Financial Markets, Industry Dynamics, and Growth

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Keywords: Endogenous Growth, Market Structure, Financial Frictions, Corporate Governance.

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1 Introduction

The quality of financial markets, including their ability to govern conflicts among firms' financiers, managers and other stakeholders, is increasingly viewed as a major determinant of the long-run performance of industrialized and emerging economies. Several scholars argue that cross-country differences in growth and productivity can be attributed to a significant extent to differences in corporate governance (Bloom and Van Reenen, 2010; La Porta, Lopez-de-Silanes, Shleifer and Vishny, 2000). Recent empirical studies confirm the importance of corporate governance in the growth process (see, e.g., De Nicolo', Laeven, Ueda, 2008). The OECD (2012) summarizes this body of evidence by arguing that "corporate governance exerts a strong influence on resource allocation. It impacts upon innovative activity and entrepreneurship. Better corporate governance, therefore, both within OECD and non-OECD countries should manifest itself in enhanced corporate performance and can lead to higher economic growth."

Although there is a broad consensus that corporate governance can be relevant for growth, there is little agreement about the channels through which its effect operates. On the one hand, the advocates of the "rule of law" view maintain that economies in which financial markets guarantee stronger protection of minority shareholders and managerial discipline enjoy more intense competition and better growth performance. According to this view, the inability of some emerging economies to ameliorate corporate governance problems hinders their efforts to catch up with advanced economies. On the other hand, the governments of several emerging countries and of some advanced ones have often pursued financial and corporate policies that have accommodated the informational opacity of businesses in financial markets as well as managers' empire building attitudes (OECD, 2010). The experience of business groups – ubiquitous in middle-income countries – is paradigmatic in this respect. Many governments have enacted policies that have protected business group affiliates, allowing them to disclose limited information to financial markets. A consequence has been that managers of large group affiliates have often been able to engage in "tunneling" activities, diverting resources especially at the expense of minority shareholders. In addition, in the belief that large businesses would better compete in global markets, governments have often favored the appointment of managers with empire building attitudes. The advocates of these policies stress that large business group affiliates have engaged in aggressive investment policies and turned out to be the engines of the rapid growth of several countries, such as Korea, Indonesia, Thailand, Brazil, Chile, and Japan. By contrast, their opponents maintain that these policies have forestalled competition and inhibited entrepreneurship. The impact on economic growth and the overall welfare consequences thus remain ambiguous a priori (see, e.g., Khanna, 2000, and Morck, Wolfenzon and Yeung, 2005, for a discussion).

This paper aims at shedding new light on this debate. Regardless of which view one endorses, the above discussion implies that, to understand the effects of corporate governance frictions on the long-run performance of an economy, one needs to investigate how such frictions influence both entrepreneurship, that is, the ease with which new firms can enter product markets, and the speed at which incumbent firms grow. On the extensive (firm entry) margin, scholars document the profound effects that corporate governance reforms have had on the market structure of various countries in recent decades, influencing the ease with which new firms break into markets (see, e.g., Fulghieri and Suominen, 2013, and Hyytinen, Kuosa and Takalo, 2002). Indeed, although unconditional correlations are merely suggestive, Figure 1 reveals a clear cross-country positive correlation between measures of investors' protection and the intensity of firm entry.[1] On the intensive (incumbents' investment) margin, there is established evidence that corporate governance frictions can distort the investment decisions of incumbent firms (see, e.g., Aghion, Van Reenen and Zingales, 2013; Shleifer and Vishny, 1997; Morck, Wolfenzon and Yeung, 2005). Clearly, analyzing how corporate governance shapes both the entry of new firms and the growth of incumbent ones can also yield far-reaching insights for the current policy debate. The Great Recession has led to calls for financial and corporate reforms. Reforms that boost the investments of incumbent firms may entail a cost in terms of more rigidity in the entry of new firms and, hence, in the market structure (The Economist, 2012).

To explore these issues, we embed imperfect corporate governance in a model economy where

[1] The data refer to 99 industrialized and emerging countries. For both firm entry and investor protection, the data are from the World Bank. Investor protection is a 1-10 index obtained as the average of three 1-10 indices for extent of disclosure, extent of director liability, and ease of shareholder suits (World Bank's Doing Business database, 2013 update). Firm entry is measured by the number of new limited liability corporations registered in 2012 per 1,000 people ages 15-64 (World Bank's Entrepreneurship Survey and database).

endogenous growth is driven both by the foundation of new firms that offer new intermediate products (the extensive margin) and by the investment of incumbent firms in the quality of their existing intermediate products (the intensive margin). The economy is populated by households, who, besides working for firms, can act as firm shareholders and managers. Active shareholders gather funds from other households (minority shareholders) to found new firms and introduce new varieties of products. Managers are in charge of production and investment decisions concerning existing products. The critical feature of our economy consists of the presence of conflicts between managers and shareholders and between active shareholders and minority shareholders. We model such frictions taking a leaf from the finance literature, especially Nikolov and Whited (2013). We let firm managers and active shareholders engage in moral hazard. In particular, as in Nikolov and Whited (2013), managers can engage in tunneling activities (divert resources from firms) and empire building (pursue private benefits tied to firm size). Firm active shareholders can monitor managers on behalf of all shareholders to mitigate managers' moral hazard. However, they can shirk on this activity, putting little effort in monitoring managers. The incentive of active shareholders to monitor managers depends on their equity stake in firms: to induce monitoring, minority shareholders need to surrender part of firms' surplus to active shareholders. Thus, firm active shareholders extract rents from minority shareholders. This way of modelling corporate governance frictions not only replicates prior studies but also matches the above-mentioned evidence on the corporate governance problems of several countries in recent decades.

We examine how corporate governance frictions affect incumbents' investment as well as the entry of new firms and, hence, the market structure. We also investigate how, in turn, the market structure feeds back on the intensity of corporate governance frictions. The analysis reveals that both tunneling and empire building activities alter the market structure by exerting an upward pressure on the size of firms and slowing down the entry of new firms. This, in turn, implies that both frictions depress the variety of intermediate products. Intuitively, the corporate governance frictions act as an additional barrier to the entry of new firms, forcing minority shareholders not only to sustain standard technological entry costs, but also to commit additional expected returns to managers and active shareholders to mitigate conflicts inside firms. The effect of the frictions on incumbents' investment can be more ambiguous. On the one hand, by inducing a consolidation of the market structure, corporate governance frictions tend to boost the rate at which incumbent firms invest in existing products. Intuitively, exactly because of the market consolidation and the larger firm size sustainable in equilibrium, incumbents can reap larger benefits from investing in their products. On the other hand, especially in the case of empire building, the corporate governance frictions distort production decisions, depressing the return on investment in existing products. We obtain that in the long run the market size effect tends to prevail and the frictions can induce more aggressive investment by incumbents.

