-productivity relationship. This is proved crucial because it allows us to invert the material-productivity function and proxy productivity shocks. Second, productivity shocks are assumed to be governed by a Markov-process uncorrelated to current capital and past material demand. Based on these two assumptions, Levinsohn-Petrin's two-step semi-parametric method yields consistent estimates for the all inputs in the production function.

Once all β_k in (3.3) are estimated, predicted productivity is computed as

$$\hat{\omega}_t = exp(y_t - \hat{\beta}_l l_t - \hat{\beta}_k k_t - \hat{\beta}_m m_t) \tag{3.4}$$

Notice ω_t is time-varying, unlike alternative methods to combat simultaneity problem (*i.e.*, OLS with firm fixed effects).

Specifically, the LP routine is fitted to an unbalanced panel of over 37,373 year-firms (clean sample) over a 12-year period (1996-2007). I use log of sales revenue as dependent variable to estimate (3.3). I control for the log of skilled and unskilled workers, separately, and the quantity of consumed electricity. Material costs enters the models as the proxy variable, and perpetual capital is used as the state variable. LP TFP estimates

$$\omega_{it} = exp(y_{it} - \hat{y}_{it}) \tag{3.5}$$

Table 3.4: Distribution of four-digit ISIC sectors by major industry classification. Data source: ENIA 1997-2007

Major Industry	Four-digit Sectors (ISIC Rev.3)	N
1. Food and Drink	1500-1699	11,178
2. Textiles and wearing apparel	1700-1999	6,197
3. Wood and Furniture	2000-2099 and 3600-3699	4,771
4. Paper and publishing	2100-2299	3,033
5. Coke, refined petroleum, chemical products and rubber	2300-2599	5,180
6. Non-metallic and basic metal products	2600-2799	1,910
7. Fabricated metal products, electrical machinery, equipment and motor vehicles	2800-3599	5,078

are estimated for seven industries separately, allowing production functions to fit the idiosyncrasies of each of them. The actual classification and frequencies of these seven industries are reported in Table 3.4.

All variable are deflated by industry-level price deflators (Source: Chile Central Bank). I follow Fernandes and Paunov (2012) in computing *capital* by using the *perpetual inventory method* for each of the four types of capital in the ENIA survey: land, building, machinery and equipment, and transport equipment. Accordingly, I use 3% depreciation rate for buildings, 7% for machinery and equipment, and 11.9% for transport equipment. Land is assumed not to depreciate. The initial value of the capital stock is given by the book value of each of the four types of capital in the first year of firm presence in sample (*ibid.*).

In order to estimate TFP some filtering needs to be done: First, only firms that hold the same industrial classification for all years are kept. Second, smaller

firms in Chile are allowed to file taxes through a simplified system. When they do so, the report 0 taxes in the ENIA questionnaire. Since its impossible to know how many taxes they pay through the simplified system, I drop all firms which systematically report 0 taxes in the ENIA survey. They represent 12,1% of all firm-year observations. Third, following Fernandes and Paunov (2012) I drop all cases that experienced a growth in sales (and perpetual capital) over 400% across two consecutive years, or a sales growth above 100% without a corresponding increment in the input variables.[28] Once all filtering is applied, the final (clean) sample is made of 37,347 year-firms. These are distributed across seven major industries, as defined in Table 3.4. I run the LP method for each of the seven major industries separately, allowing for flexibility in the production function across them.

Table 3.5 reports the LP production function estimates. All coefficients hold the expected sign. All of them but perpetual capital are significant for all industries. Capital is a lumpy variable over time, and it usually presents identification problems.[29]

TFP is not directly comparable across sectors. Thus, I work with growth

[28] On top of these three filters, I dropped two four-digit sectors because they caused TFP productivity estimate to explode. These are ISIC Rev 3 1549 (Manufacture of other food products not elsewhere classified) and 2899 (Manufacture of other fabricated metal products not elsewhere classified).

[29] For robustness, Table 3.13 in the Appendix includes the standard TFP estimates computed by OLS with sector fixed effects (the Solow method). To maximize comparability, the OLS estimates are drawn from a common production function. This estimation is followed by the full Protection-for-Tax-Compliance test in Table 3.14 where uncompetitiveness is measured by OLS TFP growth estimates. The results are virtually identical to the ones that follow.

Table 3.5: Total Factor Productivity Estimates. Method: Levinsohn-Petrin.

	(1) LP Industry 1	(2) LP Industry 2	(3) LP Industry 3	(4) LP Industry 4	(5) LP Industry 5	(6) LP Industry 6	(7) LP Industry 7
ln(Skilled)	.075***	.122***	.080***	.075***	.110***	.071***	.081***
	(.006)	(.011)	(.010)	(.013)	(.017)	(.018)	(.014)
ln(Unskilled)	.110***	.136***	.124***	.085***	.146***	.150***	.115***
	(.006)	(.015)	(.013)	(.017)	(.022)	(.022)	(.018)
ln(Electricity)	.028***	.072***	.032***	.065***	.020*	.122***	.082***
	(.006)	(.013)	(.009)	(.012)	(.010)	(.018)	(.013)
ln(Capital)	.059**	.010	.026	.033	.048	.105*	.114***
	(.024)	(.066)	(.038)	(.048)	(.033)	(.059)	(.044)
ln(Material)	.758***	.760***	.612***	.750***	.746***	.690***	.580***
	(.111)	(.098)	(.158)	(.264)	(.141)	(.231)	(.182)
N	11,178	6,197	4,771	3,033	5,180	1,910	5,078
Wald	.0639	.676	.496	.000547	.235	.379	.0204

Standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

rates (the first difference of ω_{it} logs):

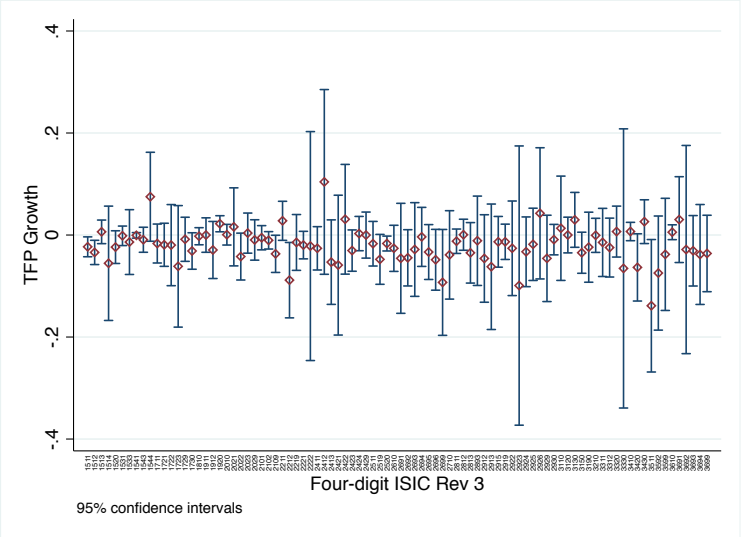
$$\Delta lnTFP = ln(\omega_{it}) - ln(\omega_{it-1}) = \epsilon_t - \epsilon_{t-1} \tag{3.6}$$

Notice that expression (3.6) drops any constant sector- and firm-level fixed effect. To avoid TFP growth rates to be biased by outliers, I winsorize TFP scores and drop all TFP below the 1st and above the 99th percentile. Then, I compute average TFP growth between 1996 and 2007 for all firms. The distribution of this variable across all four-digit manufacturing sectors is plotted in Figure 3.5. The average TFP growth rate for each sector, also plotted in Figure 3.5 (red dots in the center of each distribution), is used as the sector-level competitiveness measure in the empirical analysis.

Effective Tax Rate The ENIA survey covers all plants hiring 10 or more employees. These firms are required to enclose the tax documents they had previously submitted to the Chilean Internal Tax Services (*Servicio de Impuestos Internos* or SII). This information can be cross-checked by the Chilean Statistics Institute if reliability is under suspicion. The implicit threat should minimize tax payment misreporting.

The data quality of ENIA does not end here. On top of VAT and profit tax payments, which are disclosed separately, ENIA provides all necessary information to compute pre-tax profit. Specifically, the latter consists of profit net of all operational costs, interests and amortizations. Accordingly, I compute the

Figure 3.5: Levinsohn-Petrin TFP Growth Distribution by four-digit level sector. Mean and 95 CI%.



effective profit tax rate (EPTR) paid by each firm as

$$EPTR_{2007} = \frac{\text{Profit Tax}_{2007}}{\text{EBT}_{2007}} \tag{3.7}$$

where EBT denotes Earnings Before Tax and equals to

$$EBT = \text{Sales Revenue - Costs of Good Sold - Interests - Depreciation} \tag{3.8}$$

Likewise, for the placebo test, I define the Effective Net VAT (ENVAT) as

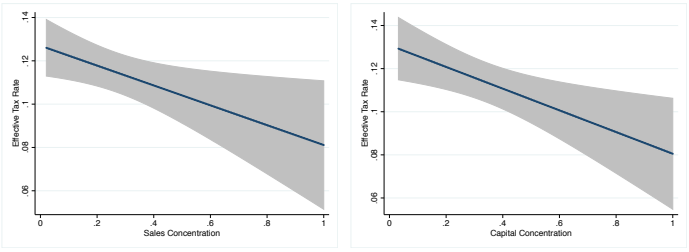
$$ENVAT = \frac{\text{Net VAT}}{EBT} \tag{3.9}$$

where Net VAT refers to the difference between *debited* and *credited* VAT payments. For each firm I compute EPTR and ENVAT, and then I compute the sector average for 2007.[30] The two resulting variables constitute the dependent variables of the analysis that follows.

Sector Taxability When fiscal capacity is low taxation is focused on concentrated sectors (Cheibub, 1998; Musgrave, 1969; Gehlbach, 2008). That is precisely what we saw in the case of Bolivia (Figure 3.1). However, Chile has a more advanced fiscal capacity than its neighbor. Chile might not need to put the burden of taxation on easy-to-tax sectors any more. Figure 3.6(a) and 3.6(b) plot the bivariate relationships between two alternative Herfindahl Indexes of market concentration (one based on sales, the other on capital), and the average effective profit tax rate, as defined in (3.7). All Herfindahl Indexes are derived out of the ENIA sample.

Figure 3.6(a) and 3.6(b) suggest that higher market concentration pushes down average effective profit tax rate. The negative relationship is indeed consistent with Richter et al. (2009) prediction, for whom concentrated firms are more effective in lobbying for lower taxes. Obviously, we cannot use any of these two indexes of market concentration as a proxy for sector taxability. Instead, I use an alternative Herfindahl Index based on spatial dispersion of industry across the territory. When firms are exposed to similar contextual factors,

[30] A few firms in ENIA form part of a *multi-unidad*, that is, they are part of a bigger conglomerate. Usually, when this is the case, only one of the firms in the conglomerate declares the group tax payments (the others have value 0). To avoid a downward bias in the sector average, I do not consider the zero-payments of firms belonging to any conglomerate.



(a) Sales Concentration (b) Capital Concentration

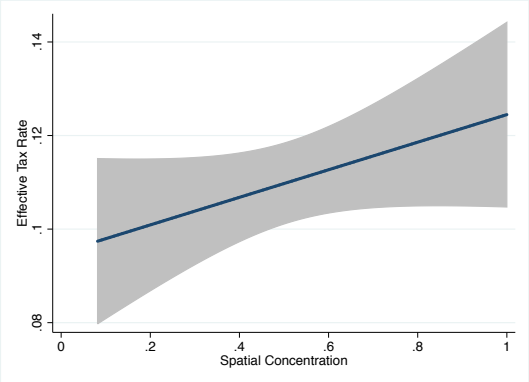
Figure 3.6: Bivariate linear relationship between Effective Tax Rate and Herfindahl Indexes of Sales and Capital concentration.

more can be learned and extrapolated from auditing one firm to the other. Moreover, geographic distance might cause coordination problems between regional delegations of the tax administration.

Chile is divided in 15 administrative regions. For each industry I compute the Herfindahl Index of spatial concentration. A given sector is spatially concentrated (and thus, easy to tax) when all firms are located in the same region. Figure 3.7 plots the bivariate linear relationship between the Herfindahl Index of spatial concentration and the average effective tax rate. As we can see, this proxy for sector taxability makes a much better work in predicting tax compliance than any of the market concentration indexes.

Controls. On top of the key magnitudes, the empirical analysis controls for export activity, lobbying capacity (approximated by the Herfindahl Indexes of market concentration in Figure 3.6), and tariff protection, which should account

Figure 3.7: Bivariate linear relationship between Effective Tax Rate and Herfindahl Indexes of Spatial Concentration. 90% CI.



for any strategic allocation of different protection devices (see *Section 2.2.2* for further details on the control variables). Export activity is measured by the value of total sector sales. The summary statistics for all variables are reported in Table 3.6. Except for NTB protection (drawn from the UNCTAD TRAINS database), all variables are drawn (or computed based on) the ENIA survey.

3.3.2. Analysis

The analysis is divided in two sections: first I assess the effect of protection on effective net VAT payments. This analysis is intended to find negative results; for that reason, I call it placebo test. The second analysis assesses the effect of protection on effective profit tax rate. Only then, I expect to find a positive and significant effect of Non-Tariff Barrier protection on tax compliance among obsolete, hard-to-tax sectors.

Table 3.6: Summary statistics of the Chilean sample. Unit of observation: four-digit ISIC Rev.3 manufacturing sector. Source: ENIA 1997-2002.

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
avg(ETR)	.113	.052	.002	.305
avg(effective VAT)	.382	.177	.057	.988
ln(sales)	17.197	1.991	12.485	2.384
ln(exports)	6.782	3.708	0	13.041
ln(capital)	16.062	2.195	9.829	19.896
Non-Tariff Barriers (NTB)	.507	.439	0	1
Tariff	1.361	1.059	.01	4.48
Market Concentration	.307	.243	.021	1
Spatial Concentration	.607	.284	.082	1
Uncompetitive	.017	.03	-.034	.118
N		85		

Placebo Test

In Table 3.7 I test the Protection-for-Tax-Compliance hypothesis for Net VAT tax rate, as defined in (3.9). Recall, this analysis is intended to be a placebo test. We should expect to find negative results. Chile's fiscal capacity for VAT is extremely high. Therefore, we can expect compliance to be driven by coercive means only. No other stimulus stimulus should be necessary.

The model specification in Table 3.7 is similar to that in Bolivia, which is itself specified in expression (3.1). However, almost everything else differs. First, the dependent variable is measured differently: for Bolivia, I measure total taxation; for Chile, the average effective tax rate.[31] Second, sector taxability is proxied differently: for Bolivia, I use market concentration; for Chile, I work

[31] In lack pre-tax profit data for Bolivia, what impedes computing the effective tax rate.

with spatial concentration.[32] Third, sector competitiveness is also measured differently: for Bolivia, I computed the share of firms involved in $R\&D$; for Chile, I estimate TFP growth and compute sector averages.

For ease of exposition, I reverse the sector taxability and competitiveness measures. In particular, let

$$\text{Hard-to-Tax} \equiv 1 - \text{spatial concentration} \tag{3.10}$$

which ranges from 0 to 1. In addition. let

$$\text{Uncompetitive} \equiv -1 \times \text{avg}(\Delta\text{TFP}) \tag{3.11}$$

where avg(ΔTFP) denotes sector average TFP growth. Both re-codifications are intended to ease the interpretation of the tree-way interactive coefficient.

Once all elements in the three-way interaction are clarified, let's evaluate the effect of NTB protection on VAT compliance. Recall, if Protection-for-Tax-Compliance fosters VAT tax compliance, we should expect $\hat{\beta}_7$ to be positive. $\hat{\beta}_6$ is the observational counter-factual. We should expect this estimate to be 0 or even negative. That is, if not protected, obsolete hard-to-tax sectors should not deviate from average payments, and if they do, they should pay lower taxes.

As I expected, Non-Tariff protection does not seem to induce any further compliance in VAT. The three-way interaction coefficient, $\hat{\beta}_7$, is not statisti-

[32] The geographic location of firms is not available in the Bolivian sample.

Table 3.7: Placebo Test. Net VAT in Chile. All models are controlled by Seven-Industry Fixed Effects.

	(1)	(2)	(3)
$\hat{\beta}_1$: Hard-to-Tax (HTT)	.108	.105	.097
	(.172)	(.173)	(.178)
$\hat{\beta}_2$: Non-Tariff Barrier (NTB)	.055	.056	.062
	(.130)	(.130)	(.130)
$\hat{\beta}_3$: Uncompetitive	-1.717	-1.813	-1.640
	(2.303)	(2.349)	(2.379)
$\hat{\beta}_4$: NTB $\times$ Uncompetitive	.220	.343	.054
	(3.165)	(3.152)	(3.273)
$\hat{\beta}_5$: NTB $\times$ HTT	-.070	-.059	-.060
	(.241)	(.243)	(.240)
$\hat{\beta}_6$: HTT $\times$ Uncompetitive	1.318	1.268	1.063
	(3.478)	(3.522)	(3.614)
$\hat{\beta}_7$: HTT $\times$ Uncompetitive $\times$ NTB	1.422	1.247	1.587
	(4.977)	(4.911)	(5.068)
$\hat{Z}_1$: ln(Sales)	-.057***	-.052**	-.048*
	(.021)	(.020)	(.026)
$\hat{Z}_2$: Capital Concentration	-.093		
	(.100)		
$\hat{Z}_3$: Sales Concentration		-.031	-.029
		(.102)	(.103)
$\hat{Z}_4$: ln(Exports)			-.003
			(.009)
$\hat{Z}_5$: Tariff			.010
			(.020)
β_0: Intercept	1.338***	1.221***	1.157***
	(.402)	(.381)	(.435)
N	85	85	85
R-squared	.267	.257	.261

Robust standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

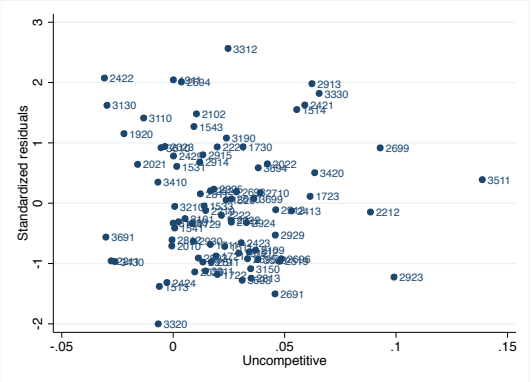
cally different from zero for any of the three models in Table 3.7. In Model 1, lobbying capacity is approximated by the capital-based Herfindahl Index of market concentration; in the second model, lobbying is approximated by the sales-based Herfindahl Index of concentration; in the third model, I control for export activity and tariff protection. The sign of $\hat{\beta}_7$ is positive in all models but not statistically significant. This result is consistent with the theory. When fiscal capacity is high, rulers should not trade protection for tax compliance; hence, we should not expect the tax compliance to increase upon protection.

