Business Tax Reforms, Management Delegation, and Growth*

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Abstract

We study the growth effects of business tax cuts in two economies that differ by corporate governance: in one, firm founders delegate production and/or in-house R&D to hired managers; in the other, they do not. In line with empirical evidence, delegation occurs if the rule of law is sufficiently strong. Despite the agency frictions that it entails, delegation improves the firm's use of resources in production and/or innovation. The interaction between taxation and governance affects aggregate productivity growth, which is driven by entry of new firms and by the accumulation of intangibles by incumbent firms. Our analysis suggests that management delegation amplifies the macroeconomic responses to changes in business income taxation. Quantitative experiments show that in the near and medium term, in response to a 1 percentage point reduction of the profit tax rate, per capita income growth rises by around 0.02 percentage points more in the delegation than in the no-delegation economy.

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1 Introduction

Several countries have lowered tax rates on dividend and profit income in recent years.[1] Supporters argue that such reductions are "pro-growth" because they boost firm investment and stimulate business dynamism. Critics worry about their redistributive effects because different occupations earn income in different forms: wages and returns on savings for workers versus compensation tied to profits, dividends and capital gains for management-related positions. The macroeconomic debate on this subject is naturally very intense. However, it largely neglects the microeconomic details of how firms make decisions and of how industry evolves as the result of such decisions. This neglect can cause analysts to miss important forces and thus misdiagnose the main issues.

For example, recent work argues that the response of investment to business taxation depends on the conflict between managers and shareholders within firms (Desai et al. 2007, Chetty and Saez 2010, Fulghieri and Suominen 2012). It follows that in countries such as the USA, where reliance on professional managers is widely diffused, it is important to account for how agency relationships within the firm shape the effects of taxes on firms' decisions. At the other end of the spectrum, it is tempting to argue that such issues are not important in economies where separation of ownership and control is not prevalent. But lack of delegation is itself a sign of acute agency issues. Delegation is an endogenous profit-driven decision governed by specific costs and benefits. An economy where it does not take place is an economy where conditions discourage it. Figure 1 shows that the reliance on professional management is highly correlated with the strength of property rights and intellectual property rights. This suggests that in countries where low quality institutions inhibit the creation of solid and easily enforceable contractual ties, a founding entrepreneur is more likely to retain full control of the firm. More generally, logic and evidence suggest that business taxation and firm governance interact, possibly in subtle ways.

These considerations raise several questions. Are the macroeconomic effects of business

[1] An OECD study found that 78 out of the 96 countries surveyed reduced the statutory corporate tax rates between 2000 and 2018, for an average reduction of 7.5 percentage points (OECD 2019). Similarly, Gechert and Heimberger (2022) document that the world average of statutory corporate tax rates declined about 15 percentage points from 1982 to 2019, going from 41% to 26% (see their Figure 1).

taxation stronger or weaker in an economy with management delegation or one without management delegation? In which of the two types of economy firms are more likely to increase investment in the short, medium, and long run in response to a tax cut? How does taxation affect agency issues themselves, including the delegation decision?

In this paper, we study this kind of questions in a Schumpeterian model of endogenous growth with endogenous market structure. Productivity growth is driven by entry of new firms that expands the variety of products and by investment of incumbent firms in the improvement of the quality of their products. The founder of a firm can delegate managerial functions to agents more skilled in performing them. With delegation, however, agency issues arise and the founder uses incentive contracts to mitigate them. When the contractual costs are sufficiently large the founder does not delegate. An important objective of the analysis is to understand how business taxation interacts with the firm's governance, including the delegation decision, and assess quantitatively the growth consequences of tax cuts in economies characterized by the presence or absence of management delegation.[2]

We consider taxes on dividends, profits and executive compensation. Earlier studies have pointed out that the effects of a corporate tax cut on firm investment are ambiguous: on the one hand, the cut stimulates firm investment by increasing after-tax profits; on the other hand, the tax cut stimulates entry and causes incumbent firms to revise downward their investment plans in anticipation of a smaller market share. The empirical relevance of these mechanisms is reviewed by Gechert and Heimberger (2022) and Suzuki (2022). In

[2]The model is scale-invariant, that is, the size of the economy does not affect long-run growth because product proliferation fragments the economy into submarkets in which firm size does not grow with the size of the economy. Ang and Madsen (2011), Madsen (2010), Madsen (2008), and Ha and Howitt (2007), among others, discuss empirical evidence in support of this class of Schumpeterian growth models. More recently, using data from the French manufacturing sector, Aghion, Bergeaud, Lequien, and Melitz (2019) have concluded that a demand shock increases firms entry and discourages in-house innovation, particularly among low productivity firms. Bond-Smith (2019) provides an excellent review of the debate on scale effects in economic theory. An important consequence of scale-invariance is that fiscal instruments that operate through the size of the aggregate market do not affect long-run growth. As shown in Peretto (2003, 2007), instruments with this property are, among others, public spending, labor income taxes and consumption taxes. Business income taxes, in contrast, affect long-run growth because they operate through the arbitrage conditions on rates of return.

our model the two effects operate over different time horizons. In the short run, the tax cut affects entry only marginally and its stimulus effect on the investment of incumbent firms is strongest. In the long run, the extensive margin becomes more significant and incumbent firms reduce their investment as they expect to lose market share. Agency frictions amplify the importance of these channels in our analysis.

We find that agency frictions and delegation do not alter the main tenet of the corporate view of finance that dividend taxation does not affect the investment plan of the firm, a conclusion in line with the findings of Yagan (2015) who argues that the 2003 dividend tax cut in the USA did not have significant near-term consequences on firm investment. We find, however, that a dividend tax cut stimulates entrepreneurship and thereby reduces the incentives of incumbents to invest. Therefore, in the long run it lowers the growth rate in both economies with delegation and economies without. The dividend tax cut raises wages only slightly in the short run and to the same extent in the two economies because it does not interact with agency issues.

Management delegation matters significantly when we evaluate the effects of a profit tax cut on firm investment, entrepreneurship, the wage and per capita GDP. We find that delegation *amplifies* the responses of these variables to the profit tax cut. Calibrating the model economy with delegation to the USA data, we find that a one percent reduction in the profit tax rate causes per capita income to growth faster, in the near term, by 0.07 percentage points in the economy without delegation and by 0.09 percentage points in the economy with delegation. The wage is slightly more responsive to the tax reform than per capita GDP. In the long run, however, the profit tax cut slows down per capita GDP growth by around 0.03 percentage points more in the delegation economy.

A cut of the tax on executive compensation favors the alignment of the managers' objective to the owner's because it weakens the managers' incentive to divert the firm's resources. This means that firm investment rises. The wage goes up not only in the short run, but also in the long run, because the intensive margin (in-house investment) responds to the tax cut more robustly than the extensive margin (entry).

As mentioned, supporters of cuts of business taxes stress that they are pro-growth and highlight that they benefit workers as well through higher wage growth. Critics stress,

instead, their redistributive consequences, highlighting that different groups in society earn different forms of income. To investigate these issues, we model managers as members of the representative households who get selected at random by the firms when they delegate. To keep things as simple as possible, we assume that managers remain in the workforce, and thus earn the wage, and perform their managerial duties as an extra activity. To emphasize the distributional implications of our model, we further assume that managers do not contribute their extra earnings to the household's budget but fully consume the extra resources that they secure. We then track the percentage increase in income and consumption that managers enjoy by virtue of their position. The comparison informs us about the contribution of delegation to inequality and also reveals that diversion is a tool that managers can use to mitigate the consumption losses due to higher taxation. Finally, we look at the welfare of the two groups. We find that the profit tax cut improves the discounted flow of utility of the representative household for about four decades in the delegation economy. Over the same time horizon, we observe more modest welfare gains and sometimes even welfare losses in the no delegation economy.

This paper contributes to the literature that studies the effects of taxation with models that allow for an endogenous market structure. Peretto (2007) studies the long-run effects of taxation in a Schumpeterian economy of that class and finds that dividend taxation has a positive effect on growth because it reduces the number of firms and thus makes incumbent firms larger. More recently Ferraro, Ghazi and Peretto (2020, 2022) use that framework to investigate quantitatively the effect of, respectively, tax policy and the special role of labor income taxes. The findings support the mechanism driving this paper. Other contributions use different frameworks. In a growth model with labor-saving innovation Gersbach, Schetter and Schneider (2018) argue that the positive difference between the tax rate on labor income and the tax rate on profit income favors entrepreneurship and innovation but depresses wages. Another notable contribution is Sedlacek and Sterk (2019), which finds that corporate tax reforms, such as that of the 2017 Tax Cuts and Job Act, can generate productivity gains due to the restructuring of industry. Akcigit and Stantcheva (2020), Gechert and Heimberger (2022) and Suzuki (2022) review recent theoretical and empirical insights on how taxation can affect the rate and direction of innovation. This study contributes to this line of research

by exploring the interaction of corporate governance with business taxation.

Another set of recent contributions focuses on the role of agency frictions. Celik and Tian (2022) and Terry (2017) use creative-destruction models to study, respectively, how agency frictions affect disruptive innovation and short-termism. Both papers abstract from the role of endogenous market structure. Iacopetta, Minetti and Peretto (2019) and Iacopetta and Peretto (2021) incorporate agency frictions in models of endogenous growth and endogenous market structure built on the framework of Peretto (2015). The goal is to understand how agency relationships affect firms' investment decisions and the resulting industry dynamics. In a departure from these contributions, and motivated by the cross-country evidence on the association between the prevalence of professional management and the rule of law (Akcigit, Harun, and Peters 2021; Grobovsek 2020), this paper endogenizes the management delegation decision by relating it to the quality of institutions and to business taxation.

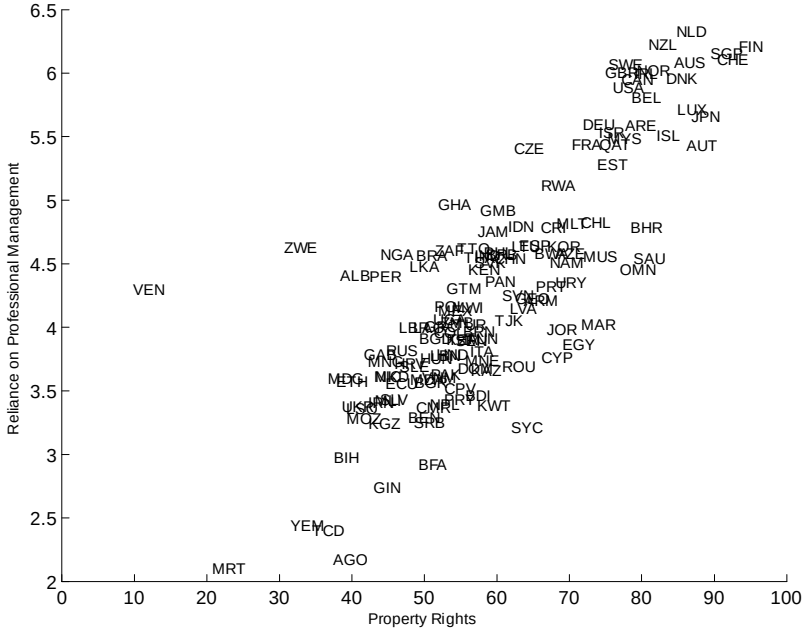
This paper also contributes to the literature on the interaction between taxation, agency costs and incentive pay. Schizer (2018) reviews the multiple channels through which governance and taxation affect one another. Chetty and Saez (2010) argue that the agency issues that arises with the separation of ownership and control should change how we think about business taxation because it tempts managers to divert the firm's resources to unproductive uses. Desai, Dyck and Zingales (2007) note, however, that taxation can be a discipline device that mitigates the managers' diversion of resources. Our model sheds light on this debate. Finally, because some results are sensitive to the size of the R&D tax deductions, this paper contributes to the debate on the growth effects of R&D subsidies (see, e.g., Chu and Wang 2020, Chu and Cozzi 2018, Impullitti 2010, and Zeng and Zhang 2007).

2 The model

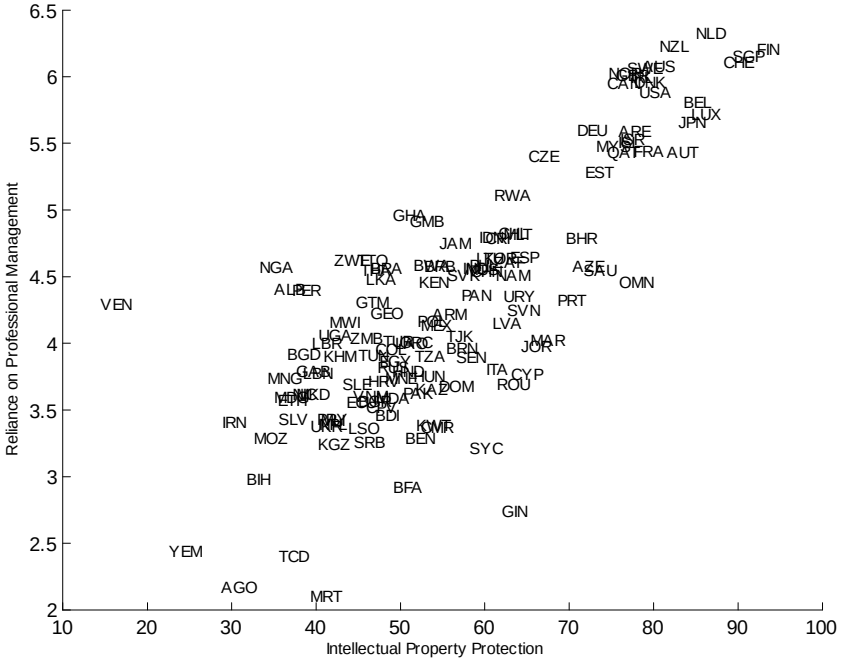
Our framework builds on Iacopetta, Minetti and Peretto (2019) and Iacopetta and Peretto (2021), which follow the "rent extraction" approach of corporate finance and model the misalignment of interests between managers and shareholders as diversion of the firm's resources (see Edmans and Gabaix 2016 for a literature review). Here we add two elements. One is the

Figure 1: Property Rights and Professional Management

Panel A: Property Rights



Panel B: Intellectual Property Protection



–Note. Authors' elaboration based on data from worldbank.org. Variables: 41645 (property rights), 41646 (intellectual property protection), and 42700 (reliance on professional management). Correlation coefficients: 0.8 (panel A) and 0.79 (panel B).

founder's choice about delegation. Depending on the anticipated agency costs, the founder delegates the management of production or innovation, or both, to managers. The other is a set of taxes on profit income, dividend income and executive compensation.

The model has the following structure. Time is continuous and runs forever. All variables are functions of time but we omit the time argument unless necessary to avoid confusion. There is a homogenous final good, which serves as our numeraire, that is consumed, used as the input for the production of intermediate goods, the accumulation of knowledge by incumbent intermediate firms and the foundation of new intermediate firms. A representative competitive firms produces the final good employing labor and an expanding variety of differentiated non-durable intermediate goods whose quality improves over time as intermediate firms accumulate knowledge in-house.