Interestingly, the market structure can in turn feed back on the intensity of corporate governance frictions. A popular idea in the literature is that managers' moral hazard can be more severe in larger firms, for example because active shareholders' monitoring becomes more complex in larger businesses (Jensen and Meckling, 1976). An increase in firms' size associated with a market consolidation can then produce an overall reduction in the efficiency of active shareholders' monitoring, exacerbating managers' incentives to engage in moral hazard. In our economy, firm size is in turn endogenously influenced by the corporate governance frictions, so a mutually reinforcing interaction ("multiplier" effect) between quality of corporate governance and market structure can arise in the growth process.

The effects illustrated above yield that the net welfare impact of corporate governance frictions is ambiguous a priori. On the one hand, the frictions tend to depress welfare by inhibiting the entry of new firms and reducing the array of intermediate products. On the other hand, when their positive effects on investment prevail over the negative ones, the frictions tend to increase welfare through this channel. When we calibrate corporate governance parameters in line with the empirical findings of Nikolov and Whited (2013) for the United States, we observe that the welfare change due to the investment effect outweighs the entry rate welfare effect. Conversely, when we consider an economy with corporate governance frictions of an intensity comparable to that found in emerging countries, the welfare cost due to the alteration of the market structure is the prevailing force. This has important policy implications: ameliorating corporate governance promotes welfare more in countries with poor initial governance (e.g., emerging countries) than in countries with good initial governance (e.g., advanced economies). Thus, the arguments often put forward in emerging countries to justify firms' informational opacity in financial markets and managers' empire building behavior appear to be misplaced.

The remainder of the paper is organized as follows. Section 2 relates the analysis to prior literature. Sections 3 and 4 present the real sector of the model economy, introduce corporate governance frictions, and solve for agents' decisions. Section 5 characterizes the general equilibrium structure and solves for the steady state. In Sections 6-8, we investigate the dynamics of the economy and the response of the economy to shocks to corporate governance frictions, for example reflecting corporate governance reforms. Section 9 studies how corporate governance frictions influence the long-run pattern of development of the economy. Section 10 concludes. The proofs of the model are relegated to the Technical Appendix.

2 Prior Literature

There is a growing literature on the role of financial markets in the growth process. Yet, little is known about the role of corporate governance frictions, especially when we take the market structure of the economy into account. Despite early attempts and calls for more research (see, e.g., Aghion and Howitt, 1998), theoretical work on how corporate governance affects growth has lagged behind the policy-oriented debate. A notable exception is recent work by Akcigit, Alp and Peters (2014). Akcigit et al. consider an effort model in which the entry rate of new firms is given. By holding up firms ex post, managers can discourage the increase in the scope of firms' product lines. Thus, in their model corporate governance frictions hamper the expansion of the range of activities of incumbent firms. Other papers that study the long-run effect of corporate governance include Caselli and Gennaioli (2013) and Cooley, Marimon and Quadrini (2014). Caselli and Gennaioli (2013) model an economy in which credit market frictions can induce the transmission of firm ownership to inefficient heirs, inhibiting the reallocation of ownership to more productive agents. In turn, such a misallocation of ownership slows down growth. Cooley, Marimon and Quadrini (2014) investigate the long-run aggregate implications of corporate governance frictions inside financial firms. In particular, they study the effects of financial managers' risk taking, when this risk taking influences the value of managers' outside option. Our paper is also related more broadly to the literature on the impact of imperfect financial markets on growth (see, e.g., Aghion, Howitt and Mayer-Foulkes, 2005; Cooley and Quadrini, 2001; Greenwood and Jovanovic, 1990, and Bencivenga and Smith, 1991).

From a modelling point of view, because our goal is to understand how corporate governance affects both the behavior of entrepreneurs in establishing new firms and the investment decisions of incumbent firms, we build on the literature that has extended models of endogenous growth to include endogenous market structure (see, e.g., Peretto, 1996 and 1999, and, for a recent survey, Etro, 2009). A further important feature of this class of models is the neutrality of the aggregate size of the market with respect to the long-run growth of per capita income. This neutrality implies that fundamentals and policy variables that work through the size of the aggregate market have no growth effects, whereas fundamentals and policy variables that reallocate resources between incumbents' investment and firm entry do have long-run growth effects (see, e.g., Peretto, 1998 and 1999; Dinopoulos and Thompson, 1998; Young, 1998; Howitt, 1999).[2] This feature is particularly useful for our purposes because it allows us to study the impact of corporate governance reforms in an economy with growing population and an expanding array of products.

Finally, the paper also relates to the literature that studies the investment distortions induced by corporate governance frictions. Immordino and Pagano (2012) examine the impact of managers' empire building in a partial equilibrium model where managers can either be incentivized through the participation to firms' equity or be audited by active shareholders. We follow a similar approach in modelling managers' incentive structure and the role of active shareholders. Eisfeldt and Rampini (2008) investigate firms' investment decisions over the business cycle when managers derive private benefits from the capital under their control, due, for instance, to empire building motives. A few static partial equilibrium studies suggest that the agency costs structure of businesses in emerging countries prompts them to pursue aggressive investment policies (see, e.g., Bebchuk, Kraakman and Triantis, 1999; Lee, 2000). Indeed, several empirical studies find that in middle-income countries business group affiliates exhibit higher investment and growth rates than normal (see, e.g., Campbell and Keys, 2002, and Choi and Cowing, 1999), while the evidence about their relative profitability is generally ambiguous (see, e.g., Khanna and Palepu, 2000, and Bertrand, Metha and Mullainathan,

[2]Empirical support for these results can be found in Laincz and Peretto (2006), Sedgley (2006), Madsen (2008) and Ulku (2007). See also Aghion and Howitt (1998, 2006), Dinopoulos and Thompson (1999), Jones (1999), and Peretto and Smulders (2002) for reviews.

2002).

3 The model: real sector

The economy is closed. There is a final good and a continuum of non-durable intermediate goods. To keep things simple, there is no physical capital. All variables are functions of (continuous) time but to simplify the notation we omit the time argument unless necessary to avoid confusion. The intermediate sector is the gist of our economy: firms enter the industry by developing new intermediate goods while incumbent firms invest in the quality of existing intermediate goods. The intermediate sector is plagued by corporate governance frictions.

3.1 Households

The economy is populated by a representative household with $L(t) = L_0 e^{\lambda t}$, $L_0 \equiv 1$, members, each endowed with one unit of labor. In addition to providing labor services, household members can also provide managerial and monitoring services inside firms.[3] The household has preferences

$$U(t) = \int_t^{\infty} e^{-(\rho-\lambda)s} \log\left(\frac{C(s)}{L(s)}\right) ds, \quad \rho > \lambda \geq 0 \tag{1}$$

where t is the point in time when the household makes decisions, ρ is the discount rate and C is consumption. The household supplies labor inelastically and thus faces the flow budget constraint

$$\dot{A} = rA + wL - C, \tag{2}$$

where A is assets holding, r is the rate of return on assets and w is the wage. The intertemporal consumption plan that maximizes (1) subject to (2) consists of the Euler equation

$$r = \rho - \lambda + \dot{C}/C, \tag{3}$$

the budget constraint (2) and the usual boundary conditions.