Effective Profit Tax Rate

Contrary to VAT, fiscal capacity for profit taxation is still weak in Chile. Evasion rate is approximately 45% and this value has not improved since democratic transition in 1990. When fiscal capacity is weak, Protection-for-Tax-Compliance might induce higher tax abidance among obsolete sectors. This is precisely what I test in Table 3.8. Model 1 sets the benchmark. It already controls for the seven major industry fixed effects, which should minimize omitted variable bias. The sign for $\hat{\beta}_7$ is clearly positive and significantly different from zero. That is, uncompetitive, hard-to-tax sectors in Chile pay higher *effective* profit tax rates once they are protected by Non-Tariff Barriers from foreign competition.

Models 2 to 5 report robustness checks. In Model 2 I run a Tobit model. The dependent variable is comprised between 0 and 1 (although no case is censured).

Figure 3.8: Chile. Potential Outliers. Standardized Residuals by Competitiveness Levels. Estimates drawn from Model 3 in Table 3.8. 90% CI.



The coefficients are virtually identical to those in Model 1; the main difference with Model 1 lies in the standard errors, which tend to be more favorable to the research hypothesis. In Model 3 I replace the lobbying capacity proxy (capital concentration) for a different measure: sales concentration. The results remain the same. In order to estimate Model 4 I run a non-robust specification for Model 3. I identify all cases whose standardized residual lies above or below two standard deviations. These are plotted in Figure 3.8.

I drop the six potential outliers cases from the sample, and re-run Model 3 specification to check whether results are driven by outliers (small samples are very sensitive to those). To the contrary, the new coefficients, reported in Model 4, seem to corroborate the research hypothesis. Finally, in Model 5 I run the clean-of-outliers sample with two additional controls: the log of exports, and tariff protection. Neither of these variables are significant. However,

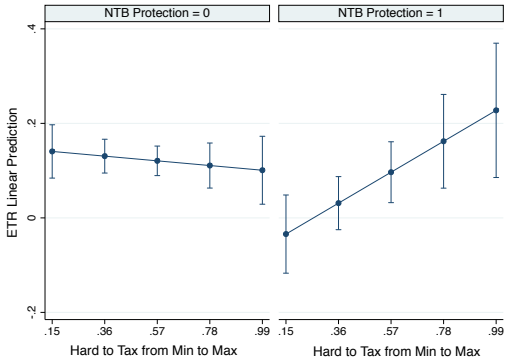
the estimate for β_7 remains virtually identical; that is, positive and statistically significant.

Next I plot the predicted effective profit tax rate for an obsolete hard-to-tax sector. For ease of exposition, I recode the Non-Tariff Barrier protection measure into a dummy variable. In particular, I classify as "protected" those sectors where more than 25% of its products are protected by a Non-Tariff Barrier.[33] The results for the new specification are reported in Table 3.9. They are virtually identical to those in Table 3.8 but the prediction is now straightforward. In particular, Figure 3.9 plots the linear prediction of the effective profit tax rate for an obsolete sector in 2007 Chile under two states of the world: in the left figure, this sector is not protected. As we would expect, the harder to tax a sector (uncompetitive or not), the lower the effective tax rate. The interesting effect, however, is plotted on the right figure, the second state of the world. This figure assumes protection is granted, and plots the linear prediction of the effective profit tax rate for different level of sector taxability. We can see that the harder it is to tax an uncompetitive sector, the more it seems to cooperate with taxation. Not only it does not evade less, but it abides by a higher effective tax rate. This result is consistent with the theoretical model. When sectors are uncompetitive and rulers have a hard time taxing them effectively, protection can be utilized to induce their tax abidance. That seems to be precisely what is going on Figure 3.9.[34]

[33] Accordingly, 42% of the sectors are not protected, 58% are.

[34] Tables 3.13 and 3.14 in the Appendix repeat the analysis for TFP estimated the standard way, with OLS and common production function. The results are identical, which suggest they are not

Figure 3.9: Predicted Effective Profit Tax Rate in 2007 Chile for Two States for World in Protection by Sector Taxability. Estimates drawn from Model 2 in Table 3.9. 90% CI.



3.4. Conclusion

Paper 2 has evaluated the incidence of Protection-for-Tax-Compliance in two starkly different contexts in Latin America: Bolivia and Chile. Bolivia is a low-income economy with weak fiscal capacity. The results suggest that both effective tariff protection and Non-Tariff Barrier coverage induce higher taxation by uncompetitive hard-to-tax sectors. The results were robust for two different measures of sector competitiveness: one based on $R\&D$ activity, the other on sector sales. The second test assessed the incidence of the research hypothesis in Chile, a middle-income economy with *a priori* high fiscal capacity.

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driven by the way sector productivity is measured. Moreover, Table 3.15 reports the results when NTB is replaced by tariff protection. They show that tariffs exert no effect on tax compliance, as I argued in *Section 2.3.1*

I claim that once we look closer at the fiscal structure in Chile we can find a significant divide in the effectiveness of direct and indirect taxation. I take advantage of this duality to test the Protection-for-Tax-Compliance hypothesis for low and high fiscal capacity within the same country. The results suggest that NTB protection has no effect on stimulating effective VAT. This is not surprising given the high effectiveness of VAT in Chile, even if compared to advanced economies. Contrarily, NTBs seem to stimulate higher tax compliance in the weakest leg of the Chilean tax system. When sectors are harder to tax and uncompetitive, NTB protection seems to induce higher profit tax abidance.

Overall, the micro-analysis of Protection-for-Tax-Compliance undertaken in Paper 2 seems consistent with the working hypothesis. Now that the theoretical model is empirically grounded, the third chapter evaluates the long-term consequences of Protection-for-Tax-Compliance. That is to say, I seek to identify the conditions under which this institutional solution is treated as a temporary device or an end in itself, and what economic consequences follow.

Table 3.8: Predicting Average Effective Profit Tax Rate in Chile. All models are controlled by Seven-Industry Fixed Effects.

	(1) OLS	(2) Tobit	(3) OLS	(4) OLS	(5) OLS
Sample →	Full	Full	Full	No Outliers	No Outliers
$\hat{\beta}_1$: Hard-to-Tax (HTT)	.033	.033	.059	.047	.043
	(.052)	(.048)	(.051)	(.046)	(.047)
$\hat{\beta}_2$: NTB Cover	.084***	.084***	.097***	.107***	.109***
	(.032)	(.029)	(.034)	(.031)	(.031)
$\hat{\beta}_3$: Uncompetitive	.436	.436	.504	.718	.764
	(.583)	(.529)	(.578)	(.631)	(.627)
$\hat{\beta}_4$: NTB Cover × Uncompetitive	-2.525**	-2.525***	-2.709***	-3.023***	-3.127***
	(.965)	(.875)	(.948)	(.980)	(1.027)
$\hat{\beta}_5$: NTB Cover × HTT	-.119*	-.119**	-.130**	-.123**	-.122**
	(.061)	(.055)	(.061)	(.057)	(.057)
$\hat{\beta}_6$: HTT × Uncompetitive	-.410	-.410	-.825	-.766	-.823
	(.907)	(.822)	(.878)	(1.063)	(1.119)
$\hat{\beta}_7$: HTT × Uncompetitive × HTT	3.335*	3.335**	4.303**	4.463**	4.590**
	(1.787)	(1.620)	(1.807)	(1.825)	(1.892)
$\hat{Z}_1$: ln(Capital)	-.007**	-.007**	-.008**	-.007**	-.006
	(.003)	(.003)	(.003)	(.003)	(.005)
$\hat{Z}_2$: Capital Concentration	-.083***	-.083***			
	(.024)	(.022)			
$\hat{Z}_3$: Sales Concentration			-.089***	-.077***	-.077***
			(.023)	(.021)	(.021)
$\hat{Z}_4$: ln(Exports)					-.001
					(.003)
$\hat{Z}_5$: Tariff					.004
					(.005)
Intercept	.212***	.212***	.214***	.185***	.163**
	(.063)	(.057)	(.059)	(.055)	(.070)
N	85	85	85	79	79
R-squared	.362	-	.361	.466	.473

Robust standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

Table 3.9: Effective Profit Tax Rate in 2007 Chile. Dummy specification for Non Tariff Barrier Protection ($d.NTB$). Outliers Dropped. Both models controlled by Seven-Industry Fixed Effects.

	(1) OLS	(2) Tobit
$\hat{\beta}_1$: Hard-to-Tax (HTT)	.037	.037
	(.051)	(.045)
$\hat{\beta}_2$: d.NTB	.091***	.091***
	(.033)	(.029)
$\hat{\beta}_3$: Uncompetitive	.709	.709
	(.626)	(.553)
$\hat{\beta}_4$: d.NTB × Uncompetitive	-2.905***	-2.905***
	(1.041)	(.921)
$\hat{\beta}_5$: d.NTB × HTT	-.112*	-.112**
	(.060)	(.053)
$\hat{\beta}_6$: HTT × Uncompetitive	-.767	-.767
	(1.126)	(.995)
$\hat{\beta}_7$: d.NTB × Uncompetitive × HTT	4.285**	4.285**
	(1.973)	(1.744)
$\hat{Z}_1$: ln(capital)	-.004	-.004
	(.005)	(.004)
$\hat{Z}_2$:Sales Concentration	-.075***	-.075***
	(.021)	(.018)
$\hat{Z}_3$:ln(Exports)	-.002	-.002
	(.003)	(.002)
$\hat{Z}_4$:Tariff	.005	.005
	(.005)	(.004)
$\hat{\beta}_0$: Intercept	.158**	.158**
	(.072)	(.064)
N	79	79
R-squared	.453	

Robust standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

3.5. Appendix Bolivia

3.5.1. Robustness Tests

Tables 3.10 and 3.11 report the coefficients of expression (1) for Tariff and NTB protection respectively once the outliers in Tables 3.2 and 3.3 are dropped from the sample.

Table 3.10: Bolivia. Robustness Checks. Effect of Tariff Protection on Tax Payments for two proxies for uncompetitiveness and Outliers dropped.

	R&D	Sales Growth
	(1)	(2)
$\hat{\beta}_1$: Hard-to-Tax (HTT)	1.150	-1.484
	(1.582)	(.969)
$\hat{\beta}_2$: Tariff	.486***	-.128
	(.164)	(.112)
$\hat{\beta}_3$: Uncompetitive	1.559*	.005
	(.918)	(.010)
$\hat{\beta}_4$: Tariff $\times$ Uncompetitive	-.660***	-.004*
	(.197)	(.002)
$\hat{\beta}_5$: Tariff $\times$ HTT	-.706*	.380*
	(.361)	(.193)
$\hat{\beta}_6$: HTT $\times$ Uncompetitive	-2.543	-.022
	(2.335)	(.018)
$\hat{\beta}_7$: HTT $\times$ Uncompetitive $\times$ Protected	1.095**	.009**
	(.513)	(.005)
$\hat{Z}_1$: ln(labor)	1.276***	1.298***
	(.085)	(.088)
$\hat{Z}_2$: Public Share	5.075***	4.625***
	(1.339)	(1.381)
$\hat{Z}_3$: Exports	.205	-.127
	(.296)	(.347)
$\hat{Z}_4$: ICE	1.434*	1.361*
	(.781)	(.766)
$\hat{Z}_5$: NTB Cover	1.350*	1.760**
	(.720)	(.739)
$\hat{\beta}_0$: Intercept	.550	2.011*
	(1.036)	(1.016)
N	74	75
R-squared	.933	.921

All models controlled by Fixed Effects at two-digit level.
Robust standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

Table 3.11: Bolivia. Robustness Checks. Effect of NTB Protection on Tax Payments for two proxies for uncompetitiveness and Outliers dropped.

	R&D	Sales Growth
	(1)	(2)
$\hat{\beta}_1$: Hard-to-Tax (HTT)	-.252	.045
	(.994)	(.674)
$\hat{\beta}_2$: NTB	7.509***	1.183
	(1.882)	(1.044)
$\hat{\beta}_3$: Uncompetitive	-.145	-.003
	(.614)	(.005)
$\hat{\beta}_4$: NTB $\times$ Uncompetitive	-6.102***	-.039**
	(1.877)	(.017)
$\hat{\beta}_5$: NTB $\times$ HTT	-9.640***	-.636
	(3.421)	(1.280)
$\hat{\beta}_6$: HTT $\times$ Uncompetitive	.626	.007
	(1.324)	(.008)
$\hat{\beta}_7$: HTT $\times$ Uncompetitive $\times$ NTB	1.744**	.049**
	(4.484)	(.021)
$\hat{Z}_1$: ln(labor)	1.235***	1.385***
	(.078)	(.087)
$\hat{Z}_2$: Public Share	4.686***	3.402**
	(1.355)	(1.467)
$\hat{Z}_3$: ICE	1.380*	1.308*
	(.824)	(.767)
$\hat{Z}_4$: Exports	.205	-.025
	(.269)	(.281)
$\hat{Z}_5$: Tariff	-.010	.018
	(.058)	(.060)
$\hat{\beta}_0$: Intercept	1.257	1.481
	(1.138)	(.943)
N	74	74
R-squared	.920	.933

All models controlled by Fixed Effects at two-digit level.
Robust standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

Table 3.12: Correspondence between ISIC Rev. 3 and ISIC Rev. 4 used for Bolivia's Analysis.

Rev 3	Description Rev 3	Rev 4	Description Rev 4
1511	Production, processing and preserving of meat and meat products	1010	Processing and preserving of meat
1513	Processing and preserving of fruit and vegetables	1030	Processing and preserving of fruit and vegetables
1514	Manufacture of vegetable and animal oils and fats	1040	Manufacture of vegetable and animal oils and fats
1520	Manufacture of dairy products	1050	Manufacture of dairy products
1531	Manufacture of grain mill products	1061	Manufacture of grain mill products
1532	Manufacture of starches and starch products	1062	Manufacture of starches and starch products
1541	Manufacture of bakery products	1071	Manufacture of bakery products
1542	Manufacture of sugar	1072	Manufacture of sugar
1543	Manufacture of cocoa, chocolate and sugar confectionery	1073	Manufacture of cocoa, chocolate and sugar confectionery
1544	Manufacture of macaroni, noodles, couscous and similar farinaceous products	1074	Manufacture of macaroni, noodles, couscous and similar farinaceous products
1549	Manufacture of other food products n.e.c.	1079	Manufacture of other food products n.e.c.
1533	Manufacture of prepared animal feeds	1080	Manufacture of prepared animal feeds
1551	Distilling, rectifying and blending of spirits; ethyl alcohol production from fermented materials	1101	Distilling, rectifying and blending of spirits
1552	Manufacture of wines	1102	Manufacture of wines
1553	Manufacture of malt liquors and malt	1103	Manufacture of malt liquors and malt
1554	Manufacture of soft drinks; production of mineral waters	1104	Manufacture of soft drinks; production of mineral waters and other bottled waters
1600	Manufacture of tobacco products	1200	Manufacture of tobacco products
1711	Preparation and spinning of textile fibers; weaving of textiles	1311	Preparation and spinning of textile fibers
1721	Manufacture of made-up textile articles, except apparel	1392	Manufacture of made-up textile articles, except apparel
1729	Manufacture of other textiles n.e.c.	1399	Manufacture of other textiles n.e.c.
1810	Manufacture of wearing apparel, except fur apparel	1410	Manufacture of wearing apparel, except fur apparel
1730	Manufacture of knitted and crocheted fabrics and articles	1430	Manufacture of knitted and crocheted apparel
1912	Manufacture of luggage, handbags and the like, saddlery and harness	1512	Manufacture of luggage, handbags and the like, saddlery and harness
1920	Manufacture of footwear	1520	Manufacture of footwear
2010	Saw-milling and planing of wood	1610	Saw-milling and planing of wood
2021	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board and other panels and boards	1621	Manufacture of veneer sheets and wood-based panels

Rev 3	Description Rev 3 (continued)	Rev 4	Description Rev 4 (continued)
2022	Manufacture of builders' carpentry and joinery	1622	Manufacture of builders' carpentry and joinery
2029	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	1629	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials
2101	Manufacture of pulp, paper and paperboard	1701	Manufacture of pulp, paper and paperboard
2102	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	1702	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard
2109	Manufacture of other articles of paper and paperboard	1709	Manufacture of other articles of paper and paperboard
2221	Printing	1811	Printing
2230	Reproduction of recorded media	1820	Reproduction of recorded media
2320	Manufacture of refined petroleum products	1920	Manufacture of refined petroleum products
2411	Manufacture of basic chemicals, except fertilizers and nitrogen compounds	2011	Manufacture of basic chemicals
2412	Manufacture of fertilizers and nitrogen compounds	2012	Manufacture of fertilizers and nitrogen compounds
2413	Manufacture of plastics in primary forms and of synthetic rubber	2013	Manufacture of plastics and synthetic rubber in primary forms
2422	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	2022	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
2424	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	2023	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
2429	Manufacture of other chemical products n.e.c.	2029	Manufacture of other chemical products n.e.c.
2423	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	2100	Manufacture of pharmaceuticals, medicinal chemical and botanical products
2511	Manufacture of rubber tires and tubes; retreading and rebuilding of rubber tires	2211	Manufacture of rubber tires and tubes; retreading and rebuilding of rubber tires
2519	Manufacture of other rubber products	2219	Manufacture of other rubber products
2520	Manufacture of plastics products	2220	Manufacture of plastics products
2610	Manufacture of glass and glass products	2310	Manufacture of glass and glass products
2692	Manufacture of refractory ceramic products	2391	Manufacture of refractory products
2693	Manufacture of structural non-refractory clay and ceramic products	2392	Manufacture of clay building materials
2691	Manufacture of non-structural non-refractory ceramic ware	2393	Manufacture of other porcelain and ceramic products