2.1 Final good production

A competitive representative firm produces the final good with the technology

$$Y = \int_0^N X_i^\theta \left(\frac{Q_i L}{N^{1-\epsilon}} \right)^{1-\theta} di, \quad 0 < \theta,\ 0 \leq \epsilon < 1 \tag{1}$$

where N is the mass of non-durable intermediate goods, X_i is the quantity of good i, and L is the flow of labor services, which in equilibrium equals the mass of workers since labor supply is inelastic (see below). The parameter ϵ measures love of variety and θ is the elasticity of output to intermediate use. The quality of intermediate good i, Q_i, is the good's ability to augment labor in Solovian fashion.

Let p_i be the price of good i and w be the wage. The final producer's profit maximization yields the input (inverse) demand functions:

$$p_i = \theta X_i^{-1+\theta} \left(\frac{Q_i L}{N^{1-\epsilon}} \right)^{1-\theta}; \tag{2}$$

$$w = (1-\theta) \frac{Y}{L}. \tag{3}$$

This demand system yields that a fraction θ of final output goes to intermediate good producers, i.e., $\int_0^N p_i X_i di = \theta Y$, and the remaining fraction, $1-\theta$, to workers.

2.2 Intermediate good firms

We begin with a description of the primitives and then present the no-delegation case.

Production and in-house innovation. Firm i transforms one unit of final good into one unit of its intermediate good. The quality of the good is

$$Q_i = Z_i^{\alpha} Z^{1-\alpha}, \quad \alpha < 1 \tag{4}$$

where Z_i is the firm's stock of knowledge and $Z = \left(\int_0^N Z_i di\right)/N$ is average knowledge. Production also requires a fixed operating cost ϕQ_i in units of the final good. The firm accumulates knowledge according to the technology

$$\dot{Z}_i = I_i, \tag{5}$$

where I_i is investment in units of the final good.

Entry. The creation of a new firm requires payment of a sunk entry cost βX in units of the final good, where $X = \left(\int_0^N X_i di\right)/N$ is average firm output. The new firm start operations with knowledge stock equal to the industry average, Z. Because intermediate firms operate under Bertrand competition, the entry sunk cost implies that the entrant introduces a new good rather than competing with an existing producer. Accordingly, only one firm operates in each product line (equivalently, industry).

The model's core mechanism is that a firm can shift its demand curve to the right by rising the quality of the good it sells. This raises profitability since, anticipating one of the properties of the firm's value-maximizing plan, our demand system (2) yields that the firm charges a constant markup over the marginal cost of production. Therefore, profitability is proportional to the volume of sales. We add to this standard mechanism a new one, namely, that the firm's founder can improve the firm's use of resources in the factory and/or the lab by hiring agents with better managerial skills than his/her own. Such delegation, however, introduces agency issues. We study this mechanism in the next section, here we review the basics of the model with no delegation.

2.3 Founder-manager

Consider a firm with no delegation: the founder manages production and investment directly. The firm's pre-tax profit is

$$\Pi_i = (p_i - 1)X_i - \phi Q_i. \tag{6}$$

The firm's distributed dividend, D_i, is the difference between after-tax profit and the firm's investment expenditure, I_i, net of tax credits:

$$D_i = \Pi_i(1 - \tau_\Pi) - (1 - \sigma\tau_\Pi)I_i, \tag{7}$$

where τ_Π is the flat tax rate on profit income and σ is the share of investment expenditure that the tax law allows the firm to deduct from its taxable profit income. Dividend income is subject to a flat tax rate τ_D.[3]

The founder-manager maximizes the value of the firm

$$V_i(t) = \int_t^\infty e^{-\int_t^\upsilon r(s)ds}(1 - \tau_D)D_i(\upsilon)d\upsilon, \tag{8}$$

subject to the demand schedule (2), the R&D technology (5), and the definitions of profit (6) and of dividend (7). The value-maximizing price is the monopolistic price $p_i = \frac{1}{\theta}$. The value-maximizing investment plan equates the return, net of taxes and of the R&D rebate, to the firm's internal asset, the firm's stock of knowledge, to the return to an outside asset (i.e., the market interest rate):

$$r = \frac{1 - \tau_\Pi}{1 - \sigma\tau_\Pi}\alpha\frac{\Pi_i}{Z_i}. \tag{9}$$

The dividend tax, τ_D, is notably absent from this expression because, as long as τ_D is constant over time, any amount of profit not distributed today to shareholders and reinvested in the firm generates a flow of profit and a corresponding stream of future tax liabilities that are equivalent, in present value, to the dividend tax paid today. If $\sigma = 1$, the profit tax is equivalent to a dividend tax and the firm's marginal gross profit $\alpha\frac{\Pi_i}{Z_i}$ equals the interest rate, r. If $\sigma < 1$, however, τ_Π distorts the firm's investment decision: for given interest rate, r, the firm accumulates a smaller stock of knowledge ($\alpha\frac{\Pi_i}{Z_i}$ is decreasing in Z_i).

[3] In our equilibrium, $D_i > 0$ (cash-rich firm) so that the firm finances investment with retained earnings rather than issuing new shares. As it is well known from the debate between the Old and New views of corporate finance, if dividends are taxed, the cash-rich firm that wants to minimize the shareholders' tax bill distributes dividends and does not finance investment with new equity.

2.4 Households

The representative household consists of L identical individuals whose mass grows at a constant rate $\lambda \geq 0$. The initial mass is $L(0) = 1$. The household has preferences

$$U(0) = \int_0^\infty e^{-(\rho-\lambda)t} \log\left(\frac{C(t)}{L(t)}\right) dt, \quad \rho > \lambda \tag{10}$$

where ρ is the intertemporal discount rate and C is the the household's consumption. The household faces the flow budget constraint (to keep the notation simple we anticipate the property that the equilibrium of the intermediate sector is symmetric)

$$\dot{e}NV + e\left(\dot{N}V + N\dot{V}\right) = \left[(1-\tau_D)D + \dot{V}\right]eN + wL + H - C, \tag{11}$$

where e and $\dot{e}$ are, respectively, the level and change of equity holding in each firm, N is the mass of firms, D is the dividend per share distributed by each firm, $\dot{V}$ is the appreciation of each firm's equity, w is the wage and H is a lump-sum transfer from the government.[4]

This setup with no disutility of work yields that the household supplies its entire labor endowment, L, and saves according to

$$\rho + \frac{\dot{C}}{C} - \lambda = r = (1-\tau_D)\frac{D}{V} + \frac{\dot{V}}{V}. \tag{12}$$

This Euler equation defines the after-tax, reservation rate of return to saving that enters the evaluation of corporate equity (8) discussed above. The household's consumption plan must also satisfy the usual boundary conditions.

In the economy with delegation, managers are members of the representative households selected at random by the firms. To keep things as simple as possible, we assume that they remain part of the workforce, and thus keep earning the wage, and perform their managerial duties as an extra activity. To emphasize the distributional implications of our model, we further assume that these individuals do not contribute their managerial earnings to the household's budget but fully consume the resources they secure in their role as managers (see section 5.3). Thus, the budget (11) includes neither the managers' income

[4] For simplicity we assume no taxation of capital gains, labor income and consumption. Allowing for such taxation does not change our qualitative results and distracts from our intended focus on business income taxation and its interaction with the agency frictions due to delegation of managerial control.

nor the resources that they appropriate through diversion. This assumption guarantees that managers earn more and consume more than the other members of the household. Managers do not receive transfers from the government. The appendix shows the correspondence between the economy's resource constraint, the budget (11) and the managers' consumption.

2.5 Government

The government collects corporate taxes net of R&D subsidy and personal dividend income and executive income taxes. The total tax revenue intake is (here too we anticipate that the equilibrium of the intermediate sector is symmetric)

$$T = N\left[\tau_D D + \tau_\Pi \left(1 - d_X\right)\Pi - \tau_\Pi \sigma I + \tau_b B\right]. \tag{13}$$

The new terms here are d_X, B and τ_b. The first, d_X, is the fraction of each firm's profit that its production manager diverts to his/her own consumption. B is the total executive compensation that each firm pays to its managers. We unpack these two terms in the next section, where we introduce our micro model of firm governance. The third new term, τ_b, is the tax rate on executive income.

The government allocates a fraction τ_H of tax revenues to the lump-sum transfer, H, to the traditional household and the rest to government consumption, G. We call τ_H the redistribution parameter because it measures the extent to which the government redirects resources from managers to the other members of the household. For $\tau_H = 0$, the model replicates the properties of those studied in Peretto (2007) and Ferraro, Ghazi and Peretto (2020, 2022) abstracting from corporate governance issues.

3 Founders and managers: governance in equilibrium

A large literature views delegation as a strategy to achieve better outcomes by assigning decision rights to better informed or more able parties (Aghion and Tirole 1997, Hart and Moore 2005, Alonso and Matouschek 2008, Marin and Verdier 2008; see Aghion et al. 2014 for a theoretical and empirical review). We consider delegation of two managerial functions: the organization and supervision of production and of in-house innovation. The agents in

charge of these functions are the production manager and the R&D manager, respectively, and for clarity of exposition we consider them different individuals.

3.1 Agent-managers

For a given stock of knowledge Z_i, the production manager delivers an intermediate good of quality $\gamma_X Q_i$, where $\gamma_X > 1$. Similarly, for a given flow of investment I_i, the R&D manager delivers $\gamma_I I_i$ units of new knowledge, where $\gamma_I > 1$. While delegation improves the firm's use of resources in production and innovation, it introduces agency problems because the managers' objectives diverge from the founder's. Following a common approach in corporate finance, we model the resulting conflict as the managers' diversion of the firm's resources to private benefits. Diversion captures a vast range of actions that damage shareholders: from tunneling, to undersupply of effort, to spending on pet projects (Edmans and Gabaix 2016). The founder uses incentive contracts to mitigate diversion and the overall agency cost of delegation is the sum of the contractual (compensation) and non-contractual (diversion) flow of the firm's resources that managers capture.

3.1.1 Production manager

With the hired manager in charge of production, the demand curve is of the same form as that with no delegation and yields that the quantity sold is $\gamma_X X_i$ and profit is

$$\Pi_i = \gamma_X \left[(p_i - 1) X_i - \phi Q_i \right]. \tag{14}$$

The monopolistic price is still $p_i = \frac{1}{\theta}$ because for simplicity we do not consider agency frictions that distort the manager's price decision.

The manager can divert a share d_{X_i} of the firm's profit, Π_i, at utility cost $\beta f(d_{X_i})\Pi_i$, where $f'(d_{X_i}) > 0$, $f''(d_{X_i}) > 0$. The cost measures the monetary and non-monetary sanctions, legal or otherwise, that the manager faces. In an environment with a strong rule of law, the cost parameter β_X is relatively high. To mitigate diversion, the founder offers a contract that features compensation, b_{X_i}, proportional to the post-diversion firm's profit, $(1 - d_{X_i})\Pi_i$. Accordingly, the manager's utility is

$$u_{X_i} = \left[(1 - \tau_b)(1 - d_{X_i}) b_{X_i} + d_i - \beta_X f(d_{X_i}) \right] \Pi_i, \tag{15}$$

where τ_b is the tax rate on executive compensation. The utility-maximizing diversion rate solves the marginal condition $1 = \beta_X f'(d_{X_i}) + (1-\tau_b)b_{X_i}$. The last term in this expression aligns the manager's interest to the owner's. The marginal condition gives us an implicit function. We thus characterize the manager's behavior as

$$d_{X_i} = d_X\left(b_{X_i}; \tau_b, \beta_X\right) \equiv \underset{d_{X_i}}{\arg\,\text{solve}} \left\{1 = \beta_X f'(d_{X_i}) + (1-\tau_b)b_{X_i}\right\}. \tag{16}$$

Since $f''(d_{X_i}) > 0$, the manager's diversion is decreasing in both b_{X_i} and β_X and increasing in τ_b. The last effect is important in our context: for given compensation, the tax induces the manager to divert more. Finally, we can verify formally that the manager's choice of the monopolistic price is in line with the owner's choice as they both want to maximize Π_i.

3.1.2 R&D manager

We leave the determination of the firm's investment plan in the hands of the founder, who earmarks a flow of funds, I_i, to knowledge accumulation. The R&D manager diverts a share d_{I_i} of it to private consumption at utility cost $\beta_I h(d_{I_i})I_i$, with $h'(d_{I_i}) > 0$, and $h''(d_{I_i}) > 0$. Therefore, knowledge accumulation is

$$\dot{Z}_i = \gamma_I\left(1 - d_{I_i}\right) I_i. \tag{17}$$

Similarly to β_X, the cost parameter β_I is a measure of the strength of the rule of law in deterring diversion. In this case as well, the founder offers an incentive contract to mitigate diversion. The contract features compensation proportional to the flow of new knowledge $b_{I_i}\dot{Z}_i$. With such a contract, the R&D manager's utility flow is

$$u_{I_i} = \left[(1-\tau_b)\gamma_I(1-d_{I_i})b_{I_i} + d_{I_i} - \beta_I h(d_{I_i})\right] I_i. \tag{18}$$

The utility-maximizing diversion rate satisfies the marginal condition $1 = \beta_I h'(d_{I_i}) + (1-\tau_b)\gamma_I b_{I_i}$, which says that the diversion cost is not only the effort but also the forgone fraction of the contractual compensation. We characterize the manager's behavior as

$$d_{I_i} = d_I\left(b_{I_i}; \tau_b, \beta_I, \gamma_I\right) \equiv \underset{d_{I_i}}{\arg\,\text{solve}} \left\{1 = \beta_I h'(d_{I_i}) + (1-\tau_b)\gamma_I b_{I_i}\right\}. \tag{19}$$

Since $h''(d_{I_i}) > 0$, diversion is decreasing in compensation b_{I_i} the efficiency parameter γ_I and the utility cost parameter β_I, and increasing in the tax rate τ_b.

3.1.3 Founder and delegation

The founder establishes the firm and then decides whether to hire managers and what compensation to offer. As already observed, the monopolistic price is the same regardless of whether the founder or the production manager sets it. The founder's other main decision is to set the path of investment. The before-tax dividend is

$$D_i = (1 - \tau_\Pi - b_{X_i}) \left[1 - d_{X_i}(b_{X_i}; \cdot)\right] \Pi_i - (1 - \sigma\tau_\Pi) I_i - b_{I_i}\gamma_I \left[1 - d_{I_i}(b_{I_i}; \cdot)\right] I_i. \tag{20}$$

The founder maximizes the present discounted of after-tax dividends (8), subject to the demand schedule (2), the R&D technology (17), the definitions of profit (14) and of dividend (20), and the managers' best response functions (16) and (19).