3.2 Final producers

A competitive representative firm produces a final good (the numeraire) that can be consumed, used to produce intermediate goods, invested in the improvement of the quality of existing intermediate goods, or invested in the creation of new intermediate goods. The technology for the production of the final good is

$$Y = \int_0^N X_i^{\theta} \left[Z_i^{\alpha} Z^{1-\alpha} \frac{L}{N^{1-\sigma}}\right]^{1-\theta} di, \quad 0 < \theta, \alpha < 1, \ 0 \leq \sigma < 1 \tag{4}$$

where Y is the final output, N is the mass of intermediate goods and X_i is the quantity of intermediate good i used in production. Given the inelastic labor supply of the household and the one-sector

[3] Such services are not in units of labor and thus their provision does not come out of labor supply.

structure of the economy, labor market clearing yields that employment in the final sector equals population size L. Quality is the ability of an intermediate good to raise the productivity of the other factors: the contribution of intermediate good i depends on its own quality, Z_i, and on the average quality, $Z = \int_0^N (Z_j/N)\, dj$, of intermediate goods. Social returns to quality and variety are equal to 1 and σ, respectively. The first-order conditions for the profit maximization problem of the final producer yield that each intermediate firm i faces the demand curve

$$X_i = \left(\frac{\theta}{P_i}\right)^{\frac{1}{1-\theta}} Z_i^{\alpha} Z^{1-\alpha} \frac{L}{N^{1-\sigma}}, \tag{5}$$

where P_i is the price of intermediate good i. The first-order conditions then imply that the final producer pays total compensation

$$\int_0^N P_i X_i di = \theta Y \quad \text{and} \quad wL = (1-\theta)\, Y \tag{6}$$

to intermediate goods and labor suppliers, respectively.

3.3 Intermediate producers

The typical intermediate firm i comes into existence when βX units of final good are invested to set up operations. Because of this sunk entry cost, the firm cannot supply an existing good in Bertrand competition with the incumbent monopolist but must introduce a new intermediate good that expands product variety. The firm enters at the average quality level and, hence, at average size (this simplifying assumption preserves symmetry of equilibrium at all times).

Once in existence, the intermediate firm i operates a technology that requires one unit of final good per unit of intermediate good produced and a fixed operating cost $\phi Z_i^{\alpha} Z^{1-\alpha}$, also in units of final good. The firm can increase the quality of its intermediate good according to the technology

$$\dot{Z}_i = I_i, \tag{7}$$

where I_i is the firm's investment, in units of final good. Using (5), the firm's net profit is

$$\Pi_i = \left[(P_i - 1)\left(\frac{\theta}{P_i}\right)^{\frac{1}{1-\theta}} \frac{L}{N^{1-\sigma}} - \phi\right] Z_i^{\alpha} Z^{1-\alpha} - I_i. \tag{8}$$

Absent corporate governance frictions, after entry at time t the firm would choose for $s \in [t, \infty)$ paths of the product's price, $P_i(s)$, and investment, $I_i(s)$, that maximize the value of the firm

$$V_i(t) = \int_t^{\infty} e^{-\int_t^s r(v) dv} \Pi_i(s) ds, \tag{9}$$

subject to (7) and (8), and taking the paths of the interest rate, $r(s)$, and of average quality, $Z(s)$, as given. The entry decision would then be represented by the free-entry condition that the (maximized) value of the firm equals the entry cost, i.e., $V_i(t) = \beta X(t)$. Our goal is to study how corporate governance frictions affect economic growth and market structure by causing production, investment and entry decisions to deviate from this frictionless case.

4 Corporate governance

We are interested in capturing conflicts of interest between managers and shareholders on one side, and between active and minority (passive) shareholders on the other side. We posit that the investment, production and pricing decisions of an intermediate firm are made by a manager. The manager maximizes his own objective function, which is not aligned with the objective function of the shareholders of the firm. We focus on two types of frictions: a "tunneling" friction, such that managers siphon off resources from firms; and an "empire building" friction such that managers derive private benefits from expanding the size of firms. These are the two frictions considered by Nikolov and Whited (2013) and a large body of corporate governance literature. Most importantly, these are the corporate governance frictions that have allegedly plagued several countries in recent decades (see, e.g., Khanna, 2000; Morck, Wolfenzon and Yeung, 2005; Campbell and Keys, 2002; Choi and Cowing, 1999).

The decisions of the manager of an intermediate firm can be monitored by the active shareholder of the firm. However, we posit that, in turn, the active shareholder cannot commit vis-à-vis the minority shareholders of the firm.

4.1 Managers

Following Nikolov and Whited (2013), we let the compensation package of a manager consist of an equity share, $e_{m,i}$, of the firm. The manager can also steal a fraction $\Sigma_i(M_i, S_i)$ of the net profit Π_i, where S_i is the manager's effort in tunneling (stealing) activities and M_i is the effort of the firm's active shareholder in monitoring the manager. We assume $\partial\Sigma_i(M_i, S_i)/\partial S_i > 0$ and $\partial\Sigma_i(M_i, S_i)/\partial M_i < 0$. The manager's effort cost of engaging in tunneling is $c^S(S_i) \cdot \Pi_i$, where the function $c^S(S_i)$ satisfies $\partial c^S(S_i)/\partial S_i > 0$, $\partial^2 c^S(S_i)/\partial S_i^2 \geq 0$. As in Nikolov and Whited (2013), on top of the conflicts with shareholders stemming from his tunneling activity, a manager's objectives can also depart from the shareholders' objectives due to an innate taste of the manager for building empires. We model such an empire building attitude by letting the manager derive private benefits from the firm's gross volume of earnings. Formally, we write the manager's utility flow as

$$\left[e_{m,i}(1 - \Sigma_i(M_i, S_i)) + \Sigma_i(M_i, S_i) - c^S(S_i)\right] \cdot (\Pi_i + \Omega P_i X_i) \tag{10}$$

Thus, a manager derives an extra utility from the volume of gross earnings $P_i X_i$ (a proxy for the firm's size). The parameter $\Omega \geq 0$ governs the size of private benefits and, hence, the intensity of the empire building friction. For computational tractability, as (10) illustrates, we let the size preference of the manager be proportional to the portion of net profit accruing to him (the term in square brackets).