Rev 3	Description Rev 3 (continued)	Rev 4	Description Rev 4 (continued)
2694	Manufacture of cement, lime and plaster	2394	Manufacture of cement, lime and plaster
2695	Manufacture of articles of concrete, cement and plaster	2395	Manufacture of articles of concrete, cement and plaster
2696	Cutting, shaping and finishing of stone	2396	Cutting, shaping and finishing of stone
2699	Manufacture of other non-metallic mineral products n.e.c.	2399	Manufacture of other non-metallic mineral products n.e.c.
2710	Manufacture of basic iron and steel	2410	Manufacture of basic iron and steel
2720	Manufacture of basic precious and non-ferrous metals	2420	Manufacture of basic precious and other non-ferrous metals
2811	Manufacture of structural metal products	2511	Manufacture of structural metal products
2812	Manufacture of tanks, reservoirs and containers of metal	2512	Manufacture of tanks, reservoirs and containers of metal
2927	Manufacture of weapons and ammunition	2520	Manufacture of weapons and ammunition
2891	Forging, pressing, stamping and roll-forming of metal; powder metallurgy	2591	Forging, pressing, stamping and roll-forming of metal; powder metallurgy
2892	Treatment and coating of metals; general mechanical engineering on a fee or contract basis	2592	Treatment and coating of metals; machining
2899	Manufacture of other fabricated metal products n.e.c.	2599	Manufacture of other fabricated metal products n.e.c.
3210	Manufacture of electronic valves and tubes and other electronic components	2610	Manufacture of electronic components and boards
3320	Manufacture of optical instruments and photographic equipment	2670	Manufacture of optical instruments and photographic equipment
3150	Manufacture of electric lamps and lighting equipment	2740	Manufacture of electric lighting equipment
2930	Manufacture of domestic appliances n.e.c.	2750	Manufacture of domestic appliances
3190	Manufacture of other electrical equipment n.e.c.	2790	Manufacture of other electrical equipment
2912	Manufacture of pumps, compressors, taps and valves	2813	Manufacture of other pumps, compressors, taps and valves
2913	Manufacture of bearings, gears, gearing and driving elements	2814	Manufacture of bearings, gears, gearing and driving elements
2914	Manufacture of ovens, furnaces and furnace burners	2815	Manufacture of ovens, furnaces and furnace burners
2919	Manufacture of other general purpose machinery	2819	Manufacture of other general-purpose machinery
2922	Manufacture of machine-tools	2822	Manufacture of metal-forming machinery and machine tools
2924	Manufacture of machinery for mining, quarrying and construction	2824	Manufacture of machinery for mining, quarrying and construction
2929	Manufacture of other special purpose machinery	2829	Manufacture of other special-purpose machinery
3420	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	2920	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
3430	Manufacture of parts and accessories for motor vehicles and their engines	2930	Manufacture of parts and accessories for motor vehicles
3599	Manufacture of other transport equipment n.e.c.	3099	Manufacture of other transport equipment n.e.c.

Rev 3	Description Rev 3 (continued)	Rev 4	Description Rev 4 (continued)
3610	Manufacture of furniture	3100	Manufacture of furniture
3691	Manufacture of jewelry and related articles	3211	Manufacture of jewelry and related articles
3692	Manufacture of musical instruments	3220	Manufacture of musical instruments
3694	Manufacture of games and toys	3240	Manufacture of games and toys
3311	Manufacture of medical and surgical equipment and orthopedic appliances	3250	Manufacture of medical and dental instruments and supplies
2211	Publishing of books, brochures, musical books and other publications	5811	Book publishing
2212	Publishing of newspapers, journals and periodicals	5813	Publishing of newspapers, journals and periodicals
2219	Other publishing	5819	Other publishing activities
1711	Preparation and spinning of textile fibers; weaving of textiles	1312	Weaving of textiles
1730	Manufacture of knitted and crocheted fabrics and articles	1391	Manufacture of knitted and crocheted fabrics
2710	Manufacture of basic iron and steel	2431	Casting of iron and steel
2720	Manufacture of basic precious and non-ferrous metals	2432	Casting of non-ferrous metals
2912	Manufacture of tanks, reservoirs and containers of metal	2812	Manufacture of fluid power equipment
2899	Manufacture of other fabricated metal products n.e.c.	3311	Repair of fabricated metal products
1512	processing and preserving of fish and fish products	1020	Processing and preserving of fish, crustaceans and mollusks
Rev 3	Description Rev (continued) 3	Rev 4	Description Rev 4 (continued)
Merged Sectors			
Average of 1911 and 1820	1820, Dressing and dyeing of fur; manufacture of articles of fur & 1911 Tanning and dressing of leather	1420,	Manufacture of articles of fur
Average of 3110 and 3120	3110 ,Manufacture of electric motors, generators and transformers, & 3120, Manufacture of electricity distribution and control apparatus, except wiring devices	2710,	Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus
Average of 3710 and 3720	3710, Recycling of metal waste and scrap & 372, Recycling of non-metal waste and scrap	3830	Materials recovery

3.6. Appendix Chile

3.6.1. OLS TFP Estimates

TFP derived from expression (3.3) can be estimated by OLS instead of Levinsohn-Petrin. In order to maximize the comparability of TFP scores across sectors I pool the full sample and estimate TFP by OLS. In order to account for industry and sector effects, I add both batteries of fixed effects. The estimates of the production function are reported in Table 3.13.

Table 3.13: TFP estimated by OLS with Industry and Sector Fixed effects.

	Coef.	se
ln(skilled)	.089***	(.002)
ln(unskilled)	.125***	(.003)
ln(electricity)	.064***	(.002)
ln(material)	.725***	(.002)
ln(capital)	.042***	(.002)
Intercept	2.659***	(.028)
N	37,373	
R-squared	.945	

*** p<.01

3.6.2. Robustness Check with OLS TFP

As a robustness test, Table 3.8 reports the same analysis than Table 3.14 once the LP TFP growth estimates have been replaced by OLS TFP growth estimates (derived from Table 3.13). The results are virtually identical to those in Table 3.8. The coefficient of interest, $\hat{\beta}_7$ is positive and statistically significant. All in all, the results in Table 3.8 are not sensitive to the method used to estimate TFP growth.

Table 3.14: Dependent Variable: Effective Profit Tax Rate. Chile 2007, OLS TFP estimates. All Models controlled by Industry fixed effect.

	(1) OLS	(2) Tobit	(3) OLS	(4) OLS	(5) OLS
Sample →	Full	Full	Full	No outliers	No outliers
$\hat{\beta}_1$: Hard-to-tax (HTT)	.067	.067*	.044	.061	.054
	(.044)	(.040)	(.047)	(.043)	(.040)
$\hat{\beta}_2$: NTB cover	.086***	.086***	.073***	.070***	.071***
	(.028)	(.026)	(.027)	(.025)	(.025)
$\hat{\beta}_3$: Uncompetitive	.821	.821	.719	.789	.839
	(.549)	(.498)	(.620)	(.550)	(.532)
$\hat{\beta}_4$: NTB cover × Uncompetitive	-2.491***	-2.491***	-2.291**	-2.050***	-2.149***
	(.930)	(.843)	(.968)	(.771)	(.802)
$\hat{\beta}_5$: HTT × NTB cover	-.114**	-.114**	-.110*	-.079	-.077
	(.054)	(.049)	(.056)	(.049)	(.047)
$\hat{\beta}_6$: HTT × Uncompetitive	-1.188	-1.188	-.814	-1.065	-1.146
	(.912)	(.827)	(1.029)	(.915)	(.900)
$\hat{\beta}_7$: HTT × Uncompetitive × NTB	4.005**	4.005**	3.054*	3.244**	3.360**
	(1.776)	(1.610)	(1.774)	(1.548)	(1.565)
$\hat{Z}_1$: ln(Capital)	-.006*	-.006**	-.005	-.006*	-.004
	(.003)	(.003)	(.003)	(.003)	(.005)
$\hat{Z}_2$: Sales Concentration	-.093***	-.093***		-.084***	-.082***
	(.024)	(.022)		(.024)	(.024)
$\hat{Z}_3$: Capital Concentration			-.086***		
			(.024)		
$\hat{Z}_4$: ln(Exports)					-.002
					(.003)
$\hat{Z}_5$: Tariff					.004
					(.006)
Intercept	.169***	.169***	.171**	.153***	.125*
	(.060)	(.054)	(.066)	(.056)	(.070)
N	85	85	85	82	82
R-squared	.346	-	.348	.313	.323

Robust standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

3.6.3. Tariff Stimulus

Given the free-trade tradition in Chile, effective tariff protection was disregarded from the very beginning as a tax compliance stimulus policy. Anyway, Table 3.15 reports the coefficients of Model 1 specification when effective tariff protection is used as the stimulus variable instead of NTB. As we can see, tariffs have no effect at all. The sign of $\hat{\beta}_7$ in Model 1 (Net VAT) is negative but is falls far from significance levels. The sign of $\hat{\beta}_7$ in Model 2 (profit tax) is positive but again falls far from statistical significance. These results seem to confirm the low suitability of tariff protection as stimulus variable for tax compliance.

Table 3.15: Tariff protection as stimulus variable for Tax Compliance in 2007 Chile.

Dep. Var →	(1) Eff. Net VAT	(2) Eff. Profit Tax Rate
$\hat{\beta}_1$: Hard to Tax (HTT)	.077	-.038
	(.182)	(.056)
$\hat{\beta}_2$: Tariff	.043	-.004
	(.066)	(.014)
$\hat{\beta}_3$: Uncompetitive	-.867	-.438
	(2.926)	(.534)
$\hat{\beta}_4$: Tariff × Uncompetitive	-.901	-.430
	(2.160)	(.403)
$\hat{\beta}_5$: Tariff × HTT	-.033	.007
	(.097)	(.022)
$\hat{\beta}_6$: HTT × Uncompetitive	2.201	.636
	(4.470)	(.799)
$\hat{\beta}_7$: Tariff × Uncompetitive × HTT	-.303	.594
	(3.786)	(.818)
$\hat{Z}_1$: ln(Sales)	-.061***	
	(.021)	
$\hat{Z}_2$: ln(Capital)		-.006*
		(.004)
$\hat{Z}_3$: Capital Concentration	-.122	
	(.101)	
$\hat{Z}_4$: Sales Concentration		-.077***
		(.024)
$\hat{\beta}_0$	1.439***	.245***
	(.391)	(.059)
N	85	85
R-squared	.278	.253

Robust standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

CHAPTER 4. PROTECTION-FOR-TAX-COMPLIANCE IN THE LONG-RUN

Chapter Abstract

This paper evaluates how policies intended to raise tax revenue in the short-run might preclude long-term investment in fiscal capacity. When public spending is required for political survival and fiscal capacity is poor, rulers might offer protection to uncompetitive producers in exchange for tax compliance. Under some conditions this institutional solution is not only self-preserving but socially optimal. I refer to this logic as Protection-for-Tax-Compliance. This exchange is socially beneficial in the short-run but not in the long-run when it discourages further investments in fiscal capacity or industrial productivity. Specifically, the theoretical model suggests a nonmonotonic relationship between the initial stock of fiscal capacity and long-term aggregate welfare. When fiscal capacity endowment is large, Protection-for-Tax-Compliance is socially detrimental. The boost in tax revenue does not compensate the wage loss upon protection. When fiscal capacity endowment is low, Protection-for-Tax-Compliance becomes an absorbing equilibrium. No further investment in fiscal capacity takes place, productivity stagnates, and the economy eventually falls in a low-income, low-fiscal capacity trap. Only when fiscal capacity takes intermediate values, the additional tax proceeds following protection are re-invested in the expansion of the fiscal capacity, what induces technological adoption among uncompetitive producers. Eventually, enhanced fiscal capacity and competitiveness makes free-trade preferable. Altogether, I present a theory of endogenous fiscal and trade institutions which emphasizes the inter-temporal trade-offs of institutional investment.[1]

[1] I gratefully acknowledge Adam Przeworski, Neal Beck, David Stasavage, and Christian Dippel for their comments and suggestions as well as participants at the *The Political Economy of State Capacity* conference held at Juan March Institute in June 2012.

4.1. Introduction

When public spending is required for political survival, rulers might pursue one of two strategies: investing in fiscal capacity or raising revenue tariffs (or both). The first strategy does not produce returns in the short-run. Institutional investment needs time to materialize (Besley and Persson, 2011; Acemoglu, 2005). The second strategy, protectionist policy, boosts revenue in the short-run but might condition future growth by creating endogenously a vested interest in the *status quo* (Tena-Junguito, 2010). This paper presents a theory that links both *revenue production policies* (Levi, 1988). In particular, I identify the conditions under which long-term institutional investment is pursued by funneling in the additional tax proceeds stemming from protectionist policy. In this theory the revenue enhancing potential of protectionist policy is revisited. Specifically, it is argued that, under some conditions, the tax incidence of protectionist policy increases among foreign producers penetrating the domestic market *and* the protected national industry. That I denote, Protection-For-Tax-Compliance.

In Paper 1 I identify the conditions under which protection is exchanged for tax compliance by domestic producers in a static framework, as well as the *trade-offs* involved in such institutional solution. For Protection-for-Tax-Compliance to arise, domestic industry must be sufficiently uncompetitive and fiscal capacity weak enough. When both conditions are simultaneously met, even a benevolent ruler might find optimal to protect inefficient industry as these, in exchange for protection from superior competitors, abide by higher

effective tax rates. This bargain is proved to be self-preserving. Anticipating the effect of free-trade in a world of Schumpeterian market competition, the protected industry's commitment to abide by higher taxes (*i.e.*, evade less) is credible.[2] In other words, Schumpeterian competition induces an obsolete producer to abide by higher effective taxes as a means of avoiding competition with superior firms. The benevolent ruler, who maximizes a linear combination of wages and public spending, pursues this protectionist solution as long as the initial stock of fiscal capacity is sufficiently low. Protectionist policy depresses nominal and relative wages; only when the fiscal capacity endowment is sufficiently low, the boost in tax proceeds following Protection-for-Tax-Compliance outweighs the wage loss. For higher levels of fiscal capacity endowment, free-trade is preferred instead.

There exists extensive historical evidence suggesting that rulers have exchanged entry barriers (licenses, tariffs, price markups) for tax abidance by incumbent producers. The brewing industry in the eighteenth century in England (Nye, 2007), the Mercantilist era in France (Ekelund and Tollison, 1981), or municipal taxes in nineteenth century Prussia (Spoerer, 2008) followed the same logic: entry barriers (operating licenses, mainly) were exchanged for higher effective tax rates. Similar agreements took place among nitrate producers in 1880s Chile (Gallo, 2008), tin producers in 1930-50s Bolivia (Gallo, 1997), and

[2]Technology innovation is the key dimension of industrial competition in a Schumpeterian market. Innovations that drive growth by creating new technologies also destroy the results of previous innovations by making them obsolete (Aghion and Howitt, 2009). That is the essence of *creative destruction*.

local businesses in pre-communist China (Wang, 2001). Likewise, Peru raised profit taxation from 1950 to 1980 by pursuing these kinds of quasi-mercantilist agreements (Webb, 1972, 1974; De Soto, 1989). Radical implementations of Protection-for-Tax-Compliance are documented by Gehlbach (2008) in post-communist Russia, Bastable (1891) in nineteenth century English trade, and Arias (2009) under the Spanish rule in Mexico. In all these settings, artificial monopolies were created to guarantee *ex ante* tax compliance by the protected firms.

These examples *also* suggest that the tax proceeds raised under Protection-for-Tax-Compliance were differently employed by government. England and Bolivia are exemplifying extremes: England protected the brewing industry in the eighteenth century and effectively raised taxation in the sector. Taxes stemming from this industry reached 43% of total tax revenue (Nye, 2007). Likewise, Bolivia used export quotas as a carrot-and-stick device to promote tax compliance among tin producers. Taxes derived from this sector reached 62% of total revenue in 1942 (Gallo, 1997). The use of Protection-for-Tax-Compliance strategies in England did not prevent the government from investing in tax administration all over the eighteenth century (Brewer, 1988). Simultaneously, the protected brewing industry used their privileged situation to expand production and reduce costs (Nye, 2007). In Bolivia, on the contrary, fiscal capacity was not expanded despite the significant increase in tax revenue stemming from export licenses.[3] The tax administration remained flawed or-

[3]Export licenses' share over total indirect domestic revenue almost tripled in this period

ganized and tax officials ill trained (Gallo, 1997). The tax base was not expanded either. By 1960 the state lacked the capacity to tax land or its products (Whitehead, 1975). Non-surprisingly, Bolivia ranked second from the bottom in a tax administration survey conducted by the IMF in the mid-60s across 49 developing economies (Bahl, 1972). The stagnation of the tax administration was accompanied by an absence of significant achievements in tin productivity. Domestic producers did not take advantage of the regulatory shelter to expand production. Bolivia's world share of tin production declined three percent over the period, from 22.3% to 19.4% (Ayub and Hashimoto, 1985). Expansion and capitalization of the mines came to a halt (Klein, 1986). Profits were not reinvested but deposited in foreign accounts (Ayub and Hashimoto, 1985). Instead of solving common technical problems[4], tin producers focused on lobbying the government to maximize export quotas (Hillman, 2002).