The appendix shows that the interior solution for b_{X_i} must satisfy

$$1 - d_{X_i} = -(1 - \tau_\Pi - b_{X_i}) \frac{\partial d_X(b_{X_i}; \tau_b, \beta_X)}{\partial b_{X_i}}. \tag{21}$$

This condition states that the founder's marginal cost of incentivizing the manager, $1 - d_{X_i}$, is equal to the marginal gain generated by the reduction of diversion, $\partial d_X / \partial b_{X_i}$, of which the owner appropriates only the fraction $1 - \tau_\Pi - b_{X_i}$. The joint solution of (16) and (21) is the pair of firm-invariant and time-invariant values $b_{X_i} = b_X(\tau_\Pi, \tau_b, \beta_X)$ and $d_{X_i} = d_X(\tau_\Pi, \tau_b, \beta_X)$. Similarly, the interior solution for b_{I_i} must satisfy

$$\left[1 - d_{I_i}(b_{I_i}; \tau_b, \beta_I, \gamma_I)\right]^2 = -\frac{1 - \sigma\tau_\Pi}{\gamma_I} \frac{\partial d_{I_i}(b_{I_i}; \tau_b, \beta_I, \gamma_I)}{\partial b_{I_i}}. \tag{22}$$

This condition states that the founder's marginal cost of incentivizing the manager, $1 - d_{I_i}$, is equal to the marginal gain generated by the reduction of diversion, $\partial d_{I_i} / \partial b_{I_i}$, multiplied by the difference between the tax-adjusted shadow value of knowledge and the contractual cost of innovation due to the compensation of the manager. Noting that the tax-adjusted shadow value of knowledge equals the diversion-adjusted cost of innovation and rearranging terms yields (22). The joint solution of (19) and (22) is the pair of firm-invariant and time-invariant values $b_{I_i} = b_I(\gamma_I, \sigma\tau_\Pi, \tau_b, \beta_I)$ and $d_{I_i} = d_I(\gamma_I, \sigma\tau_\Pi, \tau_b, \beta_I)$.

Because all contractual terms are the same across firms, from now on we drop the index i. Moreover, to simplify the notation we write the endogenous governance terms b_X, d_X, b_I and d_I, unless necessary to remind the reader that they are functions of the parameters $(\gamma_X, \gamma_I, \sigma, \tau_\Pi, \tau_b, \beta_X, \beta_I)$. The following proposition summarizes the main result.

Proposition 1 *(Governance) The founder offers compensation b_X and b_I, respectively, to the production manager and to the R&D manager. The resulting rates of diversion are d_X and d_I. This governance structure produces the rates of return to in-house innovation and equity:*

$$r = r_{Z_i} \equiv \frac{(1-\tau_\Pi - b_X)(1-d_X)\gamma_I(1-d_I)}{1-\sigma\tau_\Pi + b_I\gamma_I(1-d_I)}\alpha\frac{\Pi_i}{Z_i}; \tag{23}$$

$$r = r_{N_i} \equiv \frac{1-\tau_D}{\chi\gamma_X X}\left[(1-\tau_\Pi - b_X)(1-d_I)\Pi_i - (1-\sigma\tau_\Pi)I_i - b_I\gamma_I(1-d_I)I_i\right] + \frac{\dot{X}}{X}. \tag{24}$$

Proof. See the Appendix ■

Agency issues appear as a different wedge in the rate of return (23) with respect to the case of no delegation. Similarly, they appear as different wedges on profit and investment in the return to equity (24). We also emphasize that the endogenous governance terms are time-invariant, a property that greatly simplifies the model's dynamics.

3.1.4 Delegation of production and R&D

The founder compares the firm's return to equity with delegation to that without delegation. Taking the ratio of the expressions in (9) and (23), we define the founder's delegation surplus in percentage terms

$$s_{X,I} \equiv \underbrace{\gamma_X\left(1-\frac{b_X}{1-\tau_\Pi}\right)(1-d_X)}_{\text{production, } s_X+1} \times \underbrace{\frac{(1-\sigma\tau_\Pi)\gamma_I(1-d_I)}{1-\sigma\tau_\Pi + b_I\gamma_I(1-d_I)}}_{\text{R\&D, } s_I+1} - 1. \tag{25}$$

The founder wants to delegate either production or R&D or both if $s_{X,I} > 0$. The condition nests the two sub-cases in which only one type of delegation occurs, production or R&D. The first case obtains when we set the second term of the product equal to 1; the second when we set the first term of the product equal to 1.

Condition (25) says that the founder wants to delegate production if γ_X is sufficiently high and thus the manager provides a sufficiently large boost to the firm's sales relative to the cost of diversion and compensation that the founder bears. To see this, suppose there is no R&D delegation. Then, for $\gamma_X = 1$ the founder does not want to delegate production because the left-hand side of the inequality cannot be positive for positive compensation of the manager, even if the manager does not divert resources ($d_X = 0$). Condition (25) also says that the

founder wants to delegate R&D if the manager delivers a sufficiently large improvement in its efficiency, i.e., if γ_I is sufficiently high. In particular, suppose there is no production delegation. Then, for $\gamma_I = 1$ the founder does not want to delegate because the left-hand side of the inequality cannot be positive for positive compensation of the manager even if the manager does not divert resources ($d_I = 0$). Production and R&D delegation reinforce each other. To see this, we decompose the founder's surplus as $s_{X,I} = (s_X + 1)(s_I + 1) - 1$, where s_X and s_I are, respectively, the surpluses that obtain with only production delegation and only R&D delegation. We then have $s_{X,I} = s_X + s_I + s_X s_I$, which is larger than the sum of the two positive single-delegation surpluses.

For each type of delegation to occur, the manager's participation constraint must hold. Using Proposition 1 and the utility of the production manager in (15) and of the R&D manager in (18), we have, respectively:

$$(1 - \tau_b) b_X (1 - d_X) + d_X \geq \beta_X f(d_X); \tag{26}$$

$$b_I (1 - \tau_b) \gamma_I (1 - d_I) \geq \beta_I h(d_I). \tag{27}$$

The three conditions (25), (26) and (27) produce a partition of parameter space that identifies four possible configurations. The following proposition summarizes the formal result.

Proposition 2 *(Delegation) The economy can be in one of four possible configurations: (i) no delegation of any type if both (26) and (27) fail; (ii) only production delegation if (26) holds, (27) fails and (25) holds for $b_X = d_X = 0$; (iii) only R&D delegation if (26) fails, (27) holds and (25) holds for $b_I = d_I = 0$; (iv) both production and R&D delegation if both (26) and (27) hold and (25) holds for $b_X, d_X, b_I, d_I > 0$.*

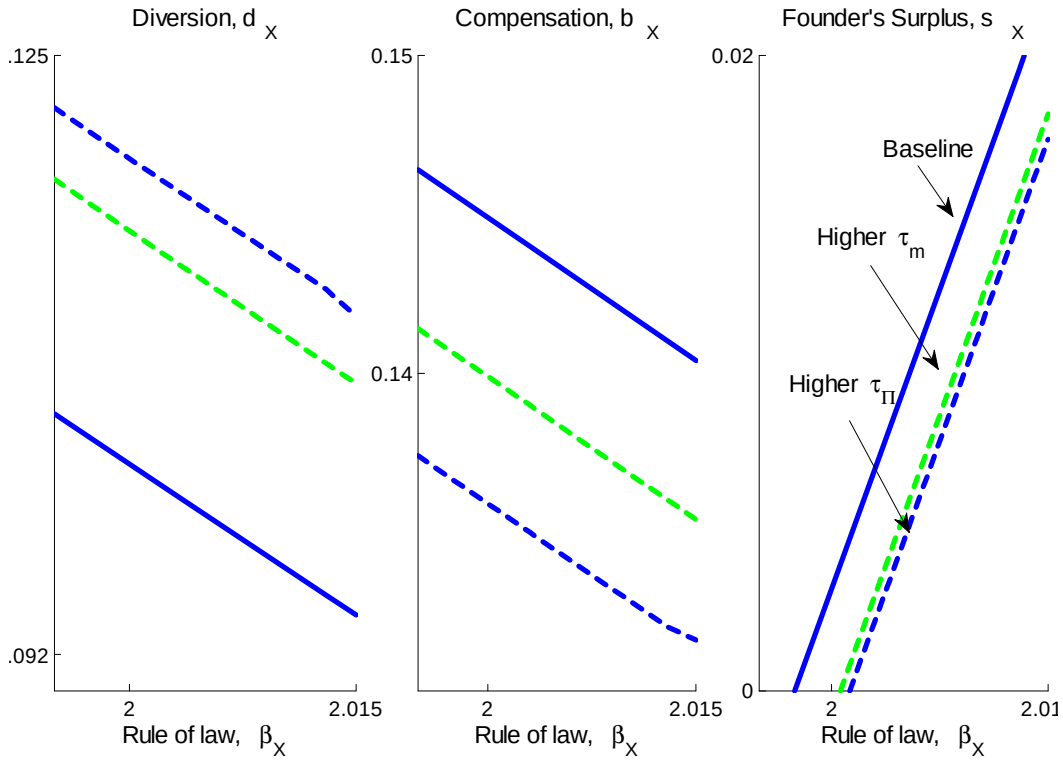
Proof. The claim follows from the discussion in the text. ■

To focus the paper on the most interesting comparison, we focus on configurations (i) and (iv) and refer to them as, respectively, the no-delegation economy and the delegation economy. In our quantitative exercise we study how the size of the delegation region changes with taxation and some of the parameters entering the governance structure of the firm described by the terms $b_X(\tau_\Pi, \tau_b, \beta_X)$, $d_X(\tau_\Pi, \tau_b, \beta_X)$, $b_I(\gamma_I, \sigma\tau_\Pi, \tau_b, \beta_I)$ and $d_I(\gamma_I, \sigma\tau_\Pi, \tau_b, \beta_I)$. One property worth stressing is that the region is invariant to firm size.[5]

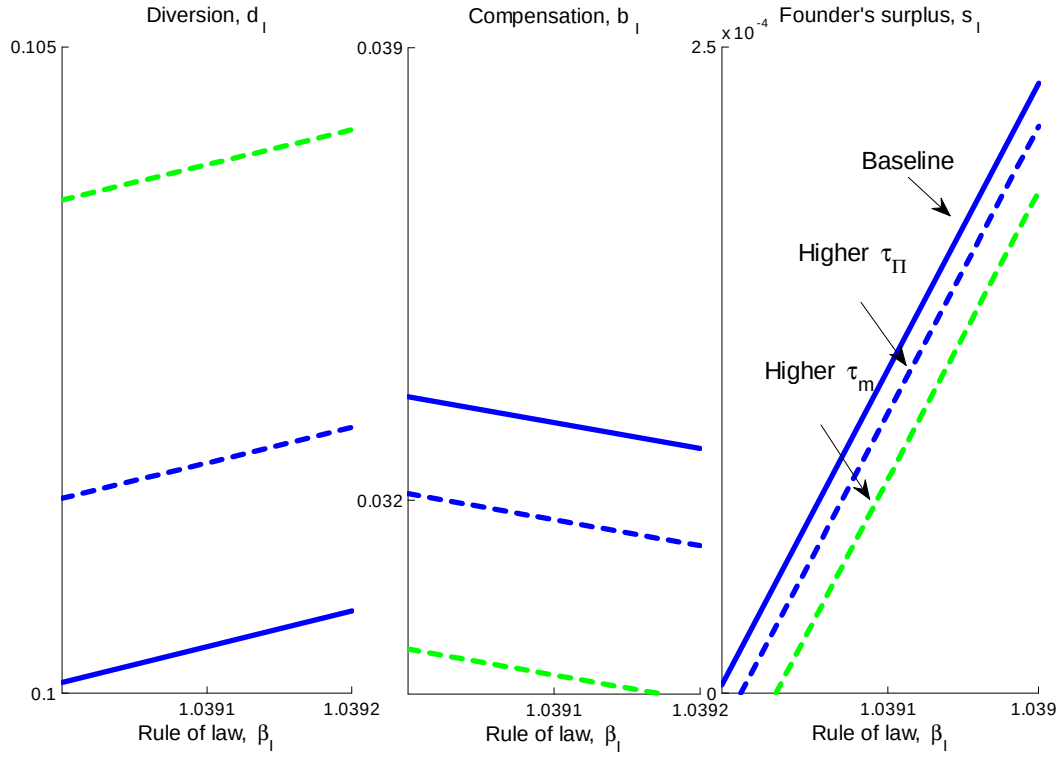
[5] In this paper we focus on how taxation and institutions affect the delegation decision in isolation from

Figure 2: Rule of Law, Delegation, and Taxes

Panel A: Delegation of Production



Panel B: Delegation of R&D



3.1.5 Rule of law and delegation

Figure 1 shows a strong correlation between reliance on professional management and the World Bank indices of the rule of law. Such evidence supports our analysis, which predicts that management delegation occurs for a larger set of parameter values when the diversion costs β_X and β_I are high. We provide details on the specification of the primitives and the mechanism producing these results in the Appendix, here we focus on the predicted quantitative relationships in relation to the evidence.

Figure 2A plots the values d_X and b_X determined in Proposition 1, as well as the surplus $s_{X,I}$, against the diversion cost parameter β_X. As diversion becomes more costly, compensation, b_X, and diversion, d_X, fall and, consequently, the founder's delegation surplus, s_X, rises.[6] This rise expands the size of the delegation region. Figure 2A also shows that taxation of corporate profit and of executive compensation inhibits delegation because it causes the surplus schedule s_X to shift down and this shrinks the size of the delegation region. Our model thus predicts a positive correlation between property rights protection and the prevalence of production delegation.

Figure 2B shows similar relationships for the R&D delegation decision. Compensation, b_I, falls with β_I. Interestingly, in this case diversion, d_I, rises.[7] Nevertheless, the founder's delegation surplus, s_I, rises. Together, these results say that the size of the R&D delegation region expands when institutions weaken the manager's moral hazard. In our interpretation of the data, the protection of the firm's intellectual property serves as a proxy for such deterrence. In the language of cross-country comparisons, this means that our model predicts a positive correlation between intellectual property rights protection and indices of the prevalence of R&D delegation.

endogenous economic variables. In a companion paper (Ferraro, Iacopetta and Peretto 2022) we study how the incentives to delegate vary with the size of the firm.

[6] The analytics in the Appendix show that the full relation can be either hump-shaped or U-shaped depending on the curvature of the utility cost of diversion. In our calibration we find it to be mild, obtaining the first case. Moreover, for the range of calibrated values of the rule of law that we use, our equilibrium is on the downward sloping part of the relationship.

[7] The analytics in the Appendix rationalize this seemingly puzzling result, showing that it is driven by the mild curvature of the utility cost of diversion that we find in our calibration.

4 General equilibrium

In this section we build the general equilibrium of the model in the configurations (i) and (iv) described in Proposition 2. A useful property of that characterization is that the no-delegation case, configuration (i), is nested in the delegation case, configuration (iv). Before proceeding, we note that the equilibrium of the intermediate sector is symmetric, i.e., firms charge the same price, produce the same quantity, and grow at the same rate. Therefore, in what follows we drop the subscript i from all expressions.

4.1 Structure of the equilibrium

We have already stated in Section 2 that the labor market clears. Moreover, final output market clearing follows from the budget constraints of the households and of the government. We now impose the remaining three equilibrium conditions. The first is that the asset market clears, that is, the traditional household's wealth equals the value of the equity issued by firms. When free entry holds, the condition is $NV = N\chi\gamma_X X$. The second condition is that the reservation rate of return to saving of the traditional household equal the rate of return to equity delivered by firms. The third condition follows from the no-arbitrage argument that for both in-house innovation and entry to occur, their rates of return must be equal. If not, one of the two is return-dominated and savers are not willing to finance it.