At time t, given the path of his shareholding, $e_{m,i}(s)$, and the path of monitoring of the active shareholder, $M_i(s)$, for $s \in [t, \infty)$, the manager of the firm chooses the paths of price $P_i(s)$, investment $I_i(s)$, and stealing effort $S_i(s)$, to maximize

$$\int_t^{+\infty} e^{-\int_t^s r(v)dv} \left[e_{m,i}(1 - \Sigma_i(M_i, S_i)) + \Sigma_i(M_i, S_i) - c^S(S_i)\right] \left[\Pi_i + \Omega P_i X_i\right] ds.$$

This expression makes clear that, due to tunneling and empire building, the manager's objective is not the maximization of the value of the firm $V_i(t)$ defined in (9). By contrast, he forms the following Hamiltonian

$$H_i = \left[e_{m,i}\left(1 - \Sigma_i\left(M_i, S_i\right)\right) + \Sigma_i\left(M_i, S_i\right) - c^S(S_i)\right] \cdot \left[\Pi_i + \Omega P_i X_i\right] + q_i I_i,$$

where q_i is the shadow value of the marginal increase in product quality. In the Technical Appendix, we report the full set of first-order conditions with respect to P_i, I_i, Z_i, and S_i. The first-order condition with respect to P_i yields

$$P_i = \frac{1}{1+\Omega}\frac{1}{\theta}. \tag{11}$$

This condition highlights the manager's incentive to underprice the intermediate good relative to the frictionless monopoly value $1/\theta$ in order to boost the size of the firm. Combining this result with the first-order conditions for I_i and Z_i, we obtain an expression for the rate of return to investment:

$$r_Z = \alpha\left[\left(\frac{1}{(1+\Omega)\theta} - 1\right)\frac{X_i}{Z_i} - \phi\left(\frac{Z}{Z_i}\right)^{1-\alpha}\right] + \frac{\dot{q}_i}{q_i}. \tag{12}$$

This expression illustrates the distortion in the return to investment due to the manager's preference for current gross earnings (empire building). This distortion results in a gross profit margin $(P_i - MC)/MC = (P_i - 1)$ that is smaller than the frictionless one, $\left(\frac{1}{\theta} - 1\right)$.[4] To ensure that the pricing decision is economically meaningful, we impose the restriction $\theta(1+\Omega) < 1$.

The first-order condition for the tunneling effort S_i says that the manager sets the marginal benefit of his tunneling effort equal to its marginal cost,

$$(1 - e_{m,i})\frac{\partial \Sigma_i\left(M_i, S_i\right)}{\partial S_i} = \frac{\partial c^S(S_i)}{\partial S_i}. \tag{13}$$

The marginal benefit is given by the marginal increase in the net profit that the manager diverts from the share $1 - e_{m,i}$ that the ownership structure allocates to the shareholders. Note that a higher equity share $e_{m,i}$ of the manager discourages tunneling because the manager would merely make costly effort to steal from himself. Thus, the manager's equity share $e_{m,i}$ is a first tool through which the manager's tunneling can be mitigated.

4.2 Active shareholders

At the foundation of an intermediate firm, we let a household member (the active shareholder of the firm) finance a share $1-\gamma$ of the entry cost βX and borrow the funds needed to cover the remaining portion γ of the entry cost from other household members (the minority or passive shareholders). The active shareholder can monitor and mitigate the tunneling of the firm's manager. However, to capture conflicts between active and minority shareholders, we posit that the active shareholder maximizes his own objective function rather than the value of the firm. Put differently, an active

[4] This is in line with the finding of some empirical studies that, controlling for market structure and other factors, empire building motives tend to depress firm profitability.

shareholder cannot commit to a given level of monitoring but must be provided with incentives to monitor through the participation to the profits of the firm. We let $e_{a,i}$ denote the equity share of the active shareholder.

The effort cost of monitoring faced by an active shareholder is $c^M(M_i, \pi_i) \cdot \Pi_i$, where $\pi_i \equiv \Pi_i/X_i$ is the firm's profit rate (profit to output ratio). This specification allows the cost of monitoring per unit of profit monitored to be a function of the firms' profit rate. This specification is thus flexible enough that we can study a scenario in which the monitoring technology of active shareholders has the same effectiveness regardless of the amount of profits to be monitored and also a scenario in which larger firms with larger profits are harder to monitor (because there are diseconomies to scale in the monitoring technology). At time t, given the paths $S_i(s)$, $P_i(s)$, $I_i(s)$ and $e_{a,i}(s)$, for $s \in [t, \infty)$, the active shareholder chooses the path of monitoring $M_i(s)$ to maximize

$$\int_t^{+\infty} e^{-\int_t^s r(v)dv} \left[e_{a,i}(s)\left[1-\Sigma_i(M_i, S_i)\right] - c^M(M_i(s), \pi_i s)\right] \Pi_i(s) ds.$$

Solving for the first-order condition with respect to M_i,

$$-e_{a,i}\frac{\partial \Sigma_i(M_i, S_i)}{\partial M_i} = \frac{\partial c^M(M_i, \pi_i)}{\partial M_i}. \tag{14}$$

This conveys a similar intuition as the first-order condition (13) for the manager's tunneling. The equity share $e_{a,i}$ of the active shareholder determines the extent to which the active shareholder monitors and mitigates the manager's tunneling.

4.3 Minority (passive) shareholders

Minority (passive) shareholders co-finance the foundation of an intermediate firm covering a portion γ of its entry cost. Because any household member can found (be the active shareholder of) a new firm, entry of new intermediate firms occurs until household members can be induced to contribute to the cost of funding new firms as minority shareholders. Put differently, entry occurs until, at the equity allocation that maximizes their expected discounted flow of dividends from an intermediate firm, minority shareholders' participation constraint holds as an equality. Then, the only decision at the foundation of an intermediate firm is about the paths $e_{m,i}(s)$ and $e_{a,i}(s)$ of the equity shares to be allocated to the manager and to the active shareholder in order to induce the behavior that maximizes the value of the minority shareholders' stake in the firm.

To develop the formal structure of this problem, we think of the first-order conditions (13) and (14) for tunneling and monitoring as reaction functions that at time $s \geq t$ yield a Nash equilibrium that is the solution of the pair of equations (dropping the s index of calendar time for simplicity)

$$\begin{aligned}(1-e_{m,i})\frac{\partial \Sigma_i(M_i(e_{m,i}, e_{a,i}), S_i(e_{m,i}, e_{a,i}))}{\partial S_i} &= \frac{\partial c^S(S_i)}{\partial S_i}, \\ -e_{a,i}\frac{\partial \Sigma_i(M_i(e_{m,i}, e_{a,i}), S_i(e_{m,i}, e_{a,i}))}{\partial M_i} &= \frac{\partial c^M(M_i, \pi_i)}{\partial M_i}.\end{aligned}$$