The opposed paths followed by Bolivia and England suggest that protectionist policy intended to raise tax proceeds in the short-run can be managed by government in starkly different ways. These two cases also suggest that the incentives to improve production techniques (either innovating or adopting superior technologies) might be endogenous to the evolution of fiscal capacity. In order to assess both questions analytically, the Protection-for-Tax-Compliance model is expanded as to allow for investment in fiscal capacity by the ruler

(Peres Cajías, 2010). Likewise, tax revenue stemming from tin industry more than tripled over the same period (Gallo, 1997).

[4]Tin mines in Bolivia were hardly accessible and were ill communicated, which increased the production costs relative to Malaysia, the world leader in tin production and main competitor.

and technological adoption by the obsolete producer. The analysis suggests a nonmonotonic relationship between the initial stock of fiscal capacity and aggregate welfare. When the endowment of fiscal capacity is large, protection of obsolete firms in exchange for higher tax compliance is socially detrimental. The reduction of wages that follows protection does not compensate the increase in tax revenue. When the endowment of fiscal capacity is too low, such compensation exists in the short-run but not in the long-term. For low levels of fiscal capacity, even a welfare utility maximizing ruler would lack the incentives to invest the additional tax proceeds in strengthening the fiscal capacity of the state. But even if she finds it convenient (low to mild fiscal capacity), she might be captured by the incumbent producers in favor of the *status quo*. Either way, Protection-for-Tax-Compliance becomes an end in itself and leads the economy to a low income, low fiscal capacity equilibrium. Only when the fiscal capacity endowment takes intermediate values, Protection-for-Tax-Compliance can be socially beneficial in the short- and long-run. For this range of the parameter space, the ruler reinvests all proceeds derived from this policy in the expansion of fiscal capacity, inducing the incumbent producers to catch-up with superior competitors. The fiscal capacity endowment eventually hits the socially optimal level and the economy switches from the protectionist equilibrium to free trade.

The extended set up emphasizes the inter-temporal dilemmas of fiscal capacity investment. It suggests that institutional *underinvestment* does not need political instability or ethnic conflict (Besley and Persson, 2011). The mere short-term opportunity costs of fiscal capacity investment (*i.e.*, lower levels of

public good consumption) might push a welfare maximizing ruler to stick to the *status quo* (*i.e.*, Protection-for-Tax-Compliance). These results also speak to the infant-industry protection literature (Harrison and Rodríguez-Clare, 2010); particularly, it sheds light on the effect of tariff protection on long-term economic growth (Tena-Junguito, 2010; Irwin, 2000; Lehmann and O'Rourke, 2011). These works find heterogenous effects of tariff protection depending on the initial income level and political institutions. This paper adds a third factor to the equation: the initial stock of fiscal capacity. Depending on this value, rulers face opposite incentives to reinvest tariff revenue in fiscal capacity building, what also determines the incentives to innovate among protected industry. The results in this paper talk to the barriers to technology adoption literature too (Mokyr, 1991; Acemoglu, 2008; Parente and Prescott, 2000; Comin and Hobijn, 2009). These works characterize technology traps as the result of rent-seeking by government. The theoretical model qualifies this debate by pointing out the incentives that even a well-intended ruler might have to protect inefficient industry. Under some conditions, Protection-for-Tax-Compliance might be the best constrained policy in the short- *and* long-run.[5]

The rest of the paper is organized as follows: Section 2 presents a simplified version of the original Protection-for-Tax-Compliance model. In Section 3, the benchmark set up is expanded into a reduced-form model of fiscal capacity investment and technology adoption. The extension analyzes first fiscal capacity

[5] In Paper 1 I identify the conditions under which Protection-for-Tax-Compliance is socially optimal in a one-period setting, and compares it to the competing mechanism of protection acquisition: *Protection for Sale* (Grossman and Helpman, 1994).

investment by a benevolent ruler, and then that of a rent-seeking ruler. Overall, the results identify a nonmonotonic relationship between Protection-for-Tax-Compliance and aggregate welfare. The long-term consequences of this kind of protectionist agreement are discussed in the Conclusion.

4.2. Set Up

Suppose there are three agents in the economy: the political ruler, the incumbent producer and a potential entrant.

The Ruler. The ruler decides over the tax rate $\tau \in [0, 1]$, and entry regulation. The latter consists of costless regulation allowing (banning) entry of superior competitors. The ruler is assumed to maximize the utility of a representative wage-earner. In particular her utility is a linear combination of wages, ω, and per capita public spending, $\bar{G} = G/L$, where L denotes the total number of wage-earners. Altogether,

$$V = \omega + \rho\bar{G} \tag{4.1}$$

where $\rho > 1$ denotes the extra-weight conferred to public spending. Public spending is pure-consumption, and is funded by tax revenue T. Taxes are raised from a sales tax. Total tax revenue is $T = \tau px$, with price p, and sales x. The ruler does not keep any additional share of T for self-consumption. All tax proceeds are funneled to public spending. Accordingly, an identity between spending G and tax revenue T is assumed (*i.e.*, $G \equiv T$).

Initially, the tax rate (and hence, tax revenue T) is upper bounded by the fiscal capacity endowment, τ_o. This parameter denotes the maximum share of private income that can be taxed. It reflects the marginal cost of tax enforcement (the lower this cost, the higher the fiscal capacity). Fiscal capacity can be reduced with *costly* investments in tax administration (Besley and Persson, 2011). However, as it is examined below, Protection-for-Tax-Compliance can achieve the same levels of fiscal capacity *without* monetary disbursements in tax administration.

Production. The economy has a fixed number L of people, who have no demand for leisure, and offer their labor inelastically.[6] All labor is hired in the final market sector. Final output is produced under perfect competition, using labor and a flow of intermediate product x of low (high) quality $A_j \in \{A_l, A_h\}$

$$Y = \frac{1}{\alpha}(A_j L)^{1-\alpha} x^{\alpha} \tag{4.2}$$

and constant returns (*i.e.*, $\alpha \in (0, 1)$). The final good Y is the *numeráire* (*i.e.*, its unit price is one). Wage in the final sector equals the marginal productivity of labor

$$\omega = \frac{(1-\alpha){A_j}^{1-\alpha} x^{\alpha}}{\alpha L^{\alpha}} \tag{4.3}$$

which is increasing in A_j, the quality of the intermediate product.

The intermediate product is produced monopolistically using a flow of final

[6] The structure of the economy is borrowed from Aghion and Howitt (2009).

product, one for one.[7] The monopolist seeks to maximize profit

$$\pi = (1 - \tau)px - x \tag{4.4}$$

where τ denotes the sales tax rate, which is imposed on intermediate good sales only.[8]

The quality of the intermediate product A_j in the final market depends on the technology vintage operated by the intermediate sector monopolist. Initially, the intermediate market is operated by an old firm which supplies the market with an input of *low* quality A_l. A more competitive firm might enter the intermediate market. In case of entry, the new entrant supplies the final market with an intermediate product of high quality $A_h > A_l$.[9]

Action Set. The ruler sets entry policy and tax policy. Entry regulation consists of costless regulation allowing (banning) entry of the new, superior competitor. Licenses, technical restrictions, price markups, or credit constraints are examples of this kind of restrictive entry regulation. Tax policy consists of a sales tax τ imposed on intermediate good sales only.

As the historical examples reviewed in the introduction suggest, entry barri-

[7] One might suspect that the existence of a monopoly might already denote high fiscal capacity. Non-natural monopolies are hard to enforce. However, working with intermediate monopolistic sector is just a simplifying assumption. The *Supplementary* material proves that the results hold if this assumption is relaxed and an oligopoly is assumed instead.

[8] Expression (4.4) implicitly implies that the intermediate producer does not hire any labor, and that the marginal cost of production is 1.

[9] Results do not depend on the source of heterogeneity between intermediate producers. The results hold if they are assumed to produce inputs of the same quality but at different marginal costs. See Paper 1 for further details.

ers might be adopted conditional on higher tax abidance by the protected firms. Here, specifically, the Protection-for-Tax-Compliance bargain consists of exchanging entry regulation for higher tax compliance, $\tau_p > \tau_o$, where τ_p denotes the tax rate in the *protectionist* regime. If barriers are not raised, a new competitive firm enters with certainty. Since this form of institutional extortion becomes ineffective with a competitive firm, the tax rate must be set from within the fiscal capacity range $\tau_e \in [0, \tau_o]$, with subscript e standing for *entry*.

So far this is a one-period static game with an extensive structure:

- First, the ruler decides whether to adopt entry barriers.
- If barriers are adopted, the old producer stays in and complies with $\tau_p > \tau_o$.
- If barriers are not raised, entry takes place, intermediate good producers compete, and abide by $\tau_e \leq \tau_o$.
- Given entry and tax policy, tax revenue, wages and profit follow.

Commitment problems in case of protection are ruled out by assumption. Repeated interaction between government and domestic producers is expected to solve any credibility issues.[10]

What follows seeks to identify the conditions under which the ruler would prefer to raise entry barriers despite keeping the unproductive firm "in".

[10] VAT collection tends to be implemented monthly, and protectionist policy (such as licenses) can be easily declined. Such flexibility, combined with the extinction payoffs upon entry (presumably, minus infinite) should be sufficient to prevent any deviation by the incumbent producer.

4.3. Analysis

The benchmark model is solved by backwards induction. We have to analyze the ruler and producers' equilibrium payoffs in case of *free-entry* and *protection* separately, and then examine when the ruler prefers to adopt *entry barriers* instead of *free-entry*.

4.3.1. Free-Entry Regime

Suppose *free-entry* is adopted. Then a new firm enters the intermediate market. Since $A_h > A_l$, the old producer instantaneously drops as a result of Schumpeterian competition.[11] Given τ_e, the new-entrant's problem is

$$\max_x \pi_h = (1 - \tau_e) p_h x_h - x_h \tag{4.5}$$

where subscript h refers to prices and production associated to input of *high* quality A_h.

Since the intermediate producer supplies a competitive market, price p_h must equal the marginal productivity of input x_h. Taking this into account, the maximization problem yields equilibrium demand

$$x_h^* = A_h L(\alpha(1 - \tau_e))^{1/(1-\alpha)} \tag{4.6}$$

[11] Schumpeterian market competition itself can be modeled. In that case, we would allow the two intermediate producers to differ in the marginal cost of production (instead of the productivity of the intermediate input). The result is identical, but requires an additional parameter, the marginal cost of production of the intermediate product. See Paper 1 for further details.

with equilibrium price

$$p_h^* = \frac{1}{\alpha(1-\tau_e)} \tag{4.7}$$

and market-clearing wage

$$\omega_h^* = \frac{1-\alpha}{\alpha} A_h(\alpha(1-\tau_e))^{\alpha/(1-\alpha)} \tag{4.8}$$

Given x_h^*, p_h^* and ω_h^*, the ruler problem reduces to

$$\begin{aligned} \max_{\tau_e} V = \quad & \omega_h^* + \rho\Big[\frac{\tau_e p_h^* x_h^*}{L}\Big] \\ \text{s.t. } & \tau_e \leq \tau_o \end{aligned} \tag{4.9}$$

In words, the ruler's maximization problem is constrained by the endowment of fiscal capacity of the economy τ_o. Since ω_h^* is decreasing in τ_e, concavity is assured. The solution to the *Lagrangian* depends on whether the fiscal constraint bites.

$$\tau_e^* = \begin{cases} (1-\alpha)\left[1 - \dfrac{1}{\rho}\right] & \text{if } \lambda = 0 \\ \tau_o & \text{if } \lambda > 0 \end{cases}$$

If fiscal capacity endowment is sufficiently large (*i.e.*, the fiscal constraint is not binding), the ruler adopts her *ideal* or unconstrained tax rate. For future reference, let

$$\tau(\lambda = 0) \equiv (1 - \alpha)\left[1 - \frac{1}{\rho}\right] \tag{4.10}$$

which implies that the unconstrained (or ideal) tax rate increases in the preference for public spending, $\rho > 1$. Expression (4.10) also implies that the equilibrium tax rate has an upper bound, $\tau_e^* < 1 - \alpha$. That is, not even a utilitarian welfare maximizing ruler with full fiscal capacity (*i.e.*, $\lambda = 0$) would confiscate all income from the wealthy. The reason lies in the effect that taxes exert on prices ($\partial p/\partial \tau > 0$) and wages ($\partial \omega/\partial \tau < 0$). Thus, in a free-entry regime, it is in the best interest of wage-earners to allow the producer to gain positive profit.

So far we have assumed that the fiscal constraint did not bind ($\lambda = 0$). This might be too much of an optimistic assumption in many economies, especially among those still developing.[12] When the constraint in (4.9) bites, the ruler adopts the maximum tax rate that the endowment of fiscal capacity allows. That is, $\tau_e^*(\lambda > 0) = \tau_o$. This is true because the ruler utility function is a strictly increasing function in $\tau_e \in [0, \tau(\lambda = 0)]$. *Proposition 6* summarizes this result.

Proposition 6. *Suppose free entry of a more productive firm is allowed, and that the fiscal constraint in (4.9) is binding. Then the ruler sets* $\tau_e^* = \tau_o$ *and raises revenue* $T\big(p_h^*, x_h^*, \tau_e^* | A_h\big)$*, with equilibrium price and wage given by (4.7) and (4.8), respectively, the old producer drops and the new entrant gains positive profit* $\pi_h(\tau_e^*, A_h) > 0$.

[12] Brautigam et al. (2008); Gillis (1989); Thirsk (1997) offer a comprehensive survey of developing economies with poor fiscal capacity.

Intuitively, *Proposition 6* states that a utilitarian welfare maximizing ruler would fully utilize the whole fiscal capacity endowment if she allows for *free-entry*. Likewise, *Proposition 6* implies that when fiscal capacity is limited (*i.e.*, the fiscal constraint bites), the equilibrium tax rate paid by the new firm is socially sub-optimal. Wage-earners would benefit from a higher tax rate (*i.e.*, higher fiscal capacity).

4.3.2. Protectionist Regime

When the intermediate monopolist is obsolete, the ruler can induce the old firm to abide by a higher tax rate $\tau_p > \tau_o$ in exchange for protection from superior competitors. Otherwise, barriers are not adopted and the incumbent producer is eventually phased out of the market by the new entrant. Notice that the ruler cannot implement the same extortion mechanism when the new firm enters. The new producer, already competitive, is in no need of protection from superior competitors. In other words, Protection-for-Tax-Compliance is only effective among old, obsolete producers.

For the sake of simplicity, assume that the ruler conditions entry barrier to the domestic producer's abidance to $\tau(\lambda = 0)$, as defined in (4.10).[13] By agreeing to the ruler's terms, the domestic firm receives the necessary protection for survival though at a high cost: abiding by a higher tax rate than the fiscal capacity endowment, $\tau(\lambda = 0) > \tau_o$. Accordingly, the equilibrium prices

[13] Strictly speaking, this cannot be an equilibrium. The ruler could further increase the tax rate up to $\pi(\tau^*) = 0$. This possibility is explored in the static version of the model in Paper 1. Results do not substantially change.

become

$$p_l^* = \frac{1}{\alpha(1-\tau_p)} \tag{4.11}$$

equilibrium demand is set to

$$x_l^* = A_l L(\alpha(1-\tau_p))^{1/(1-\alpha)} \tag{4.12}$$

and equilibrium wages are

$$\omega_l^* = \frac{1-\alpha}{\alpha} A_l(\alpha(1-\tau_p))^{\alpha/(1-\alpha)} \tag{4.13}$$

Proposition 7 summarizes the results of this sub-game.

Proposition 7. *Suppose entry barriers are raised. Then the ruler sets $\tau_p^* > \tau_o$, with $\tau_p^* = \tau(\lambda = 0)$, the optimal tax rate had the fiscal capacity constraint not bitten. Accordingly, the ruler raises tax revenue $T\big(p_l^*, x_l^*, \tau_p^* | A_l\big)$, with p_l^* and x_l^* given by (4.11) and (4.12); wages are set to (4.13); and the incumbent firm gains profit $\pi_l(\tau_p^*, A_l) > 0$.*

4.3.3. Protection-for-Tax-Compliance Equilibrium

We now focus on the comparison between the *protectionist* and the *free-entry* regimes when the fiscal capacity constraint binds ($\lambda > 0$ in (4.9)). If barriers are not raised, a new firm enters the market with certainty. In this case, wages increase (because $A_h > A_l$) but tax revenue remains constrained to the

fiscal capacity endowment, $\tau_e^*(\lambda > 0) = \tau_o$. On the contrary, if barriers are raised, wages remain low but the tax rate achieves the ruler's ideal rate (*i.e.*, the fiscal capacity constraint becomes slack). Given these alternatives, the ruler must choose between wages or tax revenue. Both cannot rise simultaneously.

For equilibrium values for $G(\tau^*)$ and $\omega(A_j, \tau^*)$ in both sub-games (summarized in *Proposition 6* and *7*), we seek to assess whether the ruler would ever prefer raising barriers to allowing for free-entry of a superior competitor. The answer depends on the technology distance between the new and the old producer, the fiscal capacity endowment (*i.e.*, how far it is from the ruler ideal tax rate), and the valuation of public spending.

Proposition 8. *(Protection-for-Tax-Compliance) Suppose the fiscal capacity constraint in (4.9) bites, and*

$$\frac{A_h}{A_l} < \rho\Big(\frac{1-\alpha(1-\rho)}{\rho}\Big)^{\frac{1}{1-\alpha}} \tag{4.14}$$

Then, there is a $\hat{\tau} < \tau(\lambda = 0)$ such that, for all $\tau_o \in [0, \hat{\tau}]$, a unique SPNE exists in which the ruler prefers to adopt entry-barriers to free-entry. In this equilibrium, the ruler sets $\tau_p^* = \tau(\lambda = 0)$, tax revenue increases up to $R(\tau_p^*) > R(\tau_e^*)$ but wages decrease to $\omega(\tau_p^*) < \omega(\tau_e^*)$; the incumbent firm stays "in" and makes profit $\pi_l(\tau_p^*) < \pi_l(\tau_o)$; and the would-be entrant remains "out".