Since rates of return are central to our analysis, we define the state variable

$$x \equiv \frac{X}{Q} = \frac{X}{Z} = \theta^{\frac{2}{1-\theta}} \frac{L}{N^{1-\epsilon}},$$

which is the quality-adjusted size of the intermediate firm. The last equality follows from using the demand (2) and shows how firm size relates to the primitive state variables of the model, the exogenous mass of workers and the endogenous mass of firms. We also define the following variables: the entry rate, $n \equiv \dot{N}/N$; the firm growth rate, $z \equiv \dot{Z}/Z$; the two households' consumption ratios, $c \equiv C/Y$ and $c^m \equiv C^m/Y$. In equilibrium all of these jumping variables become functions of the pre-determined state variable x.

Next, we use the result that expenditure on intermediates is $Np\gamma_X X = \theta Y$ and the monopolistic price, $p = \frac{1}{\theta}$, to write $N\gamma_X X = \theta^2 Y$. We use this result to rewrite the

production function of the final good, (1), in the reduced-form representation

$$Y = \theta^{\frac{2\theta}{1-\theta}} \gamma_X N^{\epsilon} Z L. \tag{28}$$

This expression says that output increases with the average knowledge stock, Z, the mass of firms, N, and employment, L. In our economy with intermediates and fixed operating costs final output is not gross domestic product (GDP), which is, instead,

$$GDP = Y - N\gamma_X (X + \phi Z) = \left[1 - \theta^2 \left(1 + \frac{\phi}{x}\right)\right] Y.$$

This expression says that an economy with smaller firms uses a larger amount of resources to cover fixed operating costs and therefore has smaller GDP for given final output.

This representation and the no-arbitrage argument on returns equalization allow us to rewrite the returns in Proposition 1 as:

$$r = \frac{\gamma_X (1 - \tau_\Pi - b_X)(1 - d_X)\gamma_I (1 - d_I)}{1 - \sigma\tau_\Pi + \gamma_I b_I (1 - d_I)} \alpha \left[\left(\frac{1}{\theta} - 1\right) x - \phi\right]; \tag{29}$$

$$r = \frac{(1 - \tau_\Pi - b_X)(1 - d_I)\left[\left(\frac{1}{\theta} - 1\right) x - \phi\right] - \frac{1 - \sigma\tau_\Pi - b_I \gamma_I (1 - d_I)}{\gamma_X \gamma_I (1 - d_I)} z}{\chi x / (1 - \tau_D)} + \frac{\dot{x}}{x} + z. \tag{30}$$

This representation nests the no-delegation case, which we obtain by simply imposing $\gamma_X = \gamma_I = 1$, which yields $b_X = d_X = b_I = d_I = 0$. The no-delegation returns are:

$$r = \frac{1 - \tau_\Pi}{1 - \sigma\tau_\Pi} \alpha \left[\left(\frac{1}{\theta} - 1\right) x - \phi\right]; \tag{31}$$

$$r = \frac{1 - \tau_D}{\chi x} \left[(1 - \tau_\Pi)\left[\left(\frac{1}{\theta} - 1\right) x - \phi\right] - (1 - \sigma\tau_\Pi) z\right] + \frac{\dot{x}}{x} + z. \tag{32}$$

All of the others expressions remain the same with $\gamma_X = \gamma_I = 1$ imposed where needed.

4.2 Governance and taxation: a preliminary analytical insight

The main interactions between the distortionary effects of business taxation and agency issues appear in the returns (29)-(30). Proposition 1 makes clear that such interactions are complex and difficult to trace. To obtain some analytical insight, in this section we abstract from the adjustment of compensation and diversion caused by a change in a tax rate and investigate the direct (or first order) effects of tax rates on innovation incentives. We discuss the full effects of tax rates quantitatively in Section 6.

Suppose a change in the profit tax rate, τ_Π. Holding constant (b_X, d_X, b_I, d_I), the changes in the returns to in-house investment in the delegation and the no-delegation economies are:

$$\frac{\partial r_Z}{\partial \tau_\Pi} = -\gamma_X \gamma_I (1-d_X)(1-d_I) \frac{1-(1-b_X)\sigma + \gamma_I b_I (1-d_I)}{[1-\sigma\tau_\Pi + \gamma_I b_I (1-d_I)]^2} \alpha \left[\left(\frac{1}{\theta}-1\right)x - \phi\right]; \quad (33)$$

$$\frac{\partial r_Z}{\partial \tau_\Pi} = -\frac{1-\sigma}{(1-\sigma\tau_\Pi)^2} \alpha \left[\left(\frac{1}{\theta}-1\right)x - \phi\right]. \quad (34)$$

Evaluating these expressions at the same pair (x, z), the return to in-house innovation is more sensitive to the change in τ_Π in the delegation economy if

$$1-(1-b_X)\sigma + \gamma_I b_I (1-d_I) > \frac{1-\sigma}{\gamma_X \gamma_I (1-d_X)(1-d_I)} \left[\frac{1-\sigma\tau_\Pi + \gamma_I b_I (1-d_I)}{1-\sigma\tau_\Pi}\right]^2.$$

The tax credit, σ, mitigates the negative effect of the profit tax rate in both economies. In particular, the inequality above reduces to $b_X + \gamma_I b_I (1-d_I) > 0$ for $\sigma = 1$ and thus surely holds. This suggests that the larger the tax credit, the larger the response of the return to in-house innovation to the profit tax cut in the delegation economy relative to the no-delegation one. Turning to the return to entry (equity), in the delegation and no delegation economy we have:

$$\frac{\partial r_N}{\partial \tau_\Pi} = -\frac{1-\tau_D}{\chi x} \left[(1-d_I)\left[\left(\frac{1}{\theta}-1\right)x - \phi\right] - \frac{\sigma z}{\gamma_X \gamma_I (1-d_I)}\right];$$

$$\frac{\partial r_N}{\partial \tau_\Pi} = -\frac{1-\tau_D}{\chi x} \left[\left(\frac{1}{\theta}-1\right)x - \phi - \sigma z\right].$$

There are two channels at work here. On one hand, the delegation economy is less sensitive to the cut of the profit tax rate because the founder surrenders a fraction of the distributed dividend to the managers as incentive pay. On the other hand, the delegation economy is more sensitive because the cost of entry is higher since firms produce more. The latter channel is stronger the more in-house R&D firms do and the higher the R&D tax credit.

To summarize, in the short run, i.e., before the endogenous adjustment in behavior and market structure takes place, a cut of the profit tax rate τ_Π boosts the return to in-house innovation more robustly in the delegation economy than in the no-delegation economy, whereas it causes a stronger response of the return to entry in the no-delegation economy than in the delegation economy. The dividend tax rate, τ_D, does not affect the return to in-house innovation regardless of the presence of delegation. It has a negative effect on the

return to entry in both economies. We close this exercise with the reminder that here we have considered only the direct effects of tax cuts by holding constant (b_X, d_X, b_I, d_I) and behavior (i.e., z). We study the full effects quantitatively in Section 6.

5 Steady state and dynamics

In this section, we study analytically the model's general equilibrium dynamics. We start with the characterization of the steady state. We than study the qualitative dynamics. We conclude with a characterization of the distributional implications of our framework.

5.1 Steady state

In steady state firm size, x, the consumption ratio, c, the entry rate, n, the firm growth rate, z, the interest rate, r, and the growth rate of final output, y, are all constant. Time differentiation of the definition of x yields

$$\frac{\dot{x}}{x} = \lambda - (1-\epsilon)\, n \Rightarrow n^* = \frac{\lambda}{1-\epsilon},$$

where an asterisk denotes a steady-state value. Time differentiation of the reduced-form production function (28) yields

$$y = \epsilon n + z + \lambda \Rightarrow y = \frac{\lambda}{1-\epsilon} + z, \tag{35}$$

which, combined with the Euler equation (12), gives

$$r = \rho + \epsilon n + z \Rightarrow r = \rho + \frac{\epsilon\lambda}{1-\epsilon} + z. \tag{36}$$

Using this expression to replace the interest rate in the returns to in-house investment and entry, (29)-(30), we obtain:

$$z = \frac{\gamma_X (1-\tau_\Pi - b_X)(1-d_X)\gamma_I (1-d_I)}{1-\sigma\tau_\Pi + \gamma_I b_I (1-d_I)} \alpha \left[\left(\frac{1}{\theta} - 1 \right) x - \phi \right] - \rho - \frac{\epsilon\lambda}{1-\epsilon}; \tag{CI}$$

$$z = \gamma_X \gamma_I (1-d_I) \frac{(1-\tau_\Pi - b_X)(1-d_I)\left[\left(\frac{1}{\theta}-1\right)x - \phi\right] - \left(\rho + \frac{\epsilon\lambda}{1-\epsilon}\right)\frac{\chi}{1-\tau_D} x}{1-\sigma\tau_\Pi - \gamma_I b_I (1-d_I)}. \tag{EI}$$

These two loci describe the combinations of (x, z) that satisfy the condition that each form of investment, in-house innovation and entry, delivers a rate of return that meets the reservation rate of return of savers. We label them the corporate investment locus (CI) and the entrepreneurial investment locus (EI), respectively. Since they are linear, we obtain the closed-form solution:

$$x^* = \frac{[(1-d_X)\alpha - (1-d_I)](1-\tau_\Pi - b_X)\phi + \frac{1-\sigma\tau_\Pi+\gamma_I b_I(1-d_I)}{\gamma_X\gamma_I(1-d_I)}\left(\rho + \frac{\epsilon\lambda}{1-\epsilon}\right)}{[(1-d_X)\alpha - (1-d_I)](1-\tau_\Pi - b_X)\left(\frac{1}{\theta}-1\right) + \left(\rho + \frac{\epsilon\lambda}{1-\epsilon}\right)\frac{\chi}{1-\tau_D}}; \tag{37}$$

$$z^* = \frac{\gamma_X(1-\tau_\Pi - b_X)(1-d_X)\gamma_I(1-d_I)}{1-\sigma\tau_\Pi + \gamma_I b_I(1-d_I)}\alpha\left[\left(\frac{1}{\theta}-1\right)x^* - \phi\right] - \rho - \frac{\epsilon\lambda}{1-\epsilon}. \tag{38}$$

The steady state (x^*, z^*) is stable if the EI intersects the CI from below. This condition reduces to

$$[(1-d_X)\alpha - (1-d_I)](1-\tau_\Pi - b_X)\left(\frac{1}{\theta}-1\right) + \frac{\chi}{1-\tau_D}\left(\rho + \frac{\epsilon\lambda}{1-\epsilon}\right) > 0.$$

This stability condition is the same as that for saddle-path stability.

Finally, the steady state interest rate is $r^* = \rho + \frac{\epsilon\lambda}{1-\epsilon} + z^*$and the final output growth rate is $y^* = \frac{\epsilon\lambda}{1-\epsilon} + z^*$. This is also the GDP growth rate because in steady state the ratio $\frac{GDP}{Y}$ is constant. The growth rate of GDP per capita is $y^* - \lambda = \frac{\lambda}{1-\epsilon} + z^*$.

5.2 Dynamics

To study dynamics we use the two functions $n(x, c)$ and $z(x, c)$ describing the equilibrium entry rate and in-house innovation rate, respectively, and the fact that the transfer ratio, $h \equiv \frac{H}{Y} = \tau_H \frac{T}{Y}$, has the simple representation

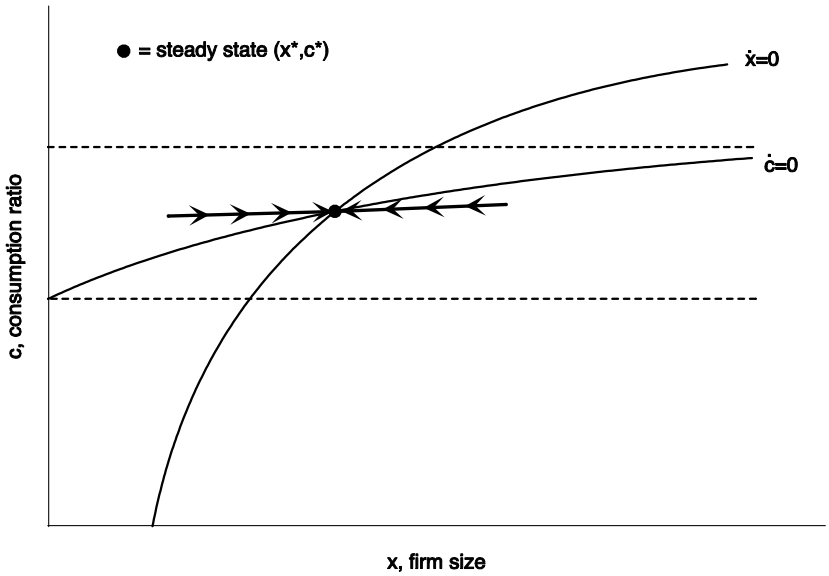
$$h(x, c) = \tau_H \theta^2 \left[\hat{\tau}_\Pi\left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) + \hat{\tau}_I \frac{z(x, c)}{x}\right].$$

Figure 3 illustrates the dynamics, the following proposition provides the formal result.

Proposition 3 *(Dynamics with delegation) The general-equilibrium dynamical system of the delegation economy in (x, c) space is:*

$$\frac{\dot{c}}{c} = \frac{c - 1 + \theta - h(x, c) - \chi\gamma_X\theta^2(\rho - \lambda)}{\chi\gamma_X\theta^2}; \tag{39}$$

Figure 3: Phase diagram for the delegation economy



$$\frac{\dot{x}}{x} = \lambda - (1-\epsilon)\, n\,(x, c)\,. \tag{40}$$

There is a unique equilibrium trajectory: given initial condition x_0, the economy jumps on the saddle path and converges to the steady state (x^*, c^*), where x^* is given by (37) and

$$c^* = \arg\operatorname{solve}\left\{\lambda = (1-\epsilon)\, n\,(x^*, c)\right\}. \tag{41}$$

Proof. See Appendix. ■

The nested structure of our model provides three special cases. The first is the case of no delegation with redistribution. We obtain it by simply setting $b_X = d_X = b_I = d_I = 0$ and $\gamma_X = \gamma_I = 1$ in the equations that produce Proposition 3. The dynamics look qualitatively similar. The second special case is that of no redistribution, i.e., the government allocates all tax revenues to its own consumption, G. This case nests the third special case, no delegation with no redistribution The following proposition provides the formal characterization of the two no-redistribution cases.

Proposition 4 *(Dynamics with no redistribution) When the government does not redistribute ($\tau_H = 0$), the $\dot{c} = 0$ locus is flat and is thus the saddle path. Accordingly, the consumption*

ratio jumps to $c^*_{\tau_H=0} \equiv 1-\theta+\chi\gamma_X\theta^2(\rho-\lambda)$. *The dynamics then reduce to*

$$\frac{\dot{x}}{x} = \lambda - (1-\epsilon)\, n\left(x, c^*_{\tau_H=0}\right).$$

This differential equation converges to $x^*_{\tau_H=0} = \arg\operatorname{solve}\left\{\lambda = (1-\epsilon)\, n\left(x, c^*_{\tau_H=0}\right)\right\}$. *If the founders do not delegate, the consumption ratio jumps to* $\bar{c}_{\tau_H=0} \equiv 1-\theta+\chi\theta^2(\rho-\lambda)$. *The dynamics then reduce to*

$$\frac{\dot{x}}{x} = \lambda - (1-\epsilon)\, n\left(x, \bar{c}_{\tau_H=0}\right).$$

This differential equation converges to $\bar{x}_{\tau_H=0} = \arg\operatorname{solve}\left\{\lambda = (1-\epsilon)\, n\left(x, \bar{c}_{\tau_H=0}\right)\right\}$.