Given the assumptions on the function $\Sigma_i(M_i, S_i)$, these two equations yield a pair (M_i, S_i) that depends on the equity shares of manager and active shareholder, $e_{m,i}$, $e_{a,i}$, and on the profit rate π_i. We thus can write $\Sigma_i(M_i(e_{m,i}, e_{a,i}, \pi_i), S_i(e_{m,i}, e_{a,i}, \pi_i)) = \Sigma_i(e_{m,i}, e_{a,i}, \pi_i)$. Using this function, we can write the problem at the foundation of an intermediate firm as maximize

$$V_i^{\text{minority}}(t) = \int_t^{+\infty} e^{-\int_t^s r(v)dv} [1 - e_{m,i}(s) - e_{a,i}(s)] [1 - \Sigma_i((e_{m,i}(s), e_{a,i}(s), \pi_i(s)))] \Pi_i(s)ds$$

subject to the participation constraint

$$\gamma\beta X(t) \leq V_i^{\text{minority}}(t). \tag{15}$$

On the left-hand side, $\gamma\beta X(t)$ is the contribution of the minority shareholders to the cost of entry. Given our assumption that the minority shareholders take as given the paths $M_i(s)$, $S_i(s)$, $P_i(s)$, $I_i(s)$, $Z_i(s)$, $Z(s)$, $X_i(s)$ — and thus $\Pi_i(s)$ — the problem does not have a dynamic constraint and thus reduces to a sequence of identical problems where the objective is to maximize (for any s)

$$[1 - e_{m,i}(s) - e_{a,i}(s)] [1 - \Sigma_i(e_{m,i}(s), e_{a,i}(s), \pi_i(s))].$$

The solution of this problem yields a pair of functions $e_{m,i}(\pi_i)$, $e_{a,i}(\pi_i)$ that allow us to define

$$\Theta(\pi_i) \equiv [1 - e_{m,i}(\pi_i) - e_{a,i}(\pi_i)] [1 - \Sigma_i(e_{m,i}(\pi_i), e_{a,i}(\pi_i), \pi_i)]. \tag{16}$$

The term $\Theta(\pi_i)$ fully captures the consequences of tunneling for the minority shareholders: at any time s, given the volume of net profit $\Pi_i(s)$ of the firm, minority shareholders receive only a fraction $\Theta(\pi_i)$ of such profits as dividends. The implications for the entry decision are as follows.

The participation constraint of minority shareholders (15), taken with the equality sign, gives us the free-entry condition for the economy with corporate governance frictions, $\gamma\beta X(t) = V_i^{\text{minority}}(t)$.[5] Taking logs and time derivatives yields the return to entry

$$r_N = \frac{\Theta(\pi_i)\Pi_i}{V_i^{\text{minority}}} + \frac{\dot{V}_i^{\text{minority}}}{V_i^{\text{minority}}} = \frac{\Theta(\pi_i)}{\gamma\beta}\frac{\Pi_i}{X} + \frac{\dot{X}}{X}. \tag{17}$$

This expression shows that the return to entry equals the dividend price ratio plus capital gains/losses. The dividend features the "leakage" term $\Theta(\pi)$ defined above which captures the two channels through which the tunneling distortion manifests itself. The first channel is direct: the minority shareholders earn only a fraction $1 - e_{a,i}(.) - e_{m,i}(.)$ of the dividend flow. The second channel is indirect: given the shares $(1 - e_{a,i}(.) - e_{m,i}(.), e_{a,i}(.), e_{m,i}(.))$, the manager and the active shareholder make stealing and monitoring decisions that result in a share $\Sigma(.)$ of the net profits being diverted from dividend distribution to the manager's pockets.

Example 1 provides analytical results on the mechanism just discussed. In the remainder of the analysis, we will make use of active shareholders' monitoring function specified in the example.

[5] We can always set $1 - \gamma$ small enough that the active shareholder's participation constraint is slack.

Example 1 *Let the stealing function and the cost of stealing and monitoring respectively be:*

$$\Sigma_i\left(M_i, S_i\right) = \mu_S \log\left(1 + S_i\right) - \mu_M \log\left(1 + M_i\right); \tag{18}$$

$$c^M(M_i) = (\eta_M + \kappa\pi_i)M \text{ and } c^S(S_i) = \eta_S S_i. \tag{19}$$

Assume

$$\mu_S > \mu_M \quad \text{and} \quad 1 - (\mu_S - \mu_M) - \mu_S \log\left(\frac{\mu_S}{\eta_S}\right) + \mu_M \log\left(\frac{\mu_M}{\mu_S}\right) + \mu_M \log\left(\frac{\mu_M}{\eta_M + \kappa\pi_i}\right) < 0.$$

The equilibrium with an interior solution for $e_{m,i}$, $e_{a,i}$, S_i, M_i and Σ_i is characterized by the following expressions for $e_{m,i}$ and $e_{a,i}$

$$e_{m,i} = 1 - \exp\left\{\frac{1 - (\mu_S - \mu_M) - \mu_S \log\left(\frac{\mu_S}{\eta_S}\right) + \mu_M \log\left(\frac{\mu_M}{\mu_S}\right) + \mu_M \log\left(\frac{\mu_M}{\eta_M+\kappa\pi_i}\right)}{\mu_S - \mu_M}\right\} \in (0,1); \tag{20}$$

$$e_{a,i} = \left(1 - e_{m,i}\right)\frac{\mu_M}{\mu_S} \in (0,1). \tag{21}$$

Conversely, if for the given set of parameters, the expressions for $e_{m,i}$ and $e_{a,i}$ imply $\Sigma_i < 0$, then the equilibrium is characterized by $S_i = M_i = e_{m,i} = e_{a,i} = 0$ and, hence, by $\Theta = 1$ (no tunneling).

Proof. See the Technical Appendix. ■

5 General equilibrium

Having solved for agents' decisions, we can now focus on the allocation of final output Y to consumption and production of intermediate goods, derive the resulting general equilibrium system and characterize the steady state. We will study dynamics in Sections 6-8.

5.1 Structure of the equilibrium

Intermediate firms receive $N \cdot PX = \theta Y$ from the final producer. Imposing symmetry in the production function (4) and using this result to eliminate X yields

$$Y = \left(\frac{\theta}{P}\right)^{\frac{\theta}{1-\theta}} N^{\sigma} Z L. \tag{22}$$

The definition of profit (8) and equations (12) and (17) show that the returns to investment and to entry depend on the quality-adjusted gross cash flow of the firm $(P-1)\,X/Z$ — i.e., revenues minus variable production costs, all scaled by quality.[6] Using (22), we thus write both returns as functions of

$$\frac{(P-1)\,X}{Z} = (P-1)\,\frac{\theta}{P}\frac{Y}{NZ} = (P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}\frac{L}{N^{1-\sigma}}. \tag{23}$$

[6] This scaling is required to make variables stationary in steady state.

We define $x \equiv L/N^{1-\sigma}$ and use it as our state variable. We can think of x as a proxy for firm size.