Proof. See Appendix. □

Proposition 8 states that a utilitarian welfare maximizing ruler finds Protection-

for-Tax-Compliance preferable to free-entry when fiscal capacity endowment is sufficiently low despite protection blocks entry of superior technology and pushes equilibrium demand and wages down. That is, the ultimate combination of lower wages but higher tax compliance by the obsolete incumbent producer is preferred to the alternative scenario with higher wages but lower tax compliance by the new producer. But this is only true as long as fiscal capacity endowment τ_o is sufficiently low (*i.e.*, $\tau_o \leq \hat{\tau}$), and the productivity differential between the old and new producer is not excessively large (*i.e.*, satisfies expression (4.14)). When these conditions are met, the ruler's marginal gain of a unit increase of per capita public spending $\bar{G}(\tau_p^*)$ is greater than the marginal loss in wages $\omega(\tau_p^*)$. By the same token, when fiscal capacity endowment is sufficiently large (*i.e.*, $\tau_o > \hat{\tau}$), the relative magnitude of these two marginal effects flip, and *free-entry* is preferred instead. This result has immediate implications: when fiscal capacity is high, protection is granted for reasons other than inducing tax compliance (*e.g.*, rent-seeking by non-utilitarian maximizer rulers).

Expression (4.14) in *Proposition 8* implies that the Protection for Tax Compliance equilibrium may only arise when the technology differential between the incumbent and would-be entrant is not too large. This is consistent with the historical survey of technology adoption conducted by Comin and Hobijn (2009). When the benefits of a new technology are too large, no barrier can prevent it from entering. It is also true that these circumstances are exceptional. Finally, it is worth mentioning that right-hand side of expression (4.14)

is increasing in the valuation of public spending ρ. That is, the more public funded-consumption is valued by the utilitarian ruler, the easier expression (4.14) is met. This result anticipates the long-term perils of Protection-for-Tax-Compliance. The more valued public spending, the more likely protectionist policy might be adopted to induce higher tax abidance. As it argued below, this may cause perverse effects in the long-run.

Altogether, *Proposition 8* states that optimal entry regulation depends on the fiscal capacity endowment. This result conveys the power of regulation once combined with the logic of Schumpeterian market competition. Protection-for-Tax-Compliance offers a unique mechanism of institutional extortion of obsolete producers. When domestic producers are uncompetitive, rulers can devise this system of sticks-and-carrots in order to induce tax compliance by protected firms. In particular, protection is granted in exchange for abidance by the ideal tax rate of a utilitarian welfare maximizing ruler. Moreover, *Proposition 8* offers an alternative explanation for protectionist policy in which entry barriers do not result from rent-seeking by government (Grossman and Helpman, 1994). Quite the contrary, *Proposition 8* states that, under some conditions, utilitarian welfare maximizing rulers might offer protection in exchange for tax compliance only. That is why, when policy is constrained, offering protection to inefficient firms might be the best constrained policy.

4.4. The Long Run

Protectionist policy might be a convenient policy for a utilitarian ruler in the short run. When fiscal capacity is poor enough, Protection-for-Tax-Compliance might be socially beneficial: wages decrease but they are fully compensated by the increase of tax revenue raised from domestic industry. Still this institutional solution might produce perverse effects in the long-run if it perpetually impedes the adoption of superior technology or discourages the investment in fiscal capacity. The Bolivian case might be a good example of the risks derived of this form of protectionist policy. Next, we explore the conditions under which Protection-for-Tax-Compliance might drive an economy into a low productivity, low fiscal capacity equilibrium.

4.4.1. Mechanics

This extension assumes that Protection-for-Tax-Compliance is already in place, and evaluates the conditions under which it is replaced by *free-entry*. The initial state of fiscal capacity is low. In terms of the benchmark model, this implies that $\tau_o < \hat{\tau}$. From *Proposition 8* the technological distance between A_l and A_h cannot be excessive for Protection-for-Tax-Compliance to be an equilibrium. Thus, we also assume that condition (4.14) is satisfied.

Now we add a second period, $t = \{1, 2\}$. Suppose fiscal capacity endowment can move from $\tau_1 = \tau_o$ up to $\tau_2 = \tau(\lambda = 0)$ at a cost σT, with $\sigma < 1$.[14]

[14] Alternatively, the goal of the investment decision could be $\tau_2 = \hat{\tau}$, as defined in *Proposition*

That is, the economy can evolve from constrained to unconstrained fiscal capacity from period 1 to period 2 if a share σ of tax revenue T is invested in fiscal capacity. Denote $I \in \{1, 0\}$ the investment decision in fiscal capacity. Then,

$$\tau_2 = \begin{cases} \tau_1 & \text{if } I = 0 \\ \tau(\lambda = 0) & \text{if } I = 1 \end{cases} \tag{4.15}$$

where $\tau_1 = \tau_o$, the fiscal capacity endowment in period 1. For the sake of simplicity, assume σ is independent of the distance between τ_o and $\tau(\lambda = 0)$.[15]

The producer is now allowed to innovate too. He might adopt technology A_h. Technological adoption takes a full period to materialize, and it is costly. The intermediate producer must funnel a share $1 - \delta$ of its own intermediate good output to R&D activities. Hence, when the intermediate producer innovates, only a share δ of intermediate good x_l reaches the final market. The magnitude of $\delta < 1$ can be related to the technological distance between A_h and A_l, but it can also be interpreted as the quality of the capital market (the lower the δ, the harder to obtain funds to invest in R&D), or even the strength of property right protection (the lower the δ, the more resources have to be

8. This possibility is evaluated in the *Supplementary material*. The results that follow still apply when we work out this other version of the model. Nevertheless, since $\hat{\tau}$ is not explicitly defined, the algebra becomes cumbersome. For that reason, I stick to $\tau_2 = \tau(\lambda = 0)$ in the main text.

[15] One would suspect the investment cost σ to be an increasing function of the distance between these two magnitudes, $\sigma = \Phi\big(\tau(\lambda) - \tau_o\big)$. Since none of them are a function of τ_1, we can solve inter-temporal problem assuming an exogenous value of σ. Then, we make use of comparative statics to evaluate how the distance between τ_o and $\tau(\lambda = 0)$ (*i.e.*, smaller or bigger σ) might condition investment in fiscal capacity or technological innovation.

funneled to guarantee the same outcome).

Given $\tau_o < \hat{\tau}$, the order of play becomes

- At the beginning of period 1, the ruler decides whether to invest σT in fiscal capacity, and sets period 1 entry policy and sales tax rate.
- The producer decides whether to adopt technology A_h at a cost $(1-\delta)x_l$, and chooses period 1 profit-maximizing output x_l.
- In Period 2, given the stock of fiscal capacity τ_2, the rules sets period 2 tax rate and entry policy.
- The producer (old or new) chooses period 2 profit-maximizing production, and the game ends.

Once we allow the ruler to invest in fiscal capacity and the producer to adopt the superior technology, we can envision four possible strategies profile. These are depicted in Table 4.1. However, two of them are unlikely and are disregarded in the analysis. First, if the ruler does invest in fiscal capacity in period 1, by expression (4.15) and *Proposition 8* she drops barriers in period 2. This implies that period 1 obsolete producer will compete with the superior firm in period 2. The only way he can inhibit entry is by innovating himself (*i.e.*, invest in technology adoption in period 1). If the incumbent does not adopt the superior technology, by Schumpeterian competition he is dropped following entry of the new firm in period 2. Thus, as long as extinction payoff is sufficiently low (as one would presume), investment in fiscal capacity by the

	PRODUCER	
RULER	Invest, Adopt	Invest, Not adopt
	Not invest, Adopt	Not invest, Not adopt

Table 4.1: Strategy profiles: Investment in Fiscal Capacity *vs.* Adoption of Higher Technology.

ruler should always be followed by adoption of the higher technology by the incumbent producer. That I call, *induced-innovation*.

Second, if the ruler does not invest in fiscal capacity, it is unlikely that the incumbent producer innovates. Since adoption is costly and fiscal capacity endowment is (and will remain) sufficiently low in period 2 as to sustain the Protection-for-Tax-Compliance equilibrium, the incumbent producer has no incentive to innovate once the ruler decides not to invest. Altogether, next section considers only two of the four strategy profiles in Table 4.1: that on the top left corner, {*invest, adopt*}; and that on the bottom right corner, {*not invest, not adopt*}.

4.4.2. Analysis

For fiscal capacity endowment τ_2 as defined in (4.15), period 2 strategies and payoffs are characterized by *Proposition 8*. We only have to analyze the investment decisions in period 1 to fully characterize the SPNE in the whole game. Period 1 best responses are solved by backwards induction within the period.

The producer In period 1, the ruler decides whether to adopt the high technology A_h. Given $\tau_o \leq \hat{\tau}$, the producer only innovates if he is induced to; that is, if and only if the ruler decides to invest in period 1. If the ruler does not invest in fiscal capacity, the producer does not innovate. His payoffs are then defined by *Proposition 8*. If the ruler invests in fiscal capacity instead, the producer is induced to innovate -as previously argued. In order to adopt the superior technology, $(1-\delta)$ units of intermediate output x are lost in period 1. This share represents the cost of technology adoption. The profit function (upon the investment decision of the ruler) becomes

$$\pi_1(I=1) = (1-\tau_1)p_1\delta x_1 - x_1 \tag{4.16}$$

That is, the producer still produces x_1 units of intermediate good, but only a share δ of it reaches to the final market. The other share $(1-\delta)$ is invested in technology adoption.

The equilibrium price p_1 is still determined by the marginal productivity of input x in the final market, $p = \partial Y/\partial x$, with Y defined by (4.2). Given p_1, the producer problem becomes

$$\max_x \pi_1(I=1) = (1-\tau_1)(A_l L)^{1-\alpha}\delta x_1^{\alpha} - x_1 \tag{4.17}$$

which is maximized for

$$x_1^*(I=1) = A_l L(\alpha\delta(1-\tau))^{\frac{1}{1-\alpha}} \tag{4.18}$$

Notice that the costs of innovation, $(1-\delta)x$, translate into lower equilibrium production in comparison to the Protection-for-Tax-Compliance equilibrium without investment in fiscal capacity (characterized by *Proposition 8*). Accordingly, equilibrium prices rise to

$$p_1^*(I=1) = \frac{1}{\alpha\delta(1-\tau_1)} \tag{4.19}$$

Altogether, induced-innovation depresses production and increases prices compared to the alternative scenario without any investment in fiscal capacity.

The Ruler The ruler decides whether to invest in fiscal capacity, $I \in \{0,1\}$, anticipating the effects of period 1 production and prices upon investment. Investment also consumes a share σ of period 1 tax revenue T. Since public spending G is also funded by taxation, fiscal capacity investment reduces per capita public spending in period 1. The exact level of public spending is determined by

$$\max_{\tau_1} V_1(I=1) = \omega_1^* + \rho\Big[\frac{(1-\sigma)T_1}{L}\Big] \tag{4.20}$$

with

$$T_1 = \tau_1 p_1^* x_1^* \tag{4.21}$$

and p_1^*, x_1^* given by (4.18) and (4.19), and equilibrium wage

$$\omega_1^* = \frac{1-\alpha}{\alpha} A_l (\delta\alpha(1-\tau_1))^{\frac{\alpha}{1-\alpha}} \tag{4.22}$$

Given all the primitives, the ruler problem is solved for

$$\tau_1^* = (1-\alpha)\Big[1 - \frac{1}{\rho(1-\sigma)}\Big] \tag{4.23}$$

Expression (4.23) implies that the equilibrium tax in period 1 is a decreasing function of σ, the cost of investing in fiscal capacity. The reason lies in how the investment costs inclines the underlying *trade-off* between wages and public spending in favor of the former. Fiscal capacity investment not only reduces the magnitude of public spending but also, due to the induced-innovation costs $(1-\delta)$, pushes wages down. This additional effect reduces the utilitarian ruler preference for higher tax rates. In turn, this explains why the equilibrium tax rate in (4.23) is lower than that in the benchmark case. Against all intuitions, when tax revenue is most needed (*i.e.*, the ruler needs taxation to fund public spending *and* investment in fiscal capacity), the utilitarian ruler has the weakest incentives to raise taxes. These are lowest when $\sigma \to \bar{\sigma}$, with

$$\bar{\sigma} = 1 - \frac{1}{\rho} \tag{4.24}$$

When $\sigma \to \bar{\sigma}$ the investment cost of fiscal capacity is so large that wages are given full priority in (4.20) and the equilibrium tax is set to 0 -thus precluding any expansion in fiscal capacity at all.[16]

[16] If σ is said to increase in the distance between the constrained and unconstrained fiscal capacity, expression (4.23) implies traps are more likely for states with weaker state capacity. These economies, despite having the highest σs and need of higher fiscal capacity investments, are those facing weaker incentives to expand fiscal capacity.

From now on, we assume $\sigma < \bar{\sigma}$.

Lemma 6. *Suppose the ruler invests in fiscal capacity in period 1 at a cost* σT*. Then, the producer is induced to adopt technology* A_h *at a cost* $(1-\delta)x_1$*. Provided that*

$$\delta < \bar{\delta} = \frac{\alpha + \frac{1-\alpha}{\rho}}{\alpha + \frac{1-\alpha}{\rho(1-\sigma)}} < 1 \tag{4.25}$$

then $\omega(I=1) < \omega(I=0)$ *and* $G(I=1) < G(I=0)$*, with* $\omega(I=0)$ *and* $G(I=0)$ *defined in Proposition 7.*

Proof. See Appendix. □

Condition (4.25) guarantees that the cost of induced-technological innovation is significant enough as to push period 1 equilibrium wages down.[17] *Lemma 6* defines a prototypical consumption inter-temporal dilemma. Both elements in the ruler utility function, wages and per capita public spending, decrease in period 1 whenever the ruler invests in fiscal capacity. The benefits of investment in fiscal capacity materialized in period 2 must be sufficiently large as to offset period 1 utility loss.

Period 2 payoffs are given by *Proposition 8*. If the ruler invests in fiscal capacity in $t = 1$, $\tau_2 = \tau(\lambda = 0)$, and *free-entry* is preferred. A new firm enters, wages rise and firms are taxed at the unconstrained tax rate. On the contrary, if the ruler does not invest in $t = 1$, $\tau_2 = \tau_1 < \hat{\tau}$ and Protection-for-Tax-Compliance is still preferred in period 2. Specifically, the two-period ruler

[17] Wages depend negatively on δ but positively on σ -since the latter reduces the equilibrium tax rate. Only when δ is sufficiently low, the first effect dominates and $\omega_1(I=1) < \omega_1(I=0)$.

payoffs are

$$V_t = \begin{cases} 2 \times \left[\omega_t(V=0) + \rho \dfrac{T_t(A_l, I=0)}{L}\right] & \text{if } I = 0 \\ \omega_1(I=1) + (1-\sigma)\rho \dfrac{T_1(I=1)}{L} & \\ \quad + \omega_2(A_h, \tau(\lambda=0)) + \rho \dfrac{T_2(A_h, \tau(\lambda=0))}{L} & \text{if } I = 1 \end{cases} \tag{4.26}$$

Proposition 9. *(Perpetual Protection-for-Tax-Compliance) Suppose Condition (4.25) in Lemma 6 is met; fiscal capacity endowment $\tau_1 < \hat{\tau}$, as defined in Proposition 8; induced-technology adoption cost $(1-\delta)x_1$, with $\delta \in (0,1)$; and investment cost in fiscal capacity σT with $\sigma \in (0, \bar{\sigma})$ and $\bar{\sigma}$ defined in (4.24). Then*

- *If $A_h < 2 - \delta^{\frac{\alpha}{1-\alpha}}$, investment in fiscal capacity in period 1 is never a SPNE.*
- *If $A_h > 2$, investment in fiscal capacity in period 1 is always a SPNE.*
- *If $2 - \delta^{\frac{\alpha}{1-\alpha}} < A_h < 2$, there is a $\hat{\sigma} < \bar{\sigma}$ such that, for all $\hat{\sigma} < \sigma \leq \bar{\sigma}$ investment in fiscal capacity is never a SPNE.*

Proof. See Appendix □

Proposition 9 states than a utilitarian ruler has an incentive to invest in fiscal capacity whenever the boost of future technology is very high ($A_h > 2$). This is consistent with Comin and Hobijn (2009) findings, which prove that no major technology innovation can be perpetually blocked. True also, major innovations are rare. When innovations are incremental ($A_h < 2$), investment depends on the innovation cost δ and the institutional investment cost σ. As δ approaches 0 (*i.e.*, induced-innovation costs grow), the parameter space of fiscal investment shrinkages. The future gains derived from the new technology do not compensate the foregone consumption in the present (that is, lower wages and lower public spending in $t = 1$). Provided $\delta > 0$ (*i.e.*, induced-innovation costs are not extreme), there is an intermediate interval of fiscal capacity cost $\sigma \in [0, \hat{\sigma}]$ in which institutional investment takes place despite that the future technology is just incremental. That is, fiscal capacity investment only takes place under very restrictive conditions: not only the institutional investment cost must be low, as one would presume, but induced-innovation costs must be low too. Otherwise, investment would be too painful in the present. Wages and tax revenue would shrink too much in the short-run to justify future returns. If these two conditions are not simultaneously met, even a welfare utility-maximizing ruler would prefer to stick to the *status quo*, that is, Protection-for-Tax-Compliance.

We already know that fiscal capacity building in peacetime requires political stability and low ethnic conflict (Besley and Persson, 2011). *Proposition 9* adds a less intuitive prediction: even if the political arena is perfectly stable (parameter $\gamma = 0$ in Besley and Persson (2011)) and ethnic divisions are frictionless

(parameter $\theta = 1/2$, *ibid.*) not even a welfare utility maximizing ruler might have the incentives to invest in fiscal capacity. The mere inter-temporal dilemma involved in institutional investment might discourage her from strengthening the tax administration.[18] Instead, this utilitarian ruler might prefer to stick to a Protection-for-Tax-Compliance strategy despite the perpetuation of low fiscal capacity and low wages. In other words, the perpetuation of poor fiscal capacity might result from the mere inter-temporal dilemmas faced by the most well-intended ruler possible.