One of the interesting properties of the equilibrium dynamical system is that in our calibration the saddle path of the delegation economy is nearly flat. The analytics explain why: in Figure 3, the saddle path is inside the band given by the dashed lines. In the calibration, the $\dot{c}=0$ locus is quite flat and thus the saddle path is nearly flat. This means that, once we account for the initial jumps, the differences in dynamics between the four cases in the two propositions depend only weakly on the behavior of the consumption ratio, which is always nearly constant if not exactly constant. The differences, instead, depend mostly on the behavior of firm size.

5.3 Implications for inequality

Managers earn total pre-tax income $NB = N\left[b_X(1-d_X)\Pi + \gamma_I(1-d_I)b_I I\right]$. Dividing the resulting after-tax income by Y gives the percentage increase in their total income over the other household members,

$$(1-\tau_b)\frac{NB}{Y} = (1-\tau_b)\frac{N}{Y}\left[b_X(1-d_X)\Pi + \gamma_I(1-d_I)b_I I\right].$$

This expression does not show the profit tax rate directly, but it contains it through its effects on diversion and managerial compensation discussed in Proposition 1. In particular, recall that the diversion and compensation of both managers are increasing in the profit tax rate. Moreover, the profit tax rate affects the firm's profit, Π, and investment, I, through the model's macroeconomic channels.

Managers consume fully the extra resources they obtain. Dividing the amount by Y gives the percentage increase in managers' consumption over the other household members,

$$\frac{C^m}{Y} = (1-\tau_b)\frac{NB}{Y} + \underbrace{\frac{N\left(d_X\Pi + d_I I\right)}{Y}}_{\text{aggregate diversion}}. \tag{42}$$

It is worth stressing the diversion component of this measure of consumption inequality. To our knowledge, this is a dimension of inequality that does not command attention in the current debate. It is also worth stressing the role of taxation in potentially reducing inequality under our redistribution scheme when $\tau_H > 0$. The twist here is that raising the tax rate on executive compensation, τ_b, raises diversion directly, where directly means that τ_b affects the decision rules, (16) and (19), of the managers. This suggests that diversion is a tool available to managers to mitigate the consumption losses associated to higher taxation of their contractual income. Such behavior has consequences for the economy, since diversion and managerial compensation are main determinants of the overall equilibrium.

6 Policy experiments

The objective of this section is to assess how the economy's response to a tax cut depends on delegation and the agency frictions it entails. We first calibrate the model with delegation to the US economy and then compare the effects of a profit and of a dividend tax cut in the delegation economy and in the no-delegation one. In all other dimensions the two economies are the same: they have the same population size, the same final good production technology and intermediate producers charge the same price. To maximize comparability, we also impose the same initial growth rate at the time of the tax cut.

6.1 Calibration

Tables 1-2 report the values of the 17 parameters of the model and our targets. Table 3 summarizes the economy's steady state. Although in general equilibrium most parameters influence most variables, to facilitate the exposition we organize the discussion around groups of parameters that are more directly connected to specific variables.

Taxes $(\tau_\Pi, \tau_D, \tau_b, \sigma)$. The profit income tax rate is $\tau_\Pi = 0.38$. This is the rate calculated by Barro and Furman (2018) combining the federal and state statutory profit tax rates before the adoption of the Tax Cuts and Jobs Act of 2017. Ordinary dividends are taxed at the federal level as regular income; some categories of dividends (qualified dividends) have a more favorable tax treatment. Hence, we set $\tau_D = \tau_b = 0.25$, a value in between the average tax rate for a single worker (29.9%) and one-earner married couple with two children (18.8%) in 2019 (OECD 2020). The degree of expensibility of investment in R&D changes frequently. Currently, in most countries it is only a fraction of the actual spending. A recent study (OECD, 2021) estimates that the implied R&D subsidy rate for profit making firms in the USA is 5%. Hence, we present results for the baseline case with $\sigma = 0.05$. The study also indicates that this rate in France $\sigma = 0.37$, the largest among the OECD countries, and that the average rate for the OECD countries is 20%. As a sensitivity check, we replicate the main quantitative experiments with France's rate.

Agency Parameters $(\beta_X, \psi_X, \gamma_X, \beta_I, \psi_I, \gamma_I)$. The production diversion cost is $-\beta_X \log(1-\psi_X d_X)$, where the new parameter ψ_X regulates curvature. We target b_X, d_X, and the production delegation surplus, s_X, and compute $(\beta_X, \psi_X, \gamma_X)$ from the three equations:

$$d_X = \frac{1}{\psi_X} - \frac{\beta_X}{1-(1-\tau_b)b_X};$$

$$1 - d_X = \frac{(1-\tau_\Pi - b_X)\,\beta_X(1-\tau_b)}{[1-(1-\tau_b)b_X]^2};$$

$$s_X = \gamma_X \left(1 - \frac{b_X}{1-\tau_\Pi}\right)(1-d_X) - 1$$

Empirical studies that focus on the USA have concluded that diversion is quite modest and incentive contracts are widely used (see the discussion in Iacopetta, Minetti and Peretto 2019). We target $b_X = 0.1$, $d_X = 0.02$ and $s_X = 0.2$. Similarly, we specify $-\beta_I \log(1-\psi_I d_I)$ and target b_I, d_I, and the R&D delegation surplus, s_I. We then compute $(\beta_I, \psi_I, \gamma_I)$ from the three equations:

$$d_I = \frac{1}{\psi_I} - \frac{\beta_I}{1-(1-\tau_b)\gamma_I b_I};$$

$$(1-d_I)^2 = \frac{(1-\sigma\tau_\Pi)\,\beta_I(1-\tau_b)}{[1-(1-\tau_b)\gamma_I b_I]^2};$$

$$s_I = \frac{(1-\sigma\tau_\Pi)\,\gamma_I\,(1-d_I)}{1-\sigma\tau_\Pi + b_I\gamma_I\,(1-d_I)} - 1.$$

We target $b_I = 0.1$, $d_I = 0.02$ and $s_I = 0.2$. The procedure yields $\gamma_X = 1.459$ and $\gamma_I = 1.445$. Relative to recent findings on cross-country differences in managerial efficiency (Grobovšek 2020; Akcigit, Harun, and Peters 2021), these figures appear to be in the low range. In an earlier study we have also concluded that the difference in efficiency of in-house knowledge accumulation attributable to agency issues between, for instance, the USA and Latin America is close to 30% (see Iacopetta and Peretto 2021).[8] Therefore, our results are a conservative estimate of the different effects of a business tax reform in the two economies. To check robustness, we also present results for $s_X = 0.3$ and $s_I = 0.3$.

Population and Technology $(\lambda, \epsilon, \theta, \rho, \alpha, \chi, \phi)$. We set $\lambda = 1.2\%$, which is the average annual population growth rate in the USA from 1910 to 2010 (Maddison data). We determine the social return to variety via (40) with $\dot{x} = 0$, which gives $\epsilon = 1 - \lambda/n$. We target an entry rate of 1.6% and obtain $\epsilon = 0.25$. The value of the entry rate is in the middle of the range spanned by the net entry rates in the U.S. manufacturing sector calculated by Lee and Mukoyama (2018) and those obtained from the U.S. Census Bureau database for the overall economy in the period 1982-2008. We target a monopolistic markup $\frac{1}{\theta} = 1.3$, which gives us $\theta = 0.769$. The markup target is inside the range of markups for the manufacturing sector in advanced countries (see, e.g., Meier and Reinelt 2020 and Vermeulen 2012). We target the standard value 2% for the growth rate of GDP per capita and the value 5% for the interest rate. These two targets give us $\rho = 0.03$. The resulting firm growth rate is $z = y - \lambda - \epsilon n = 1.6\%$. For the social return to knowledge, $1 - \alpha$, we note that in their extensive review of the literature Jones and Williams (1998) report estimates in the interval $[27\%, 100\%]$. We use the value $1 - \alpha = 0.7$. Finally, we set the sunk entry cost parameter at $\chi = 1$ and the fixed operating cost parameter at $\phi = 0.368$ to match the 2% target for per capita GDP growth. Although we do not target the saving rate, this parametrization yields a personal saving rate of 3.43%. Allowing for 5% depreciation of assets, we would have 8.43%, which is close to the average of 8.95% for the USA between 1959 and 2022 (U.S. Bureau of Economic Analysis). For the case $\sigma = 0.37$ and for the no-delegation economy,

[8] While we verify that the managers' participation constraints hold, we do not use those conditions to calibrate parameters.

we recalibrate ϕ to hit the 2% per capita GDP growth target.

6.2 Tax cuts

This section studies the dynamic response of the entry rate, the firm growth rate, the wage and per capita GDP, to cuts in the tax rates on profit, dividend and executive income.[9] As noted earlier, the no-delegation economy is nested in the delegation one. In each exercise the starting position of the econonomy is a steady state. Table 2 describes that of the delegation economy. The no delegation economy is in a similar state. We denote values for that steady state with the subscript 0, e.g., initial firm size is x_0, and denote values for the new steady state with an asterisk, e.g., the new steady-state firm size is x^*.

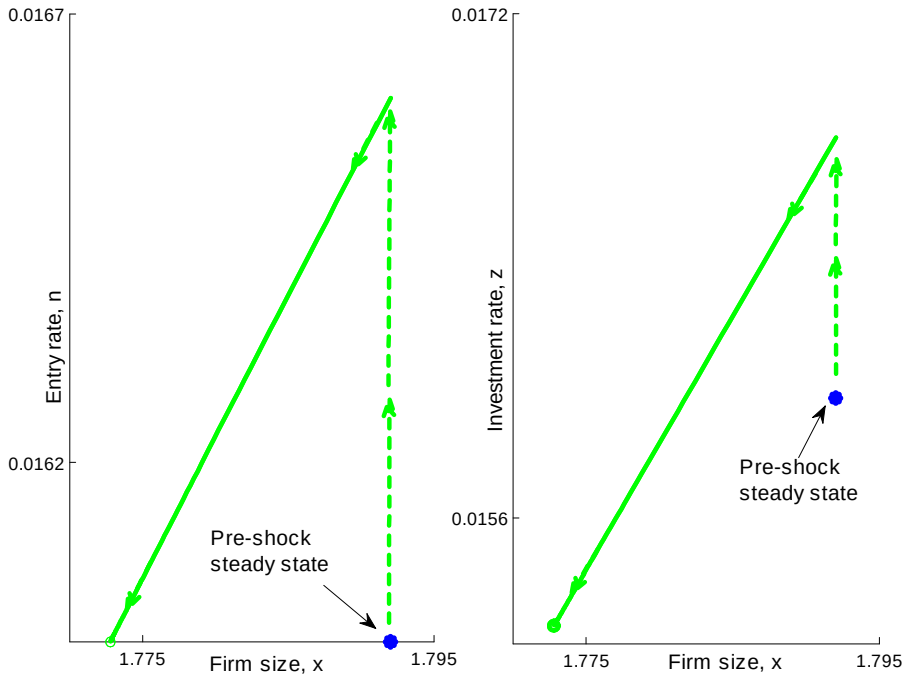
6.2.1 Profit tax

We postulate an unanticipated, permanent 1 percentage point cut of the profit tax rate, τ_Π. The two key relationships driving the dynamics are the "policy" functions $n(x)$ and $z(x)$ in Figure 4A that describe equilibrium behavior on the saddle path of the dynamical system illustrated in Figure 3. To construct them, we compute the function $c(x)$ that describes the saddle path and use it to reduce the model's intratemporal expressions describing equilibrium behavior to functions of x only. With these objects in hand, we see that in both economies there are immediate jumps up of entry and firm growth, which cause an immediate jumps up of wage growth and of GDP per capita growth. As firm size converges to the new, smaller steady-state value, both the rate of entry and the rate of firm growth slow down. The former eventually mean reverts to $n^* = n_0 = \frac{\lambda}{1-\epsilon}$; the latter, instead, keeps falling until it becomes smaller than the pre tax cut value, z_0, and eventually converges to the permanently lower steady-state value $z^* < z_0$. The quantitative difference between the two economies along the adjustment path is substantial. Figure 4B plots the time series of four variables: firm knowledge, mass of firms (goods), the wage and GDP per capita. Wage growth jumps up by 0.10 and 0.082 pp, respectively, in the delegation and no-delegation economy. Note the stronger response by 0.018 pp in the delegation economy. The positive effect of the tax

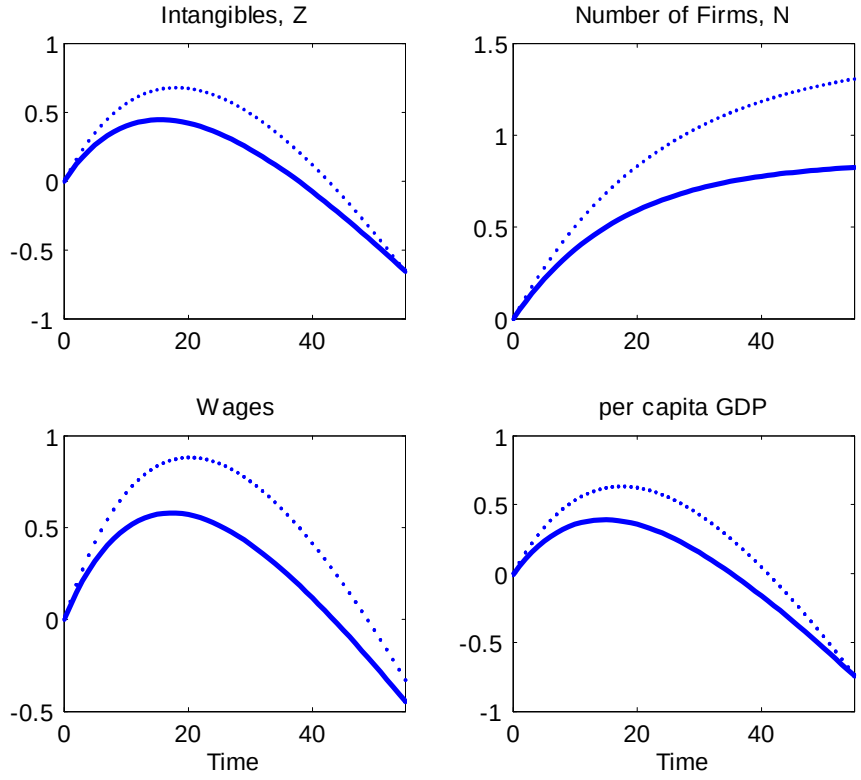
[9] All the codes to generate the figures and quantitative results are written in Matlab. They are available upon request.

Figure 4: Reduction of 1 pp of profit tax rate

Panel A: Policy Functions (Delegation)



Panel B: Time Responses



Note. The dotted (continuous) lines refer to the delegation (no delegation) economy; $\sigma = 0.05$.