Substitution of expression (23) in (12) and (17) yields the following expressions for the returns to incumbents' investment and to firms' entry:

$$r_Z = \alpha \left[(P-1) \left(\frac{\theta}{P} \right)^{\frac{1}{1-\theta}} x - \phi \right] + \frac{\dot{q}_i}{q_i}; \tag{24}$$

$$r_N = \frac{\Theta(\pi)}{\gamma\beta \left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}} \left[(P-1) \left(\frac{\theta}{P} \right)^{\frac{1}{1-\theta}} - \frac{\phi + z}{x} \right] + \frac{\dot{x}}{x} + z. \tag{25}$$

These two equations show that the returns to investment and to entry are critically influenced by the corporate governance frictions captured by $\Theta(\pi)$ and $P = 1/\theta\,(1+\Omega)$. Specifically, the empire building problem (Ω) reduces both the return to investment (24) and the return to entry (25) by reducing the quality-adjusted gross profit margin $(P-1)\,X/Z$. Moreover, empire building reduces the return to entry because managers' decision to price low enlarges the volume of production X and thus raises the cost of entry. Finally, the return to entry is decreasing in the severity of the tunneling problem $(1-\Theta(.))$: with no tunneling $\Theta(.) = 1$, with tunneling $\Theta(.) < 1$. Tunneling acts as a barrier to firm entry, forcing minority shareholders not only to sustain standard technological entry costs, but also to surrender expected returns to managers and active shareholders to mitigate resource diversion inside firms.

To complete the characterization of the equilibrium effects of corporate governance frictions, we derive an expression for the GDP of our economy, denoted by G. Subtracting the cost of intermediate production from the final output Y and using (23),

$$G = Y - N\,(X + \phi Z) = \left[1 - \frac{\theta}{P} \left(1 + \frac{\phi Z}{X} \right) \right] Y = \left[1 - \frac{\theta}{P} \left(1 + \frac{\phi}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x} \right) \right] Y,$$

where $P = 1/\,(1+\Omega)\,\theta$. GDP per capita thus equals

$$\frac{G}{L} = \underbrace{\left(\frac{\theta}{P} \right)^{\frac{\theta}{1-\theta}}}_{\text{final demand (static)}} \cdot \underbrace{\left[1 - \frac{\theta}{P} \left(1 + \frac{\phi}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x} \right) \right]}_{\text{intermediate efficiency (static IRS)}} \cdot \underbrace{N^{\sigma} Z}_{\text{intermediate technology (dynamic IRS)}}. \tag{26}$$

This expression decomposes GDP per capita in three terms. The first captures the role of the pricing decision in locating firms on their demand curve, thus determining their scale of activity. The second captures the existence of static economies of scale, which imply that larger firms produce at lower average cost. The third captures the role of product variety and product quality, which evolve over time according to the behavior of agents dictated by the returns discussed above.

5.2 The steady state

We now turn to the characterization of the steady state. Households' saving behavior yields

$$r^* = \rho + \frac{\sigma\lambda}{1-\sigma} + z^*. \tag{27}$$

Substituting this expression in the return to entry (25) and observing that, from its definition, the profit rate is given by $\pi = (P-1) - \frac{\phi+z}{x}\left(\frac{\theta}{P}\right)^{-\frac{1}{1-\theta}}$, we obtain the profit rate needed to deliver to minority shareholders their required rate of return

$$\pi^* = \arg\operatorname{solve}\left\{\rho + \frac{\sigma\lambda}{1-\sigma} = \frac{\Theta(\pi)}{\gamma\beta}\pi\right\}. \tag{28}$$

Having obtained π^* from equalizing the return to equity of minority shareholders with their reservation rate of return to saving, we can solve for the other variables of interest by substituting (27) into the returns to investment (24) and to entry (25). We obtain

$$z^* = \alpha(P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x^* - \alpha\phi - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right), \tag{CI}$$

$$z^* = \left[(P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}{\Theta(\pi^*)}\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\right] x^* - \phi. \tag{EI}$$

The first curve, which we call the corporate investment (CI) locus, describes the steady-state rate of investment $z \equiv \dot{Z}/Z$ that incumbent intermediate firms generate given the firm size x that they expect to hold in equilibrium. The second curve, which we call the entry (EI) locus, describes the steady-state investment rate z that equalizes the return to entry and the return to investment given the value of x that both entrants and incumbents expect to hold in equilibrium. The steady state is the intersection of these two curves in the (x, z) space. After some algebra,[7]

$$x^* = \frac{(1-\alpha)\phi - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)}{(1-\alpha)(P-1) - \frac{\gamma\beta}{\Theta(\pi^*)}\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)}\left(\frac{\theta}{P}\right)^{-\frac{1}{1-\theta}}, \tag{29}$$

$$z^* = \frac{\left[\alpha\phi + \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\right]\frac{\gamma\beta}{\Theta(\pi^*)} - \alpha(P-1)}{(1-\alpha)(P-1) - \frac{\gamma\beta}{\Theta(\pi^*)}\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)}\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right), \tag{30}$$

where $P = 1/\theta(1+\Omega)$. The steady state rate of firm entry (variety growth) that guarantees that the firm's size $x \equiv L/N^{1-\sigma}$ is constant in the long run equals

$$n^* \equiv \left(\frac{\dot{N}}{N}\right)^* = \frac{\lambda}{1-\sigma}. \tag{31}$$

From equation (26), we obtain the growth rate of the per capita final output and GDP as

$$\left(\frac{\dot{Y}}{Y}\right)^* - \lambda = \left(\frac{\dot{G}}{G}\right)^* - \lambda = \frac{\sigma\lambda}{1-\sigma} + z^*. \tag{32}$$

[7] Existence and stability of this steady state require the intercept condition that the EI curve starts out below the CI curve and the slope condition that the EI curve is steeper than the CI curve. Together they say that intersection exists with the EI line cutting the CI line from below. The restrictions on the parameters that guarantee this configuration are those stated in Propositions 2-3, that yield the global stability of the economy's dynamics.

Figures 2 and 3 show key properties of the model in steady state by plotting the CI locus and the EI locus, against x. For example, imagine that the government or the financial regulator enact a policy that accommodates the informational opacity of firms in financial markets or that inhibits the monitoring activity of active shareholders, favoring managers' diversion of resources. This policy change could be captured by a reduction in the monitoring efficiency of active shareholders, μ_M, or by a drop in managers' cost of stealing $c^S(S_i)$. Either shock would lead to an intensification of tunneling $1 - \Theta(.)$, that is to a reduction of $\Theta(.)$, the share of net profits appropriated by minority shareholders. Figure 2 shows that the drop in Θ makes the EI locus shift down (rotate clockwise): for a given firm size x, a lower Θ reduces the investment rate z that regulates the arbitrage entry condition. Intuitively, the expenditures on investment must drop to compensate for the fall in the share of profits that can be appropriated by the firm minority shareholders. The intensification of tunneling does not affect the CI locus, though, because it equally erodes returns and costs of investment. As Figure 2 shows, the overall effect of the shock is both a greater steady-state firm size and larger rate of investment of incumbent firms. Put differently, an increase in the severity of the tunneling problem prompts incumbents to invest more aggressively but makes the industry structure more concentrated, inducing a fall in product variety.