4.4.3. Vested Interests

Proposition 9 states that when the cost of fiscal capacity investment is small, the ruler might opt for investing in period 1 and deviate from Protection-for-Tax-Compliance in period 2. We now explore the possibility of political giving. The pockets of producers are usually plenty of money. Under some circumstances, they might prefer to bribe the ruler in order to keep the *status quo* (*i.e.*, Protection-for-Tax-Compliance) rather than adopting a new technology.[19]

[18] Besley and Persson (2011) do not reach this result because they separate the institutional investment decision, $\mathcal{F}(\tau_2 - \tau_1)$, from the policy decision, τ. In that set up, investment affects current utility by reducing the flow of public goods, but does not affect the current tax rate. That modeling strategy is convenient for extending the core model in several ways, as they do. However, one would suspect that the tax rate is prone to increase when investment costs are to be funded *on top of* public spending (still necessary for political survival). Their approach, meritorious for many reasons, seems to omit part of the core inter-temporal dilemma by arbitrarily separating the institutional investment from the policy decision.

[19] In the static version of the model in Paper 1, I evaluate the possibility that producers *buy-off* protection while keeping taxes low. Consistent with Grossman and Helpman (1994), I prove that producers can use contributions to receive protection while still paying low taxes (even below the state's fiscal capacity). However, when fiscal capacity endowment is sufficiently low, the tax associated to *contribution-induced* protection is still larger than the fiscal capacity endowment. In

Specifically, this section explores the possibility that *vested interests* use contributions (or bribing) in order to inhibit fiscal capacity investment when investment cost is low (*i.e.*, $\sigma < \hat{\sigma}$). To this end, a new stage at the very beginning of period 1 is required. In this stage, the incumbent producer evaluates whether he bribes the ruler to keep the *status quo* (*i.e.*, Protection-for-Tax-Compliance). Commitment problems are ruled out by assumption.

Analysis

The producer has an incentive to bribe whenever the profit following innovation is lower than the profit in the *status quo*, or

$$\sum_{t}^{2} \Pi_t(I = 0) \geq \sum_{t}^{2} \Pi_t(I = 1, \delta) \tag{4.27}$$

Lemma 7. *(Producer Incentive Constraint) There is a $\tilde{\delta} < \bar{\delta}$, with $\bar{\delta}$ defined in (4.25) such that, for all $\delta \leq \tilde{\delta}$, the producer has an incentive to bribe the ruler in order to keep the status quo.*

Proof. See Appendix. □

Lemma 7 defines the producer incentive constraint for bribing. It is a function of the cost of the *induced* technology adoption. As expected, when the innovation cost is big (small δ) the producer has a stronger incentive to bribe the ruler to prevent the latter from investing in fiscal capacity. δ can be as-

other words, Protection-for-Tax-Compliance is robust to the intermediation of bribes.

sociated to the cost of innovating (*i.e.*, the distance between the high and low technology); but it can also reflect the strength of property right protection (the lower the δ, the lower the returns of the innovation process); or even the quality of the financial market (the lower δ, the more difficult to fund R&D activity).

When $\delta < \tilde{\delta}$, the producer has an incentive to bribe. But it does not necessarily mean that the ruler would accept the bid. This is the case whenever the maximum feasible contribution (at least) matches the ruler indirect utility derived from investing in fiscal capacity, $V_t(I = 1)$.

Definition 1. *The maximum feasible contribution is*

$$c_{max} = \sum_{t}^{2} \Pi_t(I = 0) - \sum_{t}^{2} \Pi_t(I = 1, \delta) \tag{4.28}$$

Expression (4.28) defines the maximum contribution the producer would ever give. It is equal to the difference between his utility under the *status quo* and upon innovating.

Definition 2. *The Ruler Participation Constraint is defined by*

$$c_{max} \geq \sum_{t}^{2} V_t(I = 1) - \sum_{t}^{2} V_t(I = 0) \tag{4.29}$$

Expression (4.29) defines the Ruler participation constraint, that is, the contribution that would make her stick to the *status quo* (*i.e.*, Protection-for-Tax-Compliance) despite $\sigma < \hat{\sigma}$. The interpretation is straightforward: the ruler would only keep the *status quo* if the bribe is large enough to outbid the utility

derived from expanding the fiscal capacity of the state.

Proposition 10. *(Perpetual Protection-for-Tax-Compliance with Bribing) Suppose Lemma 7 and* $A_h \in (2 - \delta^{\frac{\alpha}{1-\alpha}}, 2)$ *are satisfied. Then, there exists a* $\tilde{\sigma} \in (0,1)$*,* $\tilde{\sigma} < \hat{\sigma}$ *such that, for all* $\sigma \in [\tilde{\sigma}, \hat{\sigma})$*, there exists a unique SPNE in which the producer has an incentive to bribe and the ruler always accepts the contribution* $c^* = \sum_{t}^{2} V_t(I = 1) - \sum_{t}^{2} V_t(I = 0)$*; in exchange, the ruler keeps the status quo (i.e., Protection-for-Tax-Compliance) despite the low wages* $\omega_t(I = 0)$ *and low fiscal capacity* $\tau_2 = \tau_1 = \tau_o < \hat{\tau}$*, as defined in Proposition 8. The obsolete producer remains "in", makes profit* $\pi_l(c^* | \delta \leq \tilde{\delta}) \geq 0$*, and the new entrant stays "out".*

Proof. See Appendix. □

Proposition 10 states that when the costs of innovation are sufficiently big ($\delta \leq \tilde{\delta}$), the producer offers a bribe to the ruler, and the ruler accepts it whenever the cost of fiscal capacity investment σ is moderately low ($\sigma \in [\tilde{\sigma}, \hat{\sigma})$). More importantly, the range of σs for which the ruler would invest in fiscal capacity is now smaller than the one in which bribes were not allowed. This implies the producer is able to align the ruler interests with his thanks to political giving. As a direct consequence, the *status quo* can be preserved in states of the world in which it would be socially optimal to invest in fiscal capacity (*i.e.*, $\sigma \in [\tilde{\sigma}, \hat{\sigma})$). Figure 4.1 plots the parameter space for which fiscal capacity investment takes place once the producer is responsive to bribing. Compared to the Pigovian ruler in *Proposition 9*, a contribution-responsive ruler would invest in fiscal

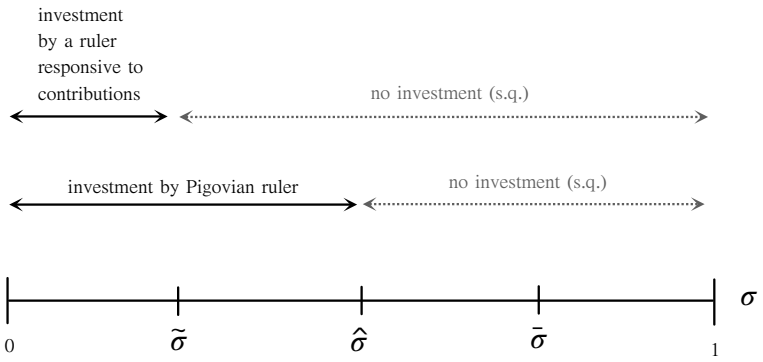


Figure 4.1: Equilibrium investment by the cost of fiscal capacity investment.

capacity in fewer states of the world. Specifically, the producer is able to *buy-off* favorable policy whenever $\sigma \in [\tilde{\sigma}, \hat{\sigma})$. Only a utilitarian ruler would invest in fiscal capacity if σ falls in this range; on the contrary, the bribe-responsive ruler prefers to take the money and keep the *status quo* despite the perpetuation of low wages, low productivity and weak fiscal capacity. In other words, obsolete producers can induce the ruler to stick to Protection-for-Tax-Compliance even when this equilibrium is detrimental for wage-earners.[20]

Proposition 9 stated that a low productivity, low fiscal capacity equilibrium might arise even in presence of a well-intended ruler who seeks to maximize social welfare. *Proposition 10* emphasizes the increased risk of falling in this kind

[20] *Proposition 10* also states that the producer stays "in" and makes positive profit despite the contribution cost, c^*. Only when *Lemma 7* is met at equality, $\delta = \tilde{\delta}$, the producer would remain "in" but make competitive profit.

of poverty traps when government is ruled by rent-seeking politicians. Both *Propositions 4 and 5* illustrate how easy is to perpetuated a *status quo* in which taxation falls on a reduced group, the incumbent producers, who in exchange of their *cooperation* get to determine policy in their own benefit and against that of labor. The perpetuation of a weak states incapable of taxing the economy gives them economic and political advantage which, in turn, might be used to perpetuate their privilege. Protection-for-Tax-Compliance might be a socially beneficial policy in the short-term as long as it helps to collect the resources required to expand fiscal capacity. However, under the circumstances identified in *Proposition 10*, Protection-for-Tax-Compliance can be utilized by producers to perpetuate a socially inefficient policy equilibrium.

4.5. Conclusions

Together, *Propositions 3 to 5* suggest a nonmonotonic relationship between the stock of fiscal capacity and long-term aggregate welfare. When the costs of expanding fiscal capacity are *low*, the opportunity cost of Protection-for-Tax-Compliance is too big and *free-entry* is preferred.[21] When the costs of expanding fiscal capacity are *large*, Protection-for-Tax-Compliance becomes a sticky equilibrium, either because the benevolent ruler lacks the incentives to invest or because she is captured by incumbent producers. For such low values of investment cost, Protection-for-Tax-Compliance is socially beneficial in the

[21] Paper 1 proves that bribes cannot delay the switch to *free-entry*.

short-term but detrimental in the long-run. Fiscal capacity does not expand and domestic productivity stagnates. Perpetual Protection-for-Tax-Compliance policy leads to a low income, weak fiscal capacity equilibrium.

Only when the cost of investing in state capacity takes *intermediate* values, can Protection-for-Tax-Compliance be socially beneficial in the short- *and* long-run. For this interval of investment costs only, tax proceeds raised by Protection-for-Tax-Compliance are reinvested in expanding the tax administration. Institutional investment itself induces technology adoption among incumbent producers, as these anticipate the consequences of an eventual entry (*i.e.*, Schumpeterian competition). Once the fiscal capacity endowment is strengthened, the economy switches from a protectionist equilibrium to a new one characterized by *free-entry*, large taxes, competitive industry and high wage.

The equilibrium characterizations for the last two cases, large and intermediate investment costs, seem consistent with the English and Bolivian experiences depicted in the Introduction. Bolivia faced pressing social needs (large ρ) from 1930 to 1952.[22] First the Chaco war, then the appeasement of an increasingly militant labor movement called for an increase in public spending. This demand was eventually met, and actually funded by the tax revenue raised from the tin sector (Gallo, 1997). Welfare expenditures expanded from 9% in the 1920s (before export licenses were used as carrot-and-stick to induce tax compliance), to 16% in the 1930s and 25% in the 1940s (*ibid.*).[23] Welfare pro-

[22] In 1952 a revolution took place and tin production was nationalized.

[23] Between 1936 and 1946 three populist, labor-friendly government ruled Bolivia. These fulfilled significant reforms in tax and agricultural policy that benefited workers at the detriment of tin

grams did expand, but the precarious fiscal capacity remained unattended. From *Proposition 9* we know that rulers seeking to maximize a joint flow of wages and public spending, as this was the case, face a strong inter-temporal dilemma when the cost of fiscal capacity is large. In particular, whenever the present opportunity cost of institutional investment is too big, a welfare utility maximizing ruler prioritizes present consumption over fiscal capacity building. This might be precisely what happened in 1930-1952 Bolivia. Social needs were rampant and the stock of state capacity was very low. The foregone consumption of institutional investment might have been too large even for a labor-friendly government. The inter-temporal dilemma perpetuated protectionist policy as a means to induce tax compliance by tin producers. But at the same time, this institutional solution prevented further institutional investments and productivity growth in the main sector of the economy. Eventually, Bolivia was trapped in a low income, low fiscal capacity equilibrium.

On the other extreme, protection of the brewing industry in mid-eighteenth century England took place when the country owned already one of the most efficient tax administrations in Europe (Dincecco, 2011).[24] Despite this relative advantage, England's fiscal capacity was still limited compared to modern tax administration. The tax base was narrow, and corruption and evasion were

producers' profits. Conservative governments ruled from 1946 to 1952. They were certainly more friendly to the tin producers; nevertheless, tax pressure on them was never relaxed. Political survival of conservative governments still required expansive welfare programs (Gallo, 1988, 1997).

[24] In 1799 the income tax, the most challenging tax to implement, was even temporarily adopted. By 1811-1815, income tax accounted for 19% of total tax revenue only, one and a half points below the share of customs duties (Daunton, 2001). The tax was dropped in 1815 and re-adopted in 1842.

still significant (Brewer, 1988; Daunton, 2001). All in all, Britain did not have poor nor strong fiscal capacity, but something in between. That is precisely the parameter space for which a ruler concerned by wage-earners' welfare would invest the extra revenue from Protection-for-Tax-Compliance in fiscal capacity. And that was indeed what happened. The British Government kept expanding the tax administration all along the eighteenth and nineteenth century (*ibid.*). Moreover, institutional investment seems to have effectively induced technological adoption: The brewing industry did enhance productivity and reduced production costs while protected (Nye, 2007).[25]

All in all, the theoretical model states that fiscal capacity cannot be too poor to begin with in order to avoid a poverty trap caused by *perpetual* Protection-for-Tax-Compliance. When the state is too weak, either the mere inter-temporal dilemma of institutional investment or policy capture would prevent further fiscal capacity expansion -even for full political stability or frictionless ethnic divisions (Besley and Persson, 2011). These results also talk to the barriers to technology adoption literature (Mokyr, 1991; Acemoglu, 2008; Parente and Prescott, 2000; Comin and Hobijn, 2009). The lack of technological adoption might be (involuntarily) induced by a welfare maximizer ruler. When the demand for public goods is high and fiscal capacity is low, Protection-for-Tax-Compliance might alleviate immediate needs at a cost of long-term institutional underinvestment. Of course, political giving might be responsible for ineffi-

[25] The two main competitors of English beer producers where: French wine, and domestic fringe producers who offered cheaper beer.

cient policy. But as we saw in *Proposition 9*, the mere inter-temporal dilemma of institutional investment might indirectly discourage technological adoption. From this point of view, technological obsolescence might not only depend on the reluctance of producers to fund costly adoption, as the standard argument goes, but also on the incapacity of the ruler to tax revenue from newer producers.

Finally, *Propositions 4 and 5* shed some light on the infant-industry debate and particularly on the effect of tariff protection on long-term economic growth (Tena-Junguito, 2010; Irwin, 2000; Lehmann and O'Rourke, 2011). The theoretical model suggests that the effect of tariff protection on growth might be conditional on the initial stock of fiscal capacity. The stock cannot be too low when tariff protection is adopted for long-term growth to follow. When the stock of fiscal capacity is intermediate, tariff revenue is reinvested in fiscal capacity and producers improve their productivity -with the expected positive effects on long-term growth (Romer, 1990). If tariff protection (or infant-industry policy) is adopted when the state capacity is too low, both the ruler and the producers would lack incentives to invest -and long-term growth should not be expected.

Altogether, this work builds on the growing literature on state capacity building by stressing the endogenous relationship between short- and long-term *revenue production policy* (Levi, 1988). We have studied how the satisfaction of current demand for public spending (attended for political survival) might condition long-term institutional investment in fiscal capacity. In particular, depending on the initial stock of fiscal capacity, short-cuts to high fiscal capac-

ity such as Protection-for-Tax-Compliance might become a stepping stone to a *high-tech, high-fiscal-capacity* equilibrium or the downslide into a *low-income, low-fiscal-capacity* trap.

4.6. Appendix

Proof of *Proposition 8*.

Proof. Denote $V_e(\cdot)$ and $V_p(\cdot)$ the ruler utility under *entry* and *protection*, respectively. $V_e(\tau_o)$ is an increasing monotone concave function in $\tau_o \in [0, \tau(\lambda = 0)]$, with $\tau(\lambda = 0)$ being the unconstrained tax rate. Given A_l, $V_p(\tau_p^* = \tau(\lambda = 0))$ defines a horizontal line in the $V - \tau$ space. When $\tau_o \to 0$, as long as (4.14) is satisfied, $V_e(\tau_e^*) < V_p(\tau_p^*)$. When $\tau_o \to \tau(\lambda = 0)$, by *Proposition 6*, $\tau_e^* = \tau(\lambda = 0)$; since $A_h > A_l$, then $V_e(\tau_e^*) > V_p(\tau_p^*)$. Thus, by the Intermediate Value Theorem, it must be true that there exists a unique $\hat{\tau},\ 0 < \hat{\tau} < \tau(\lambda = 0)$ such that $\forall \tau_o \leq \hat{\tau}$, $V_p(\tau_p^*) \geq V_e(\tau_e^*)$. □

Proof of *Lemma 6*. The ruler utility is a function of wages and per capita public spending. A sufficient condition for the existence of the ruler's intertemporal dilemma is $G(I = 1) \leq G(I = 0)$ and $\omega(I = 1) \leq \omega(I = 0)$. That is the case if $\bar{\delta} \leq 1 + (1 - \alpha)/\rho$.