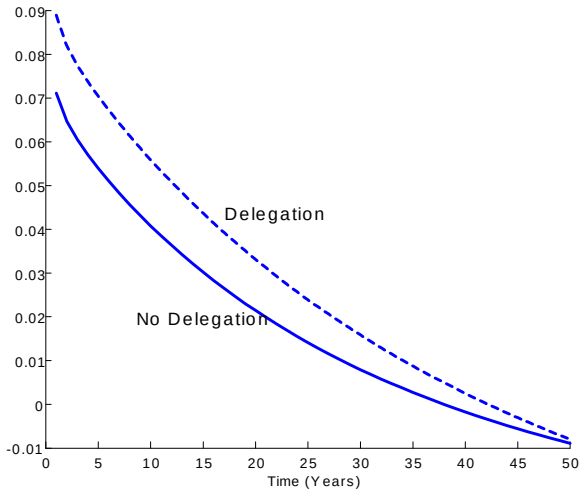
cut peaks and then wanes over time. As this process unfolds, however, the differential in percentage points between the two economies remains roughly constant in the two decades after the shock (see Table 3 and Figure 4B). The results for GDP per capita are similar, with the difference that GDP per capita is lower in the delegation economy because in that economy the new steady state value of firm size is smaller. This means that firms move up their average cost curve more than in the no-delegation economy. The same mechanism explains why, while in the long run both economies converge to a state of lower growth, the decline of the growth rate is larger in the delegation economy: since it converges to smaller firm size, it exhibits lower firm growth. In this precise sense, delegation amplifies the effects of reforms of business taxation.

Assessing the channels. In this experiment the firm governance fully adjusts to the tax cut. In particular, the founder raises the managers' compensation b_X and b_I as these become more effective in preventing diversion (see the upper section of Table 3A). We can check the importance of this channel by keeping (b_X, d_X) and (b_I, d_I) fixed at the pre cut level (as we did in the derivation of our preliminary analytical insight on the effects of tax rates on incentives). We find that only a small fraction of the response to the tax cut is accounted for by the changes in compensation and diversion (see Figures 5A and 5B). For instance, in the immediate aftermath of the tax cut wage growth accelerates by 0.094 pp compared to the 0.10 pp in the baseline case (Table B.1).

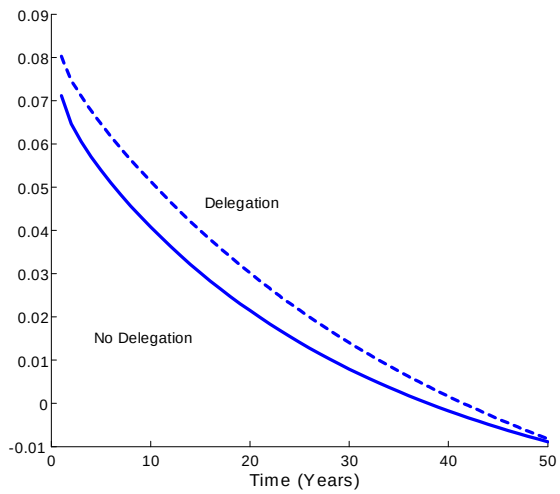
Delegation surplus of 30%. As discussed, we target a 20% delegation surplus. In an early study (Iacopetta and Peretto 2021) we estimated a larger gap in the cost of in-house knowledge accumulation between developing and developed countries. If we think of our no-delegation economy as representative of developing countries, then we would have a reason to think that the surplus from delegation is larger than 20%. To get a sense of how our results change with this target, we compute the response of an economy with governance parameters that yield a surplus of 30%. Compared to the baseline case, the delegation economy has a stronger response (Figure 5C and Table B.2). For instance, per capita GDP in the near term rises by an additional 0.03 pp and after 20 years the difference from the baseline is 0.014 pp. While both entry and firm growth are more responsive, most of the additional growth comes

Figure 5: Per capita GDP average annual growth rate (pp)

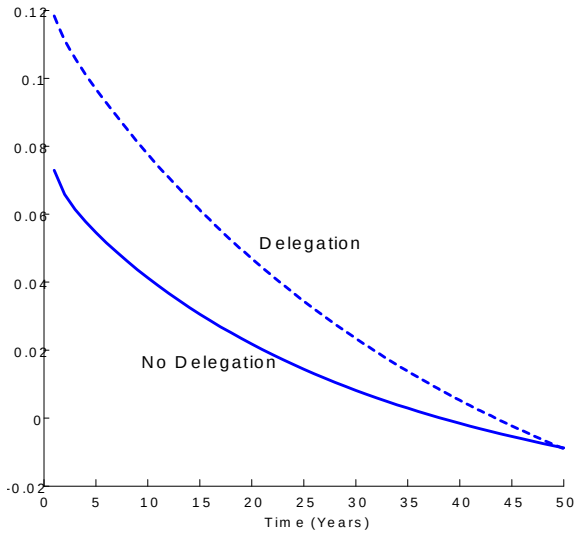
Panel A: Base Case



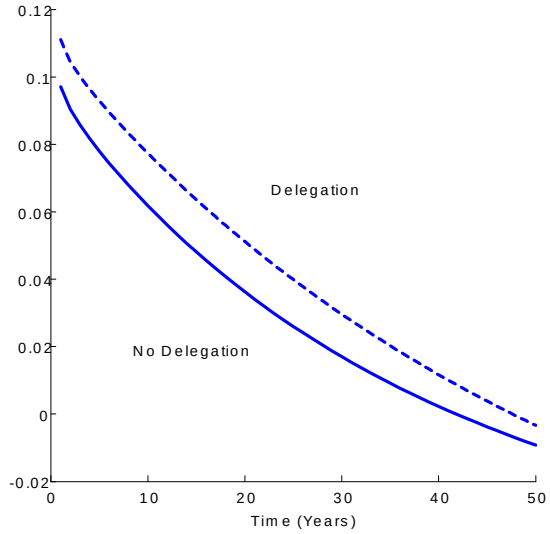
Panel B: Sticky Contracts



Panel C: Larger Efficiency Gap (30%)



Panel D: Higher initial τ_{Π} (+10pp)



Note. Reduction of τ_{Π} by 1 pp; $\sigma = 0.05$. The dotted (continuous) lines refer to the delegation (no delegation) economy..

from firm growth.

The initial tax rate. To check whether the results are sensitive to the initial tax rate, we repeat the quantitative experiments for the two economies with the tax rate 10 pp higher or 10 pp lower than the baseline one. Not surprisingly, when the initial tax rate is higher the effects of the tax cut are larger (see Figures 5A and 5D). For instance, in the year after the tax cut per capita GDP growth accelerates in the delegation and the no-delegation economy by 0.111 pp and 0.097 pp respectively (Table B.3). The corresponding figures for the baseline economy are 0.089 and 0.071 pp (Table 3). Conversely, the tax cut generates milder effects when the initial tax rate is lower (see Table 7). Nevertheless, the difference in per capita GDP growth between the two economies is not particularly sensitive to the initial tax rate. For instance, after five years from the tax cut the difference is 0.0165 pp between the baseline economies, 0.0150 pp between the high-tax economies and 0.0157 pp between the low-tax economies (compare tables 3C, B.3C, and B.4C).

Higher R&D tax credit. In an economy with higher expensibility rate, σ, the profit tax cut means a reduction of the R&D subsidy rate and an increase in the cost of in-house knowledge accumulation. While the effect occurs in both the delegation and the no-delegation economy, the former is less sensitive to the reduction of the subsidy because a fraction of the cost of in-house R&D is accounted for by the agency costs. Hence, while in the short and medium run the responses of GDP per capita, the wage, firm growth and entry are weaker than in the baseline case with $\sigma = 0.05$, the agency frictions create a larger difference in the responses of the two economies than in the baseline case. For instance, while in the baseline case after one and five years per capita GDP growth is, respectively, 0.0178 and 0.0165 pp higher in the delegation than in the no-delegation economy (Table 3C), the corresponding values when $\sigma = 0.37$ are about two times larger (see Table B.5C).

6.2.2 Dividend tax

A cut of the dividend tax rate, τ_D, generates similar effects in the two economies because τ_D does not affect in-house investment directly and does not affect agency costs. The only effect of the tax cut is a temporary acceleration of entry. The resulting expansion of the mass of

firms weakens the incentive of incumbent firms to accumulate knowledge. The entry rate, n, and the firm growth rate, z, decline in the short, medium and long run, whereas after the initial jump up the entry rate mean-reverts to its steady-state value. The amplitude and size of the response is similar in the two economies (Tables B.3A-B.3B).

6.2.3 Executive income tax

Although τ_b does not appear explicitly in the steady state expressions for steady-state firm size and firm growth, see (37) and (38), it affects the economy through agency costs. A cut of the tax rate τ_b reduces agency costs, both because diversion goes down and because the founder lowers the managers' compensation. As a result, firm growth accelerates while firm size slightly declines. In the short run, the fall of agency costs induces firm growth to overshoot its steady-state value. This produces an acceleration of wage growth. Specifically, the increase in the average annual growth rate of the wage over an horizon of one, five and ten years is 0.0193, 0.0177 and 0.0158 percentage points, respectively (see Table B.7).

6.3 Long run

Because the model allows for entry in response to a policy change, the short and long run effects of business tax cuts can be sharply different. While such cuts tends to boost the wage in the short run, they may depress it in the long run. The long-run adverse effect is caused by a crowding-in effect whereby, lured by the higher after-tax profitability of the market, new firms take a share of the incumbents' sales. This dilution of market shares depresses firm's incentives to invest in quality improvement, which in our model is a key source of labor productivity growth and thus wage growth. This mechanism, first reported in Peretto (2007), explains why we see a negative long-run effect of a profit or a dividend tax cut on per capita GDP growth. Nevertheless, in either economy the decline of the rate of growth in the case of a profit tax cut is around half of that observed for a dividend tax cut (see Tables 3 and B.6). In either case, the delegation economy responds more strongly to the tax cut, emphasizing once again that the reliance on professional managers amplifies the effects of business taxation.

7 Welfare

In this section, we compare the welfare effects of our tax cuts in the two economies. Because in our setup the government rebates the tax revenues to the representative household, we can contrast the negative wealth effect caused by the lower flow of transfers with the positive effects of a tax cut that stem from the lower tax distortions. The wealth effect of government transfers induces households to revise their consumption-saving schedule, whereas the lower tax rates affect the dynamics of productivity. Our analysis reveals that in the delegation economy the household does not experience the negative wealth effect suffered by the household in the no-delegation economy. This is because the interaction between taxation and agency relationships creates new channels linking tax rates to tax revenues (i.e., compensation and diversion) that cause tax revenues to rise in response to the tax cut. The analysis shows that the productivity effects are more pronounced in the delegation economy. We use the welfare analysis to also contrast the change in income and consumption of managers to those of the other members of the household.

The starting point of the analysis is the household's utility in (10), which in the delegation economy does not include the extra consumption of the managers. We use the reduced-form production function (28) to express the household's flow utility as

$$\log\left(\frac{C}{L}\right) = \varphi + \log c + \epsilon \log N + \log Z, \tag{43}$$

where $\varphi \equiv \frac{2\theta}{1-\theta}\log\theta$. The household's cumulated discounted utility is

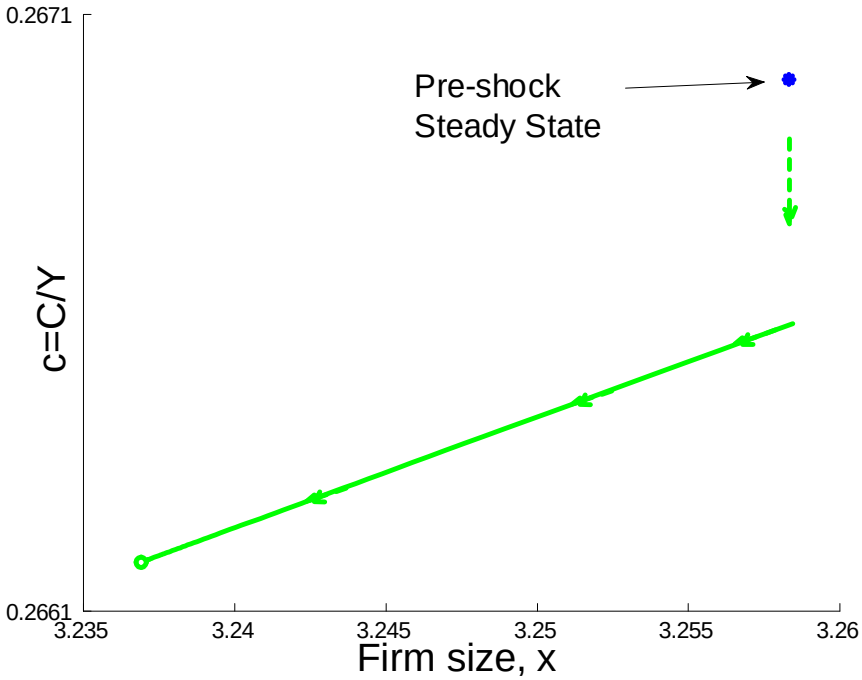
$$U(0) = \int_0^\infty e^{-(\rho-\lambda)t}\left[\varphi + \log c(t)\right] + \int_0^\infty e^{-(\rho-\lambda)t}\left[\epsilon \log N(t) + \log Z(t)\right] dt \tag{44}$$

The decomposition of the utility flow separates the productivity effect of a tax cut due to dynamics of product quality, Z, and variety, N, and the redistributive effect that runs through the consumption ratio, c.