The magnitude of the shift produced by the shock depends on the specification of active shareholders' monitoring technology. We have seen that this technology can be specified in a way such that active shareholders' monitoring has always the same effectiveness or alternatively in a way such that larger firms with larger profits are harder to monitor. For instance, if, as in Example 1, $c^M(M_i) = (\eta_M + \kappa\pi_i)M$, one can think of cases in which $\kappa > 0$ or $\kappa = 0$. In the Technical Appendix (see "Steady State and Monitoring Technologies"), we demonstrate that a shock to any parameter that increases the intensity of tunneling $1 - \Theta(.)$ makes the EI locus rotate clockwise relatively more when the marginal cost of monitoring is increasing in the profit rate ($\kappa > 0$) than when it is not ($\kappa = 0$). Thus, the shock induces a larger increase in firms' size x and in the investment rate z when $\kappa > 0$. Intuitively, when $\kappa > 0$ the increase in firms' size induced by the intensification of managers' tunneling reduces the effectiveness of active shareholders' monitoring. This tends to further exacerbate the intensity of tunneling $1 - \Theta(.)$, which in turn further spurs x and z. Thus, when there are diseconomies to scale in monitoring, a multiplier effect is at work, due to a mutually reinforcing interaction between the degree of consolidation of the market structure and the intensity of managers' tunneling.

The effects of an increase in the intensity Ω of empire building are displayed in Figure 3. Again, this shock could be interpreted as the outcome of a policy that favors managers' empire building behavior. An increase in Ω pushes both the EI and CI loci down because the empire building friction lowers the quality-adjusted gross profit margin $(P - 1)\,X/Z$ and raises the cost of entry βX. Intuitively, both the rate of return to entry and to investment fall because managers' price decisions are more distorted. Thus, for given firm size x the expenditure on investment consistent with equalization of the returns of investment and of entry to the reservation rate of return of shareholders must fall. Since both loci shift down, we have a potentially ambiguous effect. However, our algebra reveals that the increase in Ω unambiguously spurs the investment rate z and thus must increase firm size x; see Figure 3 for an illustration. As a result of the shock, therefore, the industry structure becomes more concentrated because that is what is required to have firms that invest more aggressively.

6 Dynamics and welfare: Analytical results

When active shareholders' cost of monitoring does not depend on the profit rate (in Example 1 when $\kappa = 0$), the dynamics of the economy can be traced back to that of one state variable, the firm's size x. Exploiting this property, in this section we provide an analytical background for the quantitative experiments of the next sections on the effects of corporate governance shocks. We defer to Section 8 the analysis of the case in which the marginal cost of monitoring is increasing in the profit rate ($\kappa > 0$ in Example 1).

An interesting feature of the dynamics that will emerge in this section is the evolution of the economy through three stages of development. In the most advanced stage, there is both entry of new firms and investment of incumbent firms. In earlier stages of development, either entry or investment or both, can be zero. We begin with a useful result on the consumption ratio.

Proposition 1 *Let $c \equiv C/Y$ be the economy's consumption ratio. In equilibrium,*

$$c = \begin{cases} 1 - \theta + \frac{\theta}{P}\left[(P-1) - \frac{\phi + z}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}\right] & n = 0 \quad z \geq 0 \\ 1 - \theta + \frac{(\rho - \lambda)\gamma\beta}{\Theta}\frac{\theta}{P}; & n > 0 \quad z \geq 0 \end{cases}. \tag{33}$$

Proof. See the Technical Appendix. ■

Proposition 1 identifies two regimes. In one, (our proxy for) firm size x is too small and there is no entry, in which case the consumption ratio is increasing in x because firms earn escalating rents (uncontested by entrants) from the growing market size (recall that we postulate population growth). In the other regime, firm size x is sufficiently large and there is entry, in which case the rents are capped and the consumption ratio is constant.

Proposition 2 examines the evolution of the firm size across the three stages of development.

Proposition 2 *There exists a finite threshold firm size x_N that triggers entry and a finite threshold x_Z that triggers investment by incumbents (see the proof for the expressions of x_N and x_Z). Assume:*

$$(P-1) > \frac{\beta(\rho - \lambda)}{\Theta}, \tag{34}$$

$$\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x_N - \phi\right)\left(\alpha - \frac{\sigma\Theta}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x_N}\right) < (1-\sigma)\rho + \sigma\lambda, \tag{35}$$

$$1 > \frac{\sigma\Theta}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x_N}. \tag{36}$$

Then, $x_N < x_Z$ and in equilibrium the rates of investment and entry are

$$z(x) = \begin{cases} 0 & \phi \leq x \leq x_N \\ 0 & x_N < x \leq x_Z \\ \frac{\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x-\phi\right)\left(\alpha-\frac{\sigma\Theta}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}\right)-(1-\sigma)\rho-\sigma\lambda}{1-\frac{\sigma\Theta}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}} & x_z < x < \infty \end{cases}; \tag{37}$$

$$n(x) = \begin{cases} 0 & \phi \leq x \leq x_N \\ \frac{\Theta}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\phi}{x}\right) - \rho + \lambda & x_N < x \leq x_Z \\ \frac{\Theta}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\phi+z(x)}{x}\right) - \rho + \lambda & x_z < x < \infty \end{cases}. \tag{38}$$

Firm size obeys the differential equation

$$\frac{\dot{x}}{x} = \Psi(x) \equiv \lambda - (1-\sigma)\, n(x). \tag{39}$$

Proof. See the Technical Appendix. ■

The technical assumptions (34)-(36) allow us to focus on the most interesting sequence of development in which firm entry becomes active before incumbents start investing. Assumption (34) says that the threshold x_N for entry is finite. Assumption (35) says that when the economy crosses the threshold x_N and activates entry, investment is not yet profitable and it takes additional growth of firm size x to activate it ($x_N < x_Z$). Assumption (36) says that when the economy crosses the threshold x_Z the no-arbitrage condition that returns be equalized if both entry and investment are to take place identifies a stable Nash equilibrium (see also the proof of the proposition). Proposition 3 states the formal result, including the condition that ensures that the economy does cross x_Z.

Proposition 3 *Assume*

$$\frac{\sigma\lambda}{1-\sigma} + \rho > \frac{\Theta}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\phi}{x_Z}\right); \tag{40}$$

$$\lim_{x\to\infty} \Psi(x) = \lim_{x\to\infty}\left[\rho + \frac{\sigma\lambda}{1-\sigma} - \frac{\Theta}{\gamma\beta}(1-\alpha)(P-1)\right] < 0. \tag{41}$$

There exists a unique equilibrium trajectory: given initial condition x_0 the economy converges to the steady state x^*.

Proof. See the Technical Appendix. ■

For $x \leq x_N < x_Z$, $\dot{x}/x = \lambda$ and therefore the economy crosses the threshold for entry in finite time in light of assumption (34) that guarantees that x_N is finite. For $x_N < x < x_Z$,

$$\frac{\dot{x}}{x} = \sigma\lambda + (1-\sigma)\,\rho - (1-\sigma)\,\frac{\Theta}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\phi}{x}\right). \tag{42}$$

Therefore, the economy crosses the threshold for investment in finite time since x is still growing at $x = x_Z$ in light of assumption (40).[8] Figure 4 illustrates the evolution of x across the three stages of development.