Proof. Per capita public spending is defined by $(1 - \sigma)G/L$, with $G \equiv T = \tau p x$. If no investment in fiscal capacity takes place, $\sigma = 0$, and τ, p and x are defined by *Proposition 8*. If investment takes place, $\sigma > 0$, and τ, p and x are

defined by (4.23), (4.18) and (4.19), respectively. Upon substitution,

$$\begin{aligned} G^*(I=1) = &\quad (1-\sigma)(1-\alpha-\frac{1-\alpha}{\rho(1-\sigma)})A_l L[\alpha\delta(\alpha+\frac{1-\alpha}{\rho(1-\sigma)})]^{\frac{1}{1-\alpha}} \\ G^*(I=0) = &\quad (1-\alpha-\frac{1-\alpha}{\rho})A_l L[\alpha+\frac{1-\alpha}{\rho})]^{\frac{1}{1-\alpha}} \end{aligned} \tag{4.30}$$

For $G(I=1) < G(I=0)$, it must be true that

$$(1-\sigma)\delta^{\frac{\alpha}{1-\alpha}}\left[\frac{\rho(1-\sigma)-1}{\rho-1}\right] < \left[\frac{\alpha+\frac{1-\alpha}{\rho}}{\alpha+\frac{1-\alpha}{\rho(1-\alpha)}}\right]^{\frac{\alpha}{1-\alpha}} \tag{4.31}$$

For all $\alpha \in (0,1)$, $\delta < 1$ and $\rho > 1$, the left-hand side of condition (4.31) is a negative convex function of σ that cuts the vertical axis ($\sigma = 0$) at $\delta^{\frac{\alpha}{1-\alpha}}$, and cuts the horizontal axis at $\sigma = 1$. The right-hand side of condition (4.31) is a negative concave function that cuts the vertical axis at $1 > \delta^{\frac{\alpha}{1-\alpha}}$, and the horizontal line at $\sigma = 1$. Thus, $\forall\sigma \in (0,1)$, $G(I=1) < G(I=0)$.

Wages depend on δ and τ. When no technology innovation takes place, $\delta = 1$; when innovation takes place, $\delta < 1$. Given $\tau(I=1)$ and $\tau(I=0)$, as defined by (4.23) and (4.10),

$$\begin{aligned} \omega^*(I=1) = &\quad \frac{1-\alpha}{\alpha}(\alpha\delta)^{\frac{\alpha}{1-\alpha}}[\alpha+\frac{1-\alpha}{\rho(1-\sigma)}]^{\frac{\alpha}{1-\alpha}} \\ \omega^*(I=0) = &\quad \frac{1-\alpha}{\alpha}(\alpha)^{\frac{\alpha}{1-\alpha}}[\alpha+\frac{1-\alpha}{\rho}]^{\frac{\alpha}{1-\alpha}} \end{aligned} \tag{4.32}$$

For $\omega^*(I=1) < \omega^*(I=0)$, it must be true that

$$\delta < \bar{\delta} = \frac{\alpha + \frac{1-\alpha}{\rho}}{\alpha + \frac{1-\alpha}{\rho(1-\sigma)}} \tag{4.33}$$

Since $\sigma \leq 1 - 1/\rho$, this implies $\bar{\delta} \leq 1 + (1-\alpha)/\rho < 1$. If innovation cost satisfies this condition, wages following induced-innovation are lower than those without investment in fiscal capacity. □

Proof of *Proposition 9*.

Proof. Let $\sigma \in (0, \bar{\sigma})$. Investment is preferred when $\sum_t^2 V_t(I=1,\delta) \geq \sum_t^2 V_t(I=0)$. After some rearrangement, this implies

$$\begin{aligned} & A_l(\alpha + \frac{(1-\alpha)}{\rho(1-\sigma)})^{\frac{\alpha}{1-\alpha}}\Big[\frac{1-\alpha}{\alpha}\delta^{\frac{\alpha}{1-\alpha}} + \rho(1-\sigma)\big(1-\alpha-\frac{(1-\alpha)}{\rho(1-\sigma)}\big)\Big] \\ \geq \quad & (2A_l - A_h)(\alpha + \frac{1-\alpha}{\rho})^{\frac{\alpha}{1-\alpha}}\Big[\frac{1-\alpha}{\alpha} + \rho\big(1-\alpha-\frac{(1-\alpha)}{\rho}\big)\Big] \end{aligned} \tag{4.34}$$

When $\sigma \to \bar{\sigma}$, $\tau^*(I=1) \to 0$. Thus, there is no investment and no induced innovation. For the right-hand-side of (4.34) to be greater than the left-hand side, all it is required is $A_h > 2A_l$. Normalize A_l to 1, so $A_h < 2$.

When $\sigma \to 0$,

$$\begin{aligned} & A_l(\alpha + \frac{1-\alpha}{\rho})^{\frac{\alpha}{1-\alpha}}\Big[\frac{1-\alpha}{\alpha}\delta^{\frac{\alpha}{1-\alpha}} + (1-\alpha)(\rho-1)\Big] \\ & \geq (2A_l - A_h)\Big[(\alpha + \frac{1-\alpha}{\rho})^{\frac{\alpha}{1-\alpha}} + (1-\alpha)(\rho-1)\Big] \end{aligned} \tag{4.35}$$

For the left-hand-side of (4.35) to be greater than the right-hand side, it must be the case that$A_h/A_l > (2 - \delta^{\frac{\alpha}{1-\alpha}})$. With A_l normalized to 1,

$$A_h > (2 - \delta^{\frac{\alpha}{1-\alpha}})$$

Notice that $\delta^{\frac{\alpha}{1-\alpha}} < 1$ and $A_h > 1$. Hence, $(2-\delta^{\frac{\alpha}{1-\alpha}}) < A_h < 2$ is non-empty.

The LHS of expression (4.34) is a negative convex function of σ, whereas its RHS is a horizontal line. If $A_h \in [2 - \delta^{\frac{\alpha}{1-\alpha}}), 2]$, by the Intermediate Point Theorem there exists a unique $\hat{\sigma} \in (0, \bar{\sigma})$ such that $\forall \sigma < \hat{\sigma}$ investment is preferred ($LHS > RHS$), and $\forall \sigma \in [\hat{\sigma}, \bar{\sigma})$, no investment ever takes place ($LHS \leq RHS$) □

Proof of *Lemma 7*.

Proof. Given $\omega_t(I)$ and $G_t(I) = \tau_t p_t x_t$ as defined by *Propositions 3 and 4*, $\sum_t^2 \Pi_t(I=0) > \sum_t^2 \Pi_t(I=1,\delta)$ becomes

$$(2A_l - A_h)\Big(\alpha + \frac{1-\alpha}{\rho}\Big)^{\frac{1}{1-\alpha}}\Big[\frac{1}{\rho} - 1\Big] > A_l\left[\delta\Big(\alpha + \frac{1-\alpha}{\rho}\Big)\right]^{\frac{1}{1-\alpha}}\Big[\frac{1}{\delta\rho} - 1\Big] \tag{4.36}$$

The RHS of (4.36) is an increasing function of δ, while the LHS of (4.36) is independent of it. To guarantee that both curves cut: (i) when $\delta \to 0$, $LHS > RHS$, which is straightforward; and (ii) when $\delta \to \bar{\delta}$, as defined by (4.25), $LHS < RHS$. Notice that $\bar{\delta}$ is largest when $\sigma = \bar{\sigma}$. Plugging $\bar{\sigma}$ into $\bar{\delta}$, and

replacing δ for $\bar{\delta}$ in (4.36), we reach

$$(2A_l - A_h)[\frac{1}{\alpha} - 1] < A_l\Big[\frac{\rho}{\alpha(1+\alpha(\rho-1))} - 1\Big] \tag{4.37}$$

Since $A_l > 2A_l - A_h$, all we need is the element in brackets multiplying A_l to be greater than the one multiplying $A_l > 2A_l - A_h$, which is always satisfied.

Since $LHS > RHS$ for lowest δ and $LHS < RHS$ for highest $\delta = \bar{\delta}$ (strict inequalities), by the Intermediate Point Theorem, there exists $\tilde{\delta} < \bar{\delta}$ such that, $\forall \delta < \tilde{\delta}$ the producer has an incentive to bribe, and none for $\delta \geq \bar{\delta}$. □

Proof of *Proposition 10*. First, one needs to prove that a $\tilde{\sigma} < (0, 1)$ exists such that, $\forall \sigma > \tilde{\sigma}$, the *status quo* (*i.e.*, Protection-for-Tax-Compliance) is preferred. Second, we have to prove that $\tilde{\sigma} < \hat{\sigma}$:

Proof. The ruler participation constraint can be re-expressed as

$$\sum_{t}^{2} \Big(\Pi_t(I=0) + V_t(I=0) - (\Pi_t(I=1) + V_t(I=1))\Big) \geq 0$$

Plugging all equilibrium values in yields

$$\begin{aligned}
&(2A_l - A_h)\big(\alpha + \frac{(1-\alpha)}{\rho}\big)^{\frac{\alpha}{1-\alpha}}\Big\{\alpha\big(\alpha + \frac{1-\alpha}{\alpha}\big)L\big(\frac{1}{\alpha}+1\big) + \Big[\frac{1-\alpha}{\alpha} + (1-\alpha)(\rho-1)\Big]\Big\} \\
&\geq (A_l)\delta^{\frac{\alpha}{1-\alpha}}\big(\alpha + \frac{1-\alpha}{\rho(1-\sigma)}\big)^{\frac{\alpha}{1-\alpha}}\Big\{\alpha\delta\big(\alpha + \frac{1-\alpha}{\rho(1-\sigma)}\big)L\big(\frac{1}{\delta\alpha} - 1\big) \\
&+\Big[\frac{1-\alpha}{\alpha} + (1-\alpha)(\rho(1-\sigma))\Big]\Big\}
\end{aligned} \tag{4.38}$$

Normalize $L = 1$.

Step 1. Let $\sigma \to \bar{\sigma}$, with $\bar{\sigma}$ defined by (4.24). Then, $\tau^* = 0$, which inhibits investment (*i.e.*, $\tau_2 = \tau_1 = \tau_o$) and, as a direct consequence, induced-innovation too (*i.e.*, $A_1 = A_2 = A_l$). For this constellation of parameters, the ruler would always prefers to stick to the *status quo* (see *Proposition 9*). Let $\sigma \to 0$; then for the right-hand side of expression (4.38) to be bigger than the left-hand side, it suffices with $A_h \geq 2 - \delta^{\frac{\alpha}{1-\alpha}}$. By the Intermediate Value Theorem, there exists a $\tilde{\sigma} \in (0, \bar{\sigma})$ such that, $\forall \sigma > \tilde{\sigma}$, the ruler always prefers the *status quo*.

Step 2. Compare $\hat{\sigma}$ (*Proposition 9)* and $\tilde{\sigma}$ (*Proposition 10*). $\hat{\sigma}$ is implicitly defined in the Ruler original problem

$$\Big[\alpha + \frac{1-\alpha}{\rho(1-\sigma)}\Big]^{\frac{\alpha}{1-\alpha}} = \frac{(2A_l - A_h)}{A_l \delta^{\frac{\alpha}{1-\alpha}}} \times \frac{(\alpha + \frac{1-\alpha}{\rho})^{\frac{\alpha}{1-\alpha}} \Big[\frac{1-\alpha}{\alpha} + \rho\big(1 - \alpha - \frac{(1-\alpha)}{\rho}\big)\Big]}{\Big[\frac{1-\alpha}{\alpha} + \rho\big(1 - \alpha - \frac{(1-\alpha)}{\rho}\big)\Big]}$$

and $\tilde{\sigma}$ is implicitly defined in the Ruler participation constraint in (4.38)

$$(\alpha + \frac{1-\alpha}{\rho(1-\sigma)})^{\frac{\alpha}{1-\alpha}} = \frac{(2A_l - A_h)(\alpha + \frac{(1-\alpha)}{\rho})^{\frac{\alpha}{1-\alpha}}}{(A_l)\delta^{\frac{\alpha}{1-\alpha}}} \times \frac{\alpha\big(\alpha + \frac{1-\alpha}{\alpha}\big)L\big(\frac{1}{\alpha} + 1\big) + \Big[\frac{1-\alpha}{\alpha} + (1-\alpha)(\rho - 1)\Big]}{\alpha\delta\big(\alpha + \frac{1-\alpha}{\rho(1-\sigma)}\big)L\big(\frac{1}{\delta\alpha} - 1\big) + \Big[\frac{1-\alpha}{\alpha} + (1-\alpha)(\rho(1-\sigma))\Big]}$$

where the left-hand side is an increasing function of σ. On the contrary, neither of the right-hand side expressions are a function of σ. Which

curve does the left-hand side cut first? Let

$$\begin{aligned} M = &\quad \frac{1-\alpha}{\alpha} + (1-\alpha)(\rho - 1) \\ N = &\quad \frac{1-\alpha}{\alpha} + (1-\alpha)(\rho(1-\sigma)) \\ X = &\quad (1-\alpha)(\alpha + \frac{1-\alpha}{\rho}) \\ Y = &\quad (1-\delta\alpha)(\alpha + \frac{1-\alpha}{\rho(1-\sigma)}) \end{aligned}$$

Given $M,\ N,\ X,\ Y, \tilde{\sigma} < \hat{\sigma}$ whenever

$$F1 = \frac{X+M}{Y+N} > \frac{M}{N} = F2$$

This is true if

$$\begin{aligned} &\Big[\frac{1-\alpha}{\alpha} + (1-\alpha)(\rho(1-\sigma))\Big] \times \Big[(1-\alpha)(\alpha + \frac{1-\alpha}{\rho})\Big] \\ &> \Big[\frac{1-\alpha}{\alpha} + (1-\alpha)(\rho - 1)\Big] \times \Big[(1-\delta\alpha)(\alpha + \frac{1-\alpha}{\rho(1-\sigma)})\Big] \end{aligned}$$

which is true for all $\sigma \in [0,1]$ and $\delta \in [0,1]$ (thus, satisfying Producer incentive constraint). Since $F2$ is first-order dominated by $F1$, $\tilde{\sigma} < \hat{\sigma}$ is always true.

□

4.7. Supplementary Material

4.7.1. Oligopoly

The analysis in Section 3 assumes a monopoly in the intermediate market. That is only a simplification. But it could contradict the idea of weak state capacity. Monopolies might be hard to enforce and effective enforcement might proxy the actual existence of state capacity. Now we relax this assumption and assume an oligopolist market in the intermediate sector. Again, for ease of exposition I assume two intermediate firms only $i \in \{1, 2\}$, but results hold for $N \geq 2$. Denote m and d monopoly and duopoly, respectively

Let the two firms be analogous (*i.e.*, share production costs) and compete in quantities (*i.e.* Cournot competition). Competition takes place only if entry barriers are up. Otherwise the new firm enters and drops the two analogous incumbent producers by Bertrand competition (*i.e.*, it offers a price such that none of the old firms can match).[26] The game is again solved by backwards induction. First firms set optimal production, and anticipating their behavior the ruler then decides whether to raise barriers or open the economy. Since the relaxation of the monopolist assumption only affects the protectionist regime, we only have to evaluate optimal production upon barriers being raised.

Suppose barriers are up. Total production of intermediate product in the duopoly X_d is the sum of individual production x_1 and x_2. The price of inter-

[26] For further details on Bertrand competition following entry, see section *Schumpeterian Competition* in Paper 1 Supplementary Material.

mediate duopoly p_d is still determined by the productivity of the intermediate product

$$p_d = (A_j L)^{1-\alpha} X^{\alpha-1} \tag{4.39}$$

with total duopoly production $X_d = x_1 + x_2$. Given the unitary cost of production, Firm 1 problem becomes

$$\max_{x_1} \pi_1 = (1-\tau)(A_j L)^{1-\alpha} x_1 \Big[(x_1 + x_2^*)^{\alpha-1} - 1 \Big] \tag{4.40}$$

where x_2^* denotes the anticipated equilibrium production of firm 2. Firm 1 problem is solved for x_1 as implicitly defined by

$$(1-\tau)(A_j L)^{1-\alpha}(x_1 + x_2^*)^{-2+\alpha}(\alpha x_1 + x_2^*) = 1 \tag{4.41}$$

Expression (4.41) implies x_1^* is a negative function of x_2^*, ranging from $x_1^* = 0$ to $x_1^* = AL(\alpha(1-\tau))^{1/(1-\alpha)}$, the monopolist production, X_m.[27]

Since both firms face similar production costs, the reaction function of firm 2 is symmetrical. Thus, x_2^* is implicitly defined by

$$(1-\tau)(A_j L)^{1-\alpha}(x_2 + x_1^*)^{-2+\alpha}(\alpha x_2 + x_1^*) = 1 \tag{4.42}$$

Again (4.42) defines x_2^* as a negative function of x_1^*. Since both firms are analogous, by the Cournot Theorem we know that $0 < x_1^* = x_2^* < x_m$, with

[27] The equilibrium production for a monopolist is given by (4.12) in the main text.

total oligopolistic production $X_d = x_1^* + x_2^* > X_m$.

Given $x_1^* = x_2^*$ we can express FOC in (4.41) as

$$(1-\tau)(A_jL)^{1-\alpha}(2x_1)^{-2+\alpha}(x_1(1+\alpha)) = 1 \tag{4.43}$$

and solve for x_1:

$$x_1^* = [(1-\tau_d)(1+\alpha)(A_jL)^{1-\alpha}2^{\alpha-2}]^{\frac{1}{1-\alpha}} \tag{4.44}$$

Since $x_1^* = x_2^*$, total oligopolistic production

$$X_d = \frac{A_jL}{2}[(1-\tau_d)(1+\alpha)]^{\frac{1}{1-\alpha}} \tag{4.45}$$

Given X_d^* and inverse demand $p(X_d)^*$, the ruler solves

$$\max_{\tau} V_d = \omega_d + \frac{\rho}{L}G_d \tag{4.46}$$

for $\omega_d = \partial Y/\partial L$, $G_d = \tau_d X_d p_d$ and subject to $\tau < 1$. Once again, the ruler problem maximizes for

$$\tau_d^* = 1 - \alpha - \frac{1-\alpha}{\rho} < 1 \tag{4.47}$$

which is the exact same tax rate than the one we found for the monopolist scenario. Indeed, this confirms the *ideal* character of this tax rate for the benevolent

ruler.

Given X_d^*, the ruler decides whether to raise barriers and enforce τ_d^* as defined by (4.47) or allow for free entry, with $\tau_e^* = \tau_o$ and payoffs as defined by *Proposition 6*.