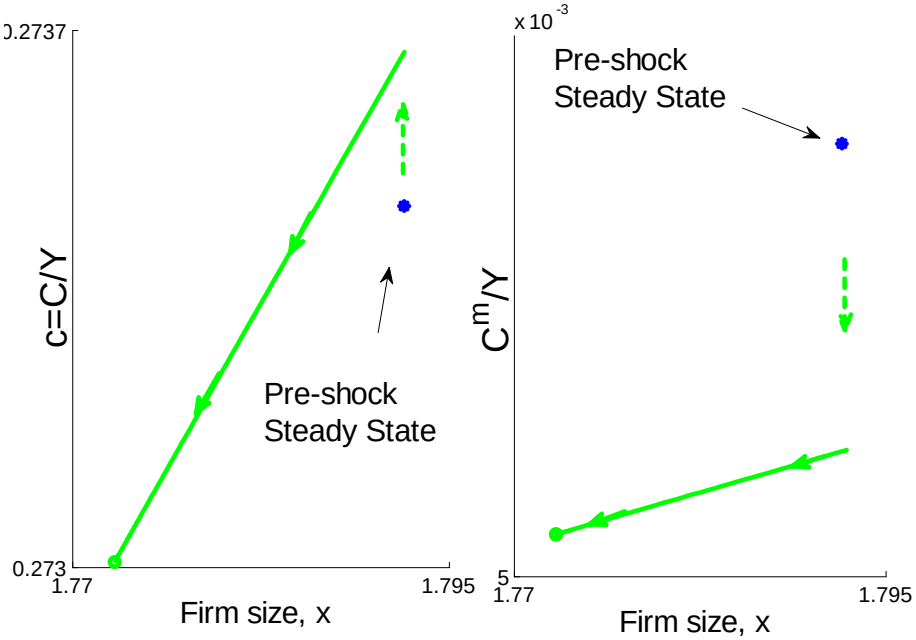
The phase diagrams in Figure 6 show the quantitative response of c to a 1% reduction of the profit tax rate, τ_Π for the two economies. As we noted in our analytical discussion, the saddle path is nearly flat and thus, after the initial jump, c changes very little throughout the rest of the transition. The initial jump is driven by the smaller government transfer caused by the tax cut; the subsequent downward movement along the saddle path is driven by the

Figure 6: Dynamics Consumption Ratios

Panel A: No Delegation



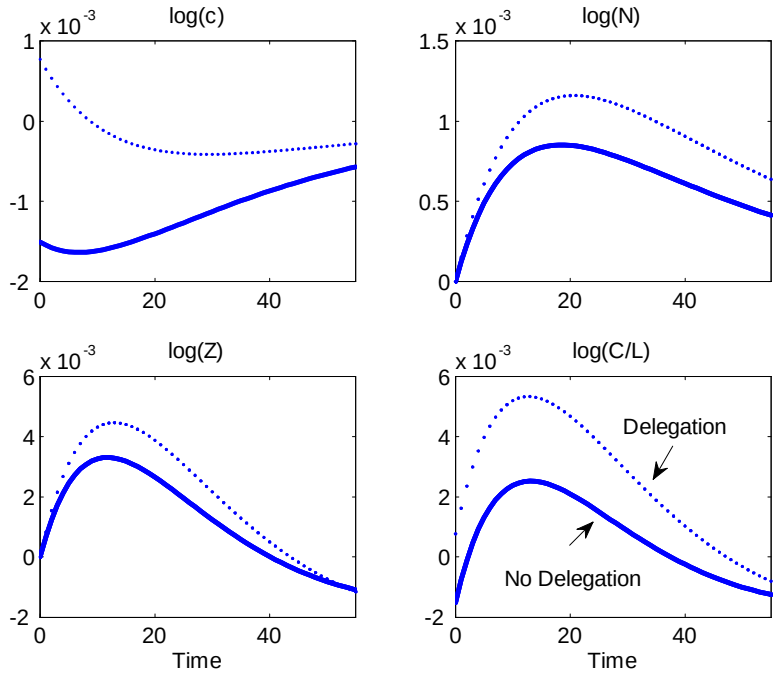
Panel B: Delegation



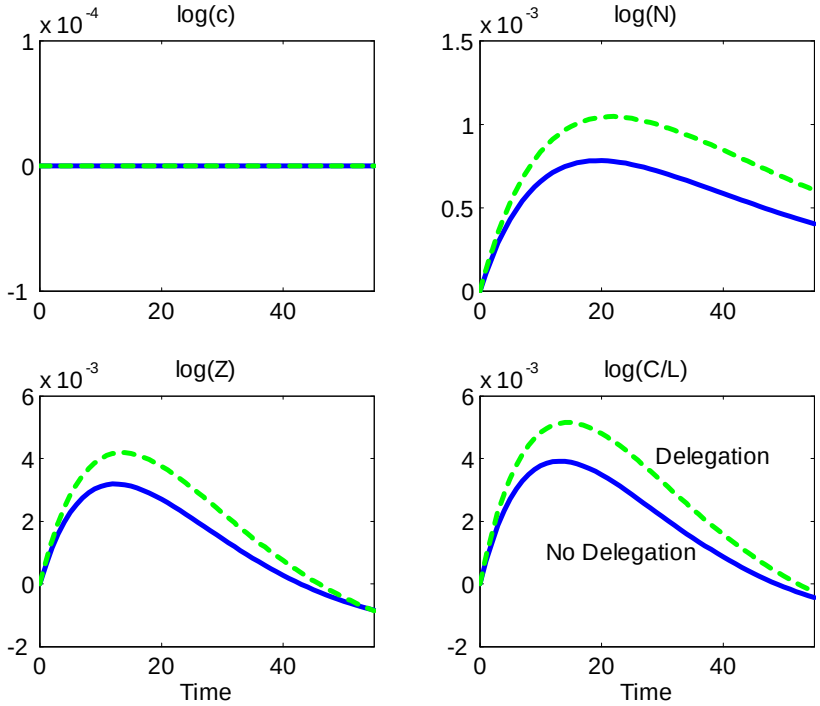
Note. Reduction of τ_{Π} by 1%; $\tau_H = 1$ and $\sigma = 0.05$.

Figure 7: Welfare Analysis

Panel A $\tau_H = 1$



Panel B: $\tau_H = 0$



Note. 1% Reduction of τ_Π.Differences from the baseline of no tax reform. See eq. (43) for welfare decomposition. The logs are time discounted.

rise of the return to entry and in-house innovation that causes a reallocation of resources from consumption to investment. Figure 7 shows the associated time series of the discounted paths of $\log\left(\frac{C}{L}\right)$ and its three components $\log c$, $\log N$ and $\log Z$. The variables are expressed as differences from the baseline of no tax reform.

In the no-delegation economy, the differential $\log\left(\frac{C}{L}\right)$ is negative for about two years after the policy change and then turns positive for about four decades. Thus, in the short and medium run the productivity effects are large enough to compensate the negative effect caused by the smaller government transfer. The reason why the differential $\log\left(\frac{C}{L}\right)$ becomes negative in the long run is that the process of entry crowds the market and reduces the innovation incentive of incumbents. As a result, the growth rate of quality eventually slows down to the point where it goes below that of the baseline of no tax cut. From then on, the economy cumulates a negative differential in quality relative to the baseline, and this force is powerful enough to drag the consumption per capita differential in negative territory.

More surprising is the response to the tax cut in the delegation economy. The three components of $\log\left(\frac{C}{L}\right)$ follow the qualitative pattern of the no-delegation economy but with larger deviations from the baseline of no tax cut. The redistribution effect, instead, does not. Figure 6B shows that in the immediate aftermath of the tax cut the consumption ratio, c, rises instead of falling. The reason is that in the short run the government's tax revenues rise, instead of falling, because diversion within firms goes down and the managers' compensation goes up. The lower diversion rises the profit tax base $(1-d_X)\Pi$ and the higher compensation of managers increases the government tax revenues collected from executives. In our calibration the expansion of the tax base is sufficiently strong to more than compensate the fall in government revenue caused by the cut of the profit tax rate. For this reason, in the delegation economy the $\log c$ differential rises not only in the medium run, as in the no-delegation economy, but also immediately after the tax cut (Figure 6B). In the long run, however, the welfare change is negative and even more so than in the no-delegation economy because the crowding-in effect is stronger.

A second reason why the $\log c$ differential rises is the lower agency costs. In our calibration, the tax cut induces managers to divert less and the founders to reduce compensation. Figure 6B shows the effect of the interaction between agency costs and taxation as the

changes in the ratios C/Y and C^m/Y. Recall that in our representation of the household in the delegation economy, C is the base consumption of all household members and C^m is the extra consumption that managers enjoy because of their position. Scaling by output, Y, expresses that extra consumption in percentage terms. As the figure shows, the tax cut causes C/Y to rise and C^m/Y to fall. This reduction of the managers' percentage consumption differential over the other members of the household is the main redistributive effect of the tax cut and is driven by the fact that diversion falls. After the initial jumps, both consumption ratios gradually decline, as the lower profit tax rate induces households to save more and thus finance both entry and firms' in-house accumulation of intangibles. This component of the mechanism shows up as the declining and then negative $\log c$ differential. The balance of forces, however, is that in the short run the welfare effect is always positive, as the dynamics of the $\log\left(\frac{C}{L}\right)$ differential shows. In the long run, the utility differential turns negative as entry slows down in-house innovation, but this takes more than 50 years to happen. Overall, then, the discounted welfare gains in the delegation economy are positive for almost half a century; in the no delegation economy they are positive for only about three decades.

8 Conclusion

Understanding the effects of corporate tax rates on investment and entrepreneurship matters not only for the evaluation of tax policy, but also for thinking about economic growth. In this paper we argued, and illustrated quantitatively, that the macroeconomic effects of business tax cuts are sensitive to firm governance. The argument's premise is that in an environment where institutions inhibit management delegation — for example, because of poor application of the rule of law and/or weak enforcement of contracts — firm founders keep control of the firm despite their inferior managerial skills. Conversely, in an environment with favorable institutions founders delegate management to agents with better managerial skills, as long as the benefits from those superior skills overcome the costs of the agency relationships.

We compared qualitatively and quantitatively the dynamic effects of business tax cuts at the firm, industry and macroeconomic level, in two otherwise identical economies that differ only the type of firm governance: delegation versus no-delegation. We found that in

the short run a profit tax cut stimulates entrepreneurship, the accumulation of knowledge by incumbent firms, and ultimately the growth of per capita income. We found that these dynamics are stronger in the delegation economy than in the no-delegation economy because the former has a more efficient organization of production and innovation that, at the same time, is more responsive to corporate taxation because the incomes of the managers are tied to profit. We calibrated the model and, among many other results, found substantial quantitative differences across the two economies in the dynamic responses of the growth rates of per capita income and consumption, of the distribution of income and consumption across managers and non-managers, and of welfare, to a 1 percentage point cut of the profit tax rate. These quantitative differences make the case that understanding the effects of corporate tax rates on investment and entrepreneurship requires taking into account firm governance. This, in turn, requires understanding the agency issues that drive it.

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Online Appendix

A.1 Founder's problem and Proposition 1

The Current Value Hamiltonian for the founder's problem is

$$\begin{aligned} CVH_i &= (1-\tau_D)\{(1-\tau_\Pi - b_{X_i})[1-d_X(b_{X_i};\tau_b,\beta_X)]\gamma_X\Pi_i - (1-\sigma\tau_\Pi)I_i + \\ &\quad -b_{I_i}\gamma_I[1-d_{I_i}(b_{I_i};\tau_b,\beta_I,\gamma_I)]I_i\} + \mu_i\gamma_I(1-d_{I_i}(b_{I_i};\tau_b,\beta_I,\gamma_I))I \end{aligned}$$

where μ_i is the shadow value of knowledge. The founder takes as given the managers' reaction functions $d_X(b_{X_i};\tau_b,\beta_X,\gamma_X)$ and $d_I(b_{I_i};\tau_b,\beta_I,\gamma_I)$ in (16) and (19). The first order conditions for compensation, repeated here with self-contained numbering for convenience, are:

$$1-d_X(b_{X_i};\tau_b,\beta_X,\gamma_X) = -(1-\tau_\Pi - b_{X_i})\frac{\partial d_X(b_{X_i};\tau_b,\beta_X,\gamma_X)}{\partial b_{X_i}}; \tag{A1}$$

$$1-d_I(b_{I_i};\tau_b,\beta_I,\gamma_I) = -\left(\frac{\mu_i}{1-\tau_D} - b_{I_i}\right)\frac{\partial d_I(b_{I_i};\tau_b,\beta_I,\gamma_I)}{\partial b_{I_i}}. \tag{A2}$$

The first order condition for investment is

$$(1-\tau_D)\left[\frac{1-\tau_\Pi\sigma}{\gamma_I[1-d_{I_i}(b_{I_i};\tau_b,\beta_I,\gamma_I)]} + b_{I_i}\right] = \mu_i. \tag{A3}$$

The combination of (A2) and (A3) gives

$$[1-d_I(b_{I_i};\tau_b,\beta_I,\gamma_I)]^2 = -\frac{1-\tau_\Pi\sigma}{\gamma_I}\frac{\partial d_I(b_{I_i};\tau_b,\beta_I,\gamma_I)}{\partial b_{I_i}}.$$

The two reaction functions, (16)-(19), and the founder's optimality conditions, (A1)-(A3), are all time-invariant and firm-invariant. Therefore, from now we drop the index i from the compensation and diversion variables $(b_{X_i}, b_{I_i}, d_{X_i}, d_{I_i})$ and from the shadow value μ_i. The condition for the state variable Z_i is

$$r\mu = (1-\tau_D)(1-\tau_\Pi - b_X)\left[1-d_X(b_X;\tau_b,\beta_X,\gamma_X)\right]\frac{\partial \Pi_i}{\partial Z_i} + \dot{\mu}.$$

Using (A3) and the result that $\dot{\mu}=0$, this equation reduces to

$$r = \frac{(1-\tau_\Pi - b_X)(1-d_X)(1-d_I)\gamma_I}{1-\tau_\Pi\sigma + b_I\gamma_I(1-d_I)}\alpha\frac{\Pi_i}{Z_i}, \tag{A4}$$

which is equation (23) in Proposition 1. Finally, time-differentiation of the firm's value (8) yields

$$r = (1-\tau_D)\frac{D}{V} + \frac{\dot{V}}{V}.$$

Using the free-entry condition $\chi\gamma_X X = V$ (with $e=1$) and the definition of (20) we obtain equation (24) in Proposition 1.

A.2 Rule of law and delegation: analytics

To illuminate the mechanism linking fundamentals like the rule of law to delegation, we model the utility costs of diversion with the functions:

$$\beta_X f(d_X) = -\beta_X \log(1 - \psi_X d_X);$$

$$\beta_I h(d_I) = -\beta_I \log(1 - \psi_I d_I).$$

Proposition 2 then says that production delegation solves the two equations:

$$d_X = \frac{1}{\psi_X} - \frac{\beta_X}{1 - (1 - \tau_b) b_X};$$

$$1 - d_X = \frac{(1 - \tau_\Pi - b_X)\, \beta_X (1 - \tau_b)}{[1 - (1 - \tau_b) b_X]^2}.$$

Substituting one in the other,

$$[1 - (1 - \tau_b) b_X]^2 = \beta_X \frac{1 - (1 - \tau_\Pi)(1 - \tau_b)}{\frac{1}{\psi_X} - 1}.$$

The left-hand side is positive, so for the equation to hold we must have $\psi_X < 1$; indeed in our calibration we obtain $\psi_X = 0.426$. We then solve the quadratic equation for b_X and substitute the result in the top equation to solve for d_X, obtaining:

$$b_X = \frac{1}{1 - \tau_b} \left[1 - \sqrt{\beta_X \frac{1 - (1 - \tau_\Pi)(1 - \tau_b)}{\frac{1}{\psi_X} - 1}} \right];$$

$$d_X = \frac{1}{\psi_X} - \sqrt{\frac{\beta_X \left(\frac{1}{\psi_X} - 1 \right)}{1 - (1 - \tau_\Pi)(1 - \tau_b)}}.$$

This solution shows that both b_X and d_X are decreasing in β_X.

Proposition 2 then says that R&D delegation solves the two equations:

$$d_I = \frac{1}{\psi_I} - \frac{\beta_I}{1 - (1 - \tau_b) \gamma_I b_I};$$

$$1 - d_I = \frac{\sqrt{(1 - \sigma \tau_\Pi)(1 - \tau_b) \beta_I}}{1 - (1 - \tau_b) \gamma_I b_I}.$$

The solution is:

$$\begin{aligned} b_I &= \frac{1}{(1 - \tau_b)\gamma_I} \left[1 - \frac{\beta_I - \sqrt{(1 - \sigma \tau_\Pi)(1 - \tau_b)\beta_I}}{\frac{1}{\psi_I} - 1} \right]; \\ d_I &= \frac{1}{\psi_I} - \left(\frac{1}{\psi_I} - 1 \right) \left[1 - \sqrt{\frac{(1 - \sigma \tau_\Pi)(1 - \tau_b)}{\beta_I}} \right]^{-1}. \end{aligned}$$

Then, we see directly that:

$$\frac{\partial b_I}{\partial \beta_I} = -\frac{1}{(1-\tau_b)\gamma_I} \frac{1 - \frac{1}{2}\beta_I^{-\frac{1}{2}-1}\sqrt{(1-\sigma\tau_\Pi)(1-\tau_b)}}{\frac{1}{\psi_I} - 1};$$

$$\frac{\partial d_I}{\partial \beta_I} = \left(\frac{1}{\psi_I} - 1\right)\left[1 - \sqrt{\frac{(1-\sigma\tau_\Pi)(1-\tau_b)}{\beta_I}}\right]^{-2} \sqrt{\frac{(1-\sigma\tau_\Pi)(1-\tau_b)}{\beta_I}} \frac{1}{2\beta_I}.$$

The sign of each derivative depends on $\frac{1}{\psi_I} - 1$. In the calibration we obtain $\psi_I = 0.855$ and so the first derivative says that the b_I is hump-shaped in β_I with a maximum at

$$\beta_I = \sqrt[3]{\frac{1}{2}(1-\sigma\tau_\Pi)(1-\tau_b)}.$$

The second derivative, instead, is always positive so that d_I is monotonically increasing in β_I. The analytical insight for this result is that the response of diversion to the rule of law depends on the curvature of the utility cost of diversion. We find the curvature to be mild ($\psi_I < 1$) and thus obtain that diversion rises with its utility cost.

A.3 Proof of proposition 3

As stated in the paper, we consider parameters such that both in-house innovation and entry are always positive, i.e., $z > 0$ and $n > 0$. We proceed in steps.

Step 1. We time-differentiate the production function (28) and combine the result with the return to saving (12) to obtain

$$\frac{\dot{c}}{c} = \frac{\dot{C}}{C} - \frac{\dot{Y}}{Y} = r - \rho + \lambda - \epsilon n - z - \lambda = r - \rho - \epsilon n - z.$$

We then combine this expression with the return to in-house innovation (23) to write

$$\frac{\dot{c}}{c} = \Psi_1 \alpha x \left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) - \rho - \epsilon n - z, \tag{A.1}$$

where to make the notation tractable we define

$$\Psi_1 \equiv \frac{\gamma_X (1-\tau_\Pi - b_X)(1-d_X)\gamma_I(1-d_I)}{1-\sigma\tau_\Pi + b_I\gamma_I(1-d_I)}.$$

Next, we use (14) and the definition of x to write the return to equity in Proposition 1 as

$$r = \Psi_2 \left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) - \Psi_3 \frac{z}{x} + \frac{\dot{Y}}{Y} - n,$$

where to make the notation tractable we define:

$$\Psi_2 \equiv \frac{1-\tau_D}{\chi}(1-\tau_\Pi - b_X)(1-d_X);$$

$$\Psi_3 \equiv \frac{1-\tau_D}{\chi}\frac{1-\sigma\tau_\Pi - b_I\gamma_I(1-d_I)}{\gamma_X}.$$

We combine the expression just derived with the saving schedule (12) to obtain, after some manipulations,

$$n = \Psi_2\left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) - \Psi_3\frac{z}{x} - \rho + \lambda - \frac{\dot{c}}{c}.$$

We combine the expression with (A.1) to write

$$(1-\epsilon)\,n = (\Psi_2 - \Psi_1\alpha x)\left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) - \left(\frac{\Psi_3}{x} - 1\right)z + \lambda, \tag{A.2}$$

We have thus reduced the returns to in-house innovation, entry and saving to 2 equations in z, n and $\dot{c}/c$. We need another equation to solve for the 3 variables.

Step 2. We write:

$$\Pi = \gamma_X X\left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right);$$

$$\begin{aligned} D &= (1-\tau_\Pi - b_X)(1-d_X)\Pi - [1-\sigma\tau_\Pi + b_I\gamma_I(1-d_I)]\,I \\ &= \gamma_X X\left[(1-\tau_\Pi - b_X)(1-d_X)\left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) - \frac{1-\sigma\tau_\Pi + b_I\gamma_I(1-d_I)}{\gamma_X\gamma_I(1-d_I)}z\right]; \end{aligned}$$

$$\begin{aligned} B &= b_X(1-d_X)\Pi + \gamma_I(1-d_I)b_I I \\ &= \gamma_X X\left[b_X(1-d_X)\left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) + \frac{b_I}{\gamma_X}\frac{z}{x}\right]. \end{aligned}$$

Using these expressions, the government's tax revenues are

$$\begin{aligned} T &= \tau_D N D + \tau_\Pi(1-d_X)N\Pi - \tau_\Pi\sigma N I + \tau_b B \\ &= N\gamma_X X\left[\hat{\tau}_\Pi\left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) + \hat{\tau}_I\frac{z}{x}\right] \\ &= \theta^2\left[\hat{\tau}_\Pi\left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) + \hat{\tau}_I\frac{z}{x}\right]Y, \end{aligned}$$

where:

$$\hat{\tau}_\Pi \equiv [\tau_D(1-\tau_\Pi - b_X) + \tau_\Pi + \tau_b b_X](1-d_X);$$

$$\hat{\tau}_I \equiv \frac{\tau_D(1-\sigma\tau_\Pi) - \tau_\Pi\sigma + (\tau_D - \tau_b)b_I\gamma_I(1-d_I)}{\gamma_X\gamma_I(1-d_I)}.$$

These are the effective tax rates on profit and in-house investment (firm growth), respectively. We then write the transfer ratio

$$\frac{H}{Y} = \tau_H \frac{T}{Y} = \tau_H \theta^2 \left[\hat{\tau}_\Pi \left(\frac{1}{\theta} - 1 - \frac{\phi}{x} \right) + \hat{\tau}_I \frac{z}{x} \right] = \tau_H h$$

and define the function

$$h(x,c) \equiv \tau_H \theta^2 \left[\hat{\tau}_\Pi \left(\frac{1}{\theta} - 1 - \frac{\phi}{x} \right) + \hat{\tau}_I \frac{z(x,c)}{x} \right]$$

to summarize the dependence of the transfer ratio on x and c. Next, we impose the normalization $e = 1$ (each firm issues one share) in the household's budget, and use the free-entry condition, $NV = N\chi\gamma_X X = \chi\gamma_X \theta^2 Y$, and the saving rule (12), to obtain

$$\frac{\dot{N}V + N\dot{V}}{NV} = \rho - \lambda + \frac{\dot{C}}{C} + \frac{wL + H - C}{NV}.$$

After rearranging terms, this becomes

$$\frac{\dot{c}}{c} = \frac{c - 1 + \theta - h(x,c) - \chi\gamma_X \theta^2 (\rho - \lambda)}{\chi\gamma_X \theta^2},$$

which is equation (39) in Proposition 3.

Step 3. We combine (39) and (A.1) to write

$$z = \frac{\left(\Psi_1 \alpha x + \frac{\tau_H \hat{\tau}_\Pi}{\chi\gamma_X} \right) \left(\frac{1}{\theta} - 1 - \frac{\phi}{x} \right) - \epsilon n - \frac{c - 1 + \theta + \chi\gamma_X \theta^2 \lambda}{\chi\gamma_X \theta^2}}{1 - \frac{\tau_H \hat{\tau}_I}{\chi\gamma_X} \frac{1}{x}}.$$

We then solve this equation jointly with (A.2) to obtain:

$$n(x,c) = \frac{\left[\Psi_2 - \Psi_1 \alpha x - \left(\frac{\Psi_3}{x} - 1 \right) \frac{\Psi_1 \alpha x + \frac{\tau_H \hat{\tau}_\Pi}{\chi\gamma_X}}{1 - \frac{\tau_H \hat{\tau}_I}{\chi\gamma_X} \frac{1}{x}} \right] \left(\frac{1}{\theta} - 1 - \frac{\phi}{x} \right) + \frac{\frac{\Psi_3}{x} - 1}{1 - \frac{\tau_H \hat{\tau}_I}{\chi\gamma_X} \frac{1}{x}} \frac{c - 1 + \theta + \chi\gamma_X \theta^2 \lambda}{\chi\gamma_X \theta^2} + \lambda}{1 - \epsilon - \frac{\frac{\Psi_3}{x} - 1}{1 - \frac{\tau_H \hat{\tau}_I}{\chi\gamma_X} \frac{1}{x}} \epsilon};$$

$$z(x,c) = \frac{\left(\Psi_1 \alpha x + \frac{\tau_H \hat{\tau}_\Pi}{\chi\gamma_X} \right) \left(\frac{1}{\theta} - 1 - \frac{\phi}{x} \right) - \epsilon n(x,c) - \frac{c - 1 + \theta + \chi\gamma_X \theta^2 \lambda}{\chi\gamma_X \theta^2}}{1 - \frac{\tau_H \hat{\tau}_I}{\chi\gamma_X} \frac{1}{x}}.$$

Step 4. Now that we have $n(x,c)$ and $z(x,c)$, two functions characterize the equilibrium behavior of firms and entrepreneurs. The first is the R&D intensity function $\frac{z(x,c)}{x}$. Accounting for the corner solutions due to the non-negativity constraints $\frac{1-\theta}{\theta} - \frac{\phi}{x} \geq 0$ and $z \geq 0$, this function has the following properties: (i) it is positive for $x > x_Z(c) > \frac{\phi\theta}{1-\theta} > 0$; (ii) it is

monotonically increasing and bounded above in x, converging to the value $z_\infty(c) > 0$; (iii) it is monotonically decreasing in c. Then, we have

$$\dot{c} \geq 0: \quad c \geq c(x)_{\dot{c}=0},$$

where

$$c(x)_{\dot{c}=0} \equiv \arg\text{solve}\left\{c = \tau_H \theta^2 \left[\hat{\tau}_\Pi \left(\frac{1}{\theta} - 1 - \frac{\phi}{x}\right) + \hat{\tau}_I \frac{z(x,c)}{x}\right] + 1 - \theta + \chi\gamma_X \theta^2 (\rho - \lambda)\right\}.$$

Applying the implicit function theorem, we establish that $c(x)_{\dot{c}=0}$ has the following properties: (i) it starts with value $c\left(\frac{\phi\theta}{1-\theta}\right)_{\dot{c}=0} = 1 - \theta + \chi\gamma_X\theta^2(\rho - \lambda)$ for $x = \frac{\phi\theta}{1-\theta}$; (ii) it is monotonically increasing and bounded above in x, converging to

$$c(\infty)_{\dot{c}=0} = \arg\text{solve}\left\{c = \tau_H \theta^2 \left[\hat{\tau}_\Pi \left(\frac{1}{\theta} - 1\right) + \hat{\tau}_I z_\infty(c)\right] + 1 - \theta + \chi\gamma_X \theta^2 (\rho - \lambda)\right\}.$$

The second function is the entry function $n(x,c)$, which, accounting for the corner solutions due to the non-negativity constraints $\frac{1-\theta}{\theta} - \frac{\phi}{x} \geq 0$ and $n \geq 0$, has the following properties: (i) it is positive for $x > x_N(c) > \frac{\phi\theta}{1-\theta} > 0$; (ii) it is monotonically increasing and bounded above in x, converging to the value $n_\infty(c) > 0$; (iii) it is monotonically decreasing in c. Then, we have

$$\dot{x} \geq 0: \quad n(x,c) \geq \frac{\lambda}{1-\epsilon}.$$

Applying the implicit function theorem, we establish that $c(x)_{\dot{x}=0}$ has the following properties: (i) it is positive for $x > x_N > 0$, where

$$x_N = \arg\text{solve}\left\{n(x,0) = \frac{\lambda}{1-\epsilon}\right\};$$

(ii) it is monotonically increasing and bounded above in x, converging to

$$c(\infty)_{\dot{c}=0} = \arg\text{solve}\left\{n(\infty,c) = \frac{\lambda}{1-\epsilon}\right\}.$$

The resulting phase diagram shows that the system is saddle path stable. We denote the saddle path $c = c_{sp}(x)$ and note that is is upward sloping and lies within the band

$$c\left(\frac{\phi\theta}{1-\theta}\right)_{\dot{c}=0} < c_{sp}(x) < c(\infty)_{\dot{c}=0}.$$

This band can be quite narrow, suggesting that the saddle path can be nearly flat. Indeed, this is what we find in our calibration.

A.4 GE accounting

We now verify that key accounting relations hold. Suppose $\tau_H < 1$. Then, proceeding as before we have

$$\begin{aligned}\dot{N}V &= (1-\tau_D)\,ND + wL + \tau_D ND + \tau_\Pi (1-d_X)\,N\Pi - \tau_\Pi \sigma NI + \tau_b NB - G - C \\ &= ND + \tau_\Pi (1-d_X)\,N\Pi - \tau_\Pi \sigma NI + \tau_b NB + wL - G - C\end{aligned}$$

Now use the dividend

$$D = (1-\tau_\Pi - b_X)(1-d_X)\,\Pi - [1-\sigma\tau_\Pi + b_I\gamma_I(1-d_I)]\,I$$

and rearrange terms to write

$$\dot{N}V = (1-b_X)(1-d_X)\,N\Pi - [1+b_I\gamma_I(1-d_I)]\,NI + \tau_b NB + wL - G - C.$$

Recall that

$$B = b_X(1-d_X)\,\Pi + \gamma_I(1-d_I)b_I I$$

and that the managers' budget is

$$C^m = N\left[(1-\tau_b)\,B + d_X\Pi + d_I I\right]$$

Then, we use these expressions to write, after canceling terms,

$$\dot{N}V = N\Pi - (1-d_I)\,NI + wL - G - C - C^m.$$

We note that actual investment is $\dot{Z} = \gamma_I(1-d_I)\,I$ and write

$$\dot{N}V = N\Pi - \dot{Z}/\gamma_I + wL - G - C - C^m.$$

This is again the economy's resource constraint. The derivation for $\tau_H = 1$ follows the same steps. The household budget plus the government budget plus the normalization $e = 1$ yield

$$\begin{aligned}\dot{N}V + N\dot{V} &= (1-\tau_D)\,ND + N\dot{V} + wL + \tau_D ND + \tau_\Pi(1-d_X)\,N\Pi - \tau_\Pi\sigma NI + \tau_b NB - C \\ &= ND + \tau_\Pi(1-d_X)\,N\Pi - \tau_\Pi\sigma NI + \tau_b NB + N\dot{V} + wL - C\end{aligned}$$

Using the dividend and rearranging terms yields

$$\dot{N}V = (1-b_X)(1-d_X)\,N\Pi - [1+b_I\gamma_I(1-d_I)]\,NI + \tau_b NB + wL - C.$$

Using the expressions for B and C^m, we write, after canceling terms,

$$\dot{N}V = N\Pi - (1-d_I)\,NI + wL - C - C^m.$$

We note that actual investment is $\dot{Z} = \gamma_I(1-d_I)\,I$ and write

$$\dot{N}V = N\Pi - \dot{Z}/\gamma_I + wL - C - C^m.$$

This is the economy's resource constraint.