The next sections will study the dynamic response of the economy to shocks to corporate governance frictions as well the welfare effects of the shocks. As we prove in the Technical Appendix using (1), the welfare change induced by a shock to one or more corporate governance friction parameters is related to the detrended patterns of the entry rate n and of the investment rate z as follows (the value of an object after the shock is indicated with a "$'$")

$$\Delta U = \underbrace{\log(\frac{\Lambda'}{\Lambda})}_{\text{initial}} + \int_0^{+\infty} \underbrace{e^{-(\rho-\lambda)t}\int_0^t \{\sigma\Delta n'(s)ds + \Delta z'(s)]\}}_{\text{transition}}dt + \int_0^{+\infty} \underbrace{e^{-(\rho-\lambda)t}\Delta z^*}_{\text{long-run}}dt \tag{43}$$

where $\Lambda \equiv [1-\theta+\frac{(\rho-\lambda)\gamma\beta}{\Theta}\frac{\theta}{P}]\left(\frac{\theta}{P}\right)^{\frac{\theta}{1-\theta}}$, $\Delta n'(s) \equiv n(x(s)) - n'^*$, $\Delta z'(s) \equiv z(x(s)) - z'^*$, $\Delta z^* \equiv z'^* - z^*$. The expression in (43) shows that a corporate governance shock affects welfare through three channels: an initial level effect associated with an immediate (and permanent) change of the consumption-output ratio; a transitional effect associated with the adjustment of the entry rate and of the investment rate to the new conditions (with both investment and entry detrended with their post-shock values); and a long-run effect that accounts for the permanent changes caused by the shock (that is, capturing the welfare change that would be observed if the adjustments were to occur immediately after the shock). All the terms in (43) depend on the state variable $x(t)$. Therefore, the evolution of the welfare change can be linked to time through $x(t)$.

An advantage of the closed form solution of the dynamics of x is that we can also obtain analytical results for the impact of corporate governance shocks on welfare. In particular, we can prove the following:

Proposition 4 *Consider the transition path of an economy that starts at time* 0 *with initial condition* $x_0 > x_Z$ *and converges to* x^**. Under the approximation* $\sigma\Theta/\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x \cong 0$ *(i.e.,* x *sufficiently large),* x *evolves according to the linear differential equation*

$$\dot{x} = \nu \cdot (x^* - x)\,, \tag{44}$$

[8] Note that x_Z is always finite so, given population growth, the economy can fail to cross it only if there is premature market saturation due to entry. The intuition behind the dynamics is that we have chosen a configuration of parameters such that the quality-adjusted gross profitability of firms, $(P-1)\,X/Z$, rises throughout the range $[\phi, x_Z]$. Consequently, the dissipation of profitability due to entry gains sufficient force to induce convergence to a constant value of x only in the region where firms have already activated investment.

where

$$\nu \equiv (1-\sigma)\left[(1-\alpha)(P-1)\frac{\Theta}{\gamma\beta}-\left(\rho+\frac{\sigma\lambda}{1-\sigma}\right)\right]. \tag{45}$$

Therefore, the explicit solution for the economy's path is

$$x(t) = x_0 e^{-\nu t} + x^*\left(1-e^{-\nu t}\right). \tag{46}$$

Using this result when integrating (43), the welfare change induced by a shock that affects one or more parameters can be rewritten as[9]

$$\Delta U = \frac{1}{\rho-\lambda}\{\log(\frac{\Lambda'}{\Lambda}) + \left(z'^* - z^*\right) - \frac{\alpha x^*\left(P'-1\right)\left(\frac{\theta}{P'}\right)^{\frac{1}{1-\theta}} + \frac{\sigma\nu'}{1-\sigma}}{\rho-\lambda+\nu'}(\frac{x'^*}{x^*}-1)\}. \tag{47}$$

Proof. See the Technical Appendix. ■

7 Calibration and response to shocks

In this section and the next, we conduct experiments to study quantitatively the dynamic adjustment of the economy when it is hit by shocks to corporate governance frictions. These shocks can be thought as the effects of policy reforms, for example. In recent decades, a large number of corporate governance reforms have been enacted in advanced and emerging economies. These reforms have modified the rules governing the activity of auditors, the composition and prerogatives of boards of directors, the allocation of power among corporate stakeholders, the punishment of corporate frauds, the disclosure requirements in capital markets (OECD, 2012).

In this section, we study quantitatively the dynamics investigated analytically in the previous section for the case in which active shareholders' cost of monitoring does not depend on the profit rate. In Section 8, we will study quantitatively the dynamics for the case in which active shareholders' cost of monitoring does depend on the profit rate. In both sections, we conduct experiments focusing on the most advanced stage of development ($x > x_Z$) in which both firm entry and incumbents' investment take place, that is, $n > 0$ and $z > 0$. We defer the reader to Section 9 for a quantitative analysis of the effects of corporate governance frictions on the long-run evolution of the economy through earlier stages of development in which either investment ($x_N < x < x_Z$) or both entry and investment ($x < x_N$) do not take place.

7.1 Calibration

Table 1, Panel A, displays the chosen parameterization of the baseline economy. The population growth rate λ is set equal to 1.21 percent, which corresponds to the average population growth rate in the United States from 1910 to 2009 (Maddison data). The value of α is inferred from comparing the private return on capital with the social return to investment in product quality. If

[9] Since we are mostly interested in corporate governance shocks, this expression excludes shocks to $\rho, \sigma, \theta, \lambda$,and α. A generalized expression for ΔU can be found in the Technical Appendix.

the investment decisions were taken by internalizing the spillover effects of investment, the return would be $1/\alpha$ times the private return (see (24)). Jones and Williams (1998) survey several empirical studies that put the rate of return on R&D (a proxy for investment in product quality) in the range of 30-100 percent. Using a conservative lower bound of 30% for the social return and a private rate of return on capital of 5%, we set α equal to 1/6.

The parameter Ω that governs managers' empire building is set equal to 0.1%, in the ballpark of the estimates of Nikolov and Whited (2013) for the United States. The monopolistic price P is set to 1.3, following the empirical literature on the Lerner index. As a result, if $\Omega = 0.1\%$, the corresponding value of the parameter θ is 0.768. Because we target a long-run growth rate of per capita income of 2% and an interest rate of 5%, the discount rate, ρ, is set to 0.03.

The social return to variety, σ, is pinned down by the steady state relationship (31), $\sigma = 1-\lambda/n$. Laincz and Peretto (2006) observe that in recent years the net entry rate of establishments in the U.S. manufacturing sector has roughly been equal to the population growth rate, implying $\sigma = 0$. According to the World Bank Entrepreneurship database, in 2005 firm entry and exit rates in the United States were 12.5 and 10 percent, respectively, implying a net entry rate n of 2.5% and $\sigma = 0.5$. We pick a value of σ in the middle of the interval, letting $\sigma = 0.25$. Then, the associated entry rate n is 1.61 percent.

The four parameters