Proposition 11. *Suppose the fiscal capacity constraint in (2.9) bites, and*

$$\frac{1}{2^\alpha}\Big(\frac{1+\alpha}{\alpha}\Big)^{\frac{\alpha}{1-\alpha}} < \frac{A_h}{A_l} < \Big(\frac{1+\alpha}{\rho\alpha}\Big)^{\frac{\alpha}{1-\alpha}} \frac{(\rho\alpha+1-\alpha)^{\frac{1}{1-\alpha}}}{2^\alpha} \tag{4.48}$$

Then, there exists a $\hat{\tau}_d < \tau(\lambda = 0)$ such that, for all $\tau_o \in [0, \hat{\tau}_d]$, a unique SPNE exists in which the ruler prefers to adopt entry-barriers to free-entry. In this equilibrium, the ruler sets $\tau_p^* = \tau(\lambda = 0)$, tax revenue increases up to $R(\tau_p^*) > R(\tau_e^*)$ but wages decrease to $\omega(\tau_p^*) < \omega(\tau_e^*)$; the oligopolist firms stay "in" and make profit $\pi_l(\tau_p^*) < \pi_l(\tau_o)$; and the would-be entrant remains "out".

The proof of this *Proposition* follows the exact same lines as *Proposition 8*. Expression (4.48) means: on the one hand, that the technological distance between the oligopolists and the would-be entrant cannot be too large for a Protectionist equilibrium to exist. On the other hand, the distance between the oligopolist and the would-be entrant must be large enough for new wages to outweigh the opportunity loss of a higher tax rate. Notice that

$$\frac{1}{2^\alpha}\Big(\frac{1+\alpha}{\alpha}\Big)^{\frac{\alpha}{1-\alpha}} > \frac{A_h}{A_l} > 1 \tag{4.49}$$

That is, the minimum technological distance between both firms must be larger than in the monopolist scenario. The reason lies in the effect of entry on market structure. Now if entry takes place, production shrinkages because the oligopoly is replaced by a monopoly; the boost in technology following entry must be now even larger to outweigh the reduction of wages related to the change in market structure. In other words, in an oligopolistic scenario the benevolent ruler is more demanding with the new technology.

Now we compare $\hat{\tau}_d$ to $\hat{\tau}_m$ as defined by *Proposition 8* and *6* respectively. Recall, $\hat{\tau}$ defines the cutoff for which Protection-for-Tax-Compliance is preferred to free-entry. This cut-off is defined by the point of τ_o (the fiscal capacity stock) at which the utility under protection cuts the utility under free-entry. To sign $\hat{\tau}_k$, with $k \in \{d, m\}$, we need to evaluate the ruler utility for both market structures under protection. On the one hand, wages are greater under oligopoly than monopoly, holding productivity constant. Oligopoly production X_d is greater than monopoly production X_m. Since wages are increasing in production, $\omega_d^* > \omega_m^*$. Since prices are inversely proportional to production, it is also straightforward that $P_d(X_d^*) > p_m(x_m^*)$. Since $\tau_d^* = \tau_m^*$, it is obvious that

$$V(d|A_l) = \omega_d^* + \frac{\rho}{L}\left[\tau_d^* p_d^* x_d^*\right] > \omega_m^* + \frac{\rho}{L}\left[\tau_m^* p_m^* x_m^*\right] = V(m|A_l) \quad (4.50)$$

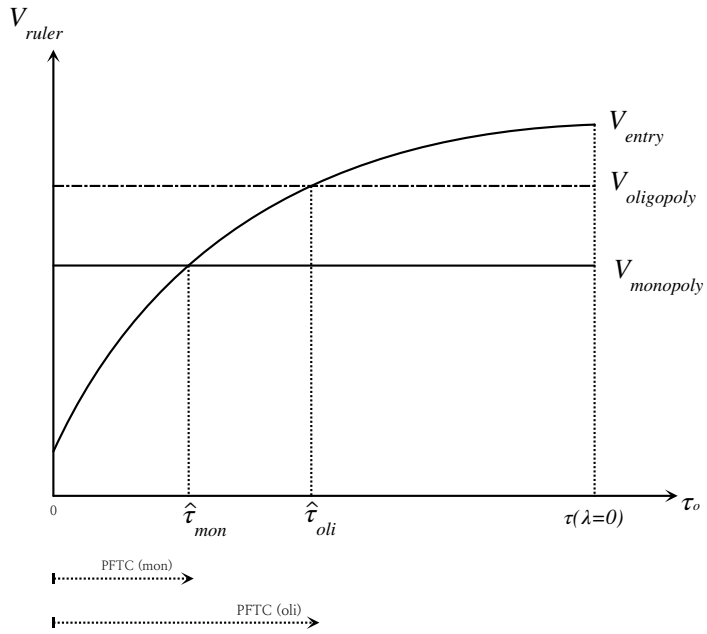
that is, the ruler utility under protection is greater when the market is oligopolistic than monopolistic. Therefore, it is direct that the parameter space for which

Protection-for-Tax-Compliance is preferred to *free-entry* is greater with a domestic oligopoly than a monopoly. That is, $\hat{\tau}_d > \hat{\tau}_m$.

Figure 4.2 plots this intuition. $V_e(A_h)$ defines the ruler utility of entry as a function of τ_o, the stock of fiscal capacity. This is a concave increasing function that maximizes at $\tau_o = \tau(\lambda = 0) = 1 - \alpha(1 - 1/\rho)$, the *ideal* tax rate of the benevolent ruler. The two horizontal lines represent the utility conferred by Protection-for-Tax-Compliance when the market is monopolistic (solid line) and oligopolistic (dashed line) and $A = A_l$. V_e cuts later V_d simply because $V_d > V_m$. For that same reason, $\hat{\tau}_d > \hat{\tau}_m$. In other words, the parameter space for which protection is preferred $\tau_o \in [0, \hat{\tau}_k]$ with $k \in \{d, m\}$ is greater when the incumbent domestic market is oligopolistic than monopolistic (find it plotted at the bottom of Figure 4.2).

This analysis shows that the assumption of a monopolist producer in the main text, though might contradict the idea of weak state capacity, is just a simplification. We could assume an incumbent oligopoly instead, and we would still get a parameter space satisfying the existence of Protection for Tax Compliance. The parameter space for an oligopoly is indeed greater than the one for a monopoly since (1) wages with an oligopoly are larger than under a monopoly, what softens the wage-revenue trade-off under protection; and (2) the differential between the new and old technology must be larger for a new monopolist firm to outweigh the reduction of wages derived from the change in market structure upon entry.

Figure 4.2: Protection for Tax Compliance (PFTC) parameter space for Incumbent Monopoly and Oligopoly.



4.7.2. Investment Goal

Why is the investment goal is $\tau(\lambda = 0)$ and not $\hat{\tau}$, as defined in *Proposition 8*? $\hat{\tau}$ is not explicitly defined. That makes results less intuitive, but they do not change is essence. That is, there still exists a non-empty interval $\sigma \in (0, \hat{\hat{\sigma}})$ for which investment takes place. This Supplementary Section sketches the existence of this interval and compares it to the one defined by *Proposition 9*.

By *Proposition 8*, $\tau_o < \hat{\tau} \leq \tau(\lambda = 0)$. Since $\partial\tau^*/\partial\sigma < 0$, in case of

investment, $\sigma(\hat{\tau}) < \sigma(\tau(\lambda = 0))$. Moreover, since $\sigma = 0$ when investment is null,

$$\tau^*(I = 1|\text{goal}\,\hat{\tau}) < \tau^*(I = 0) \tag{4.51}$$

This is a crucial result. It raises the same inter-temporal dilemma to that in the main text, this time however for investment goal $\hat{\tau}$. On the one hand, this inter-temporal dilemma is responsible for the positive relationship of σ and period 1 wage, ω_1. In particular, since $\sigma(\text{goal}\,\hat{\tau}) < \sigma(\text{goal}\,\tau(\lambda = 0))$, by (4.23) $\tau^*(\text{goal}\,\tau(\lambda = 0)) < \tau^*(\text{goal}\,\hat{\tau})$. Given $\partial\omega/\partial\tau < 0$, $\omega^*(\text{goal}\,\hat{\tau}) < \omega^*(\text{goal}\,\tau(\lambda = 0))$. On the other hand, public spending utility G is increasing in $\tau \in (0, \tau(\lambda = 0)$. Since $\tau^*(\text{goal}\,\hat{\tau}) > \tau^*(\text{goal}\,\tau(\lambda = 0))$. In sum, when the investment goal is $\hat{\tau}$ instead of $\tau(\lambda = 0)$, period 1 equilibrium wage is lower but equilibrium per capita public spending is higher.

1. Provided the investment goal is $\hat{\tau}$, when is invested pursued by a benevolent ruler? Suppose all *Proposition 9* pre-conditions are met. Then, there exist a unique SPNE such that for all $\sigma < \hat{\hat{\sigma}}$ and $\hat{\hat{\sigma}} \in (0, 1)$ investment is preferred. Proof similar to that of *Proposition 9*.

2. Provided $\hat{\hat{\sigma}}$ exists, how does it compare to $\hat{\sigma}$ defined in *Proposition 9*? Answer: $\hat{\hat{\sigma}} < \hat{\sigma}$

   Proof. Let $\omega_j^t(I)$ and $G_j^t(I)$ be the indirect utility of wages and per capita public spending following investing in fiscal capacity $I \in \{0, 1\}$, with goal $j \in \{l, h\}$, where l denotes investment *goal* $\hat{\tau}$ and h investment *goal*

$\tau(\lambda = 0)$, in period $t \in \{1, 2\}$. Investment takes place whenever

$$\begin{aligned}
&\omega_l^1(I=1) + G_l^1(I=1) \geq \\
&2\Big[\omega(I=0) + G(I=0)\Big] - \Big[\omega_l^2(I=1) + G_l^2(I=1)\Big] \quad \text{if goal is } \hat{\tau} \\
&\\
&\omega_h^1(I=1) + G_h^1(I=1) \geq \\
&2\Big[\omega(I=0) + G(I=0)\Big] - \Big[\omega_h^2(I=1) + G_h^2(I=1)\Big] \quad \text{if goal is } \tau(\lambda=0)
\end{aligned} \tag{4.52}$$

Notice that the right-hand side expressions in (4.52) do not depend on σ, the investment cost. On the contrary, both left-hand sides describe a monotone negative function in σ. Now let $V_j^t(I=1)$ be the total indirect utility per period. By *Proposition 3*, $V_j^t(I=1)$ is increasing in τ^*. Given goals $\hat{\tau}$ and $\tau(\lambda=0)$, if investment takes place $V_h^2(I=1) > V_l^2(I=1)$. That implies

$$2\Big[\omega(I=0) + G(I=0)\Big] - V_h^2(I=1) < 2\Big[\omega(I=0) + G(I=0)\Big] - V_l^2(I=1) \tag{4.53}$$

Given (4.53), the left-hand side in (4.52) cuts the top right-hand side at earlier. That is, at a value $\sigma = \hat{\hat{\sigma}} < \hat{\sigma}$. □

This result implies that the parameter space of positive investment for the lower goal, $\hat{\tau}$, is smaller than the one for the higher goal, $\tau(\lambda = 0)$. The reason lies in the marginal gain of period 1 investment. Since this is relatively smaller for the lower goal, the incentives to invest also weaken. Altogether, focusing on the higher investment goal $\tau(\lambda = 0)$ sets a more conservative scenario as it expands the parameter space of positive investment.

CHAPTER 5. CONCLUSION

This dissertation revisits two generally accepted results in Political Economy: First, protectionist policy is used to tax foreign producers penetrating the national market (thus, benefiting domestic industry). Second, protectionist policy involves some degree of rent-seeking by government.

I claim that under some conditions, neither of these assertions are necessarily true. When fiscal capacity is weak and national producers are uncompetitive, protectionist policy (*i.e.*, entry barriers) might induce tax compliance by domestic industry and might be adopted by a welfare utility-maximizing ruler unresponsive to bribes or contributions. Thus, it is not always true that the burden of protectionist policy falls only on foreign producers penetrating the national market, nor that protection always results from rent-seeking by government.

These results are theoretically evaluated in the Paper 1, and tested using a cross-national sample of 32 economies, in which I exploit cross-country variation in fiscal capacity (proxied by the number of officials working for the tax administration). The results are consistent with the theoretical prediction: when fiscal capacity is low, uncompetitive sectors that receive protection from foreign

competitors tend to pay higher tax rates.

The second paper reevaluates the theoretical predictions in Paper 1, this time exploiting within-country variation in sector taxability. Two country-specific analyses are fulfilled: Chile and Bolivia, which are argued to vary in their stock of fiscal capacity. In these set ups, sector taxability is proxied by market structure (that is, how oligopolistic the sector is) and geographic dispersion. This last measure, novel as far as I am concerned, captures sector taxability reasonably well, even better than market concentration. When a sector is spread across the territory, coordination within the tax administration is harder and the information spill-overs from auditing are lower. Input prices, transportation costs, labor supply, even demand might change from region to region and thus creates opportunities for avoidance and evasion.

The country-specific studies are implemented making use of industrial surveys. The two countries represent opposing stories in tax performance and, in turn, fiscal capacity. The empirical analysis suggests that both tariff and Non-Tariff-Barriers (NTB) stimulate tax payments among obsolete sectors in Bolivia. Tariffs result inconsequential in Chile, but NTBs seem to induce higher tax compliance for the weakest leg of the tax system in this country: that is, profit taxes. Chile turns out to be a particularly valuable case to test for Protection-for-Tax-Compliance: the two main taxes in the country, VAT and profit taxes, have performed quite differently since democratic transition. Whereas the profit tax has performed poorly, the VAT is internationally praised for its productivity. This wide divide across tax types allows me to use the VAT as a

placebo test for Protection-for-Tax-Compliance. Consistent with the research hypothesis, I only find evidence for my theory for profit taxation.

In Paper 3, I consider the extension of the static set up in a dynamic framework. In particular, I evaluate the conditions under which the tax revenue derived from Protection-for-Tax-Compliance might be reinvested in expanding the stock of fiscal capacity (*e.g.*, increase funds and personnel of tax administration). I find that reinvestment takes place only if Protection-for-Tax-Compliance is adopted when the fiscal capacity of the state is not too low. Otherwise, the present reinvestment costs are too large to ignite investment. More importantly, the analysis emphasizes the inter-dependence of institutional investment and technology adoption. The former induces the latter but the short-term cost of technology adoption might itself discourage institutional investment. Essentially, institutional investment and productivity growth are fully endogenous under the Protection-for-Tax-Compliance model.

Protection-for-Tax-Compliance is proved to hold a non-monotonic relationship with long-term aggregate welfare. When the initial stock of fiscal capacity is low, Protection-for-Tax-Compliance becomes a long-term equilibrium. In other words, if protection is adopted when the stock of fiscal capacity is too low, protectionist policy eventually drives the economy into a low-income, low-fiscal capacity trap. When the initial stock of fiscal capacity is high, Protection-for-Tax-Compliance is bad for aggregate welfare in the short- and long-term, and therefore we should not observe it being adopted in the first place. Only when the initial stock of fiscal capacity is intermediate, the revenue stemming from

Protection-for-Tax-Compliance is reinvested in expanding the fiscal capacity of the state. This, in turn, stimulates technology adoption among domestic producers. Eventually, the economy switches endogenously from a low-fiscal capacity, low-income equilibrium to one characterized by high-fiscal capacity and high-income level.

The reinterpretation of protectionist policy undertaken in this dissertation sheds some light onto two seemingly unrelated literatures: one being the barriers to technology adoption (Comin and Hobijn, 2009; Krusell and Rios-Rull, 1996; Mokyr, 1991; Parente and Prescott, 2000), the other being the effect of infant industry protection (Edwards, 1993; Harrison and Rodríguez-Clare, 2010). The analysis shows that the perpetuation of low technology might be driven by the lack of incentives of the ruler (even if benevolent) to reinvest a share of the revenue to improve fiscal capacity. When that is the case, opening the economy is not a credible threat and domestic producers lack the incentives to invest. This result emphasizes the inter-dependence of institutional investment and productivity growth.

The results of this dissertation also qualify the infant industry literature. The results suggest that protection only stimulates productivity growth among protected industry if the ruler's threat to open the economy in the future is credible. This only happens if the initial stock of fiscal capacity is large enough. Otherwise, the induced cost of innovation (added to those of institutional investment) would be too large in the short-term to make this option preferred to the *status quo*. When fiscal capacity is too low, protection of infant industry does not

generate the right set of incentives for domestic producers to innovate.

All in all, this dissertation evaluates one particular dimension of state growth, fiscal capacity, right from its micro-foundations. States might have remained weak for centuries. Backwardness can easily be explained by kleptocrat, selfish rulers who maximize self-consumption or policy-capture by powerful interest groups. However, these answers overlook the essential short- and long-term dilemmas of taxation and fiscal capacity investment. Most of my analyses (but not all of them) have assumed a benevolent, welfare utility-maximizing ruler to evaluate the solutions to those dilemmas in absence of these *usual suspects*. The approach resulted in being useful: First, it proved to us that protection can arise even in absence of rent-seeking by government, as commonly assumed (Grossman and Helpman, 1994; Gehlbach, 2008). Second, departing from Besley and Persson (2011), it also proved that under-investment in fiscal capacity might happen even if society is frictionless and rulers seek to maximize long-term social welfare. Interest groups, reckless incumbents and social divisions are major impediments to state capacity and economic growth, but backwardness and weak state institutions might be explained without them.

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endógenamente desde el equilibrio proteccionista con baja capacidad fiscal y empresas obsoletas al equilibrio de libre mercado con alta capacidad fiscal y empresas competitivas. Por el contrario, si la política de Cumplimiento Fiscal a cambio Protección es adoptada cuando la capacidad fiscal es demasiado débil o la captura de los grupos de interés demasiado alta, no debemos esperar ninguna reinversión en el stock de capacidad fiscal. En concreto, estas economías quedarían atrapadas en un equilibrio de pobreza crónica caracterizada por industrias ineficientes y baja capacidad fiscal. En suma, la tesis demuestra que la Protección a cambio de Cumplimiento Fiscal sólo maximiza la utilidad social en el corto y largo plazo para niveles iniciales de capacidad fiscal intermedios. La teoría desarrollada en esta tesis muestra, en esencia, los dilemas inter-temporales de la lógica de la supervivencia política aplicada al campo la inversión en instituciones fiscales.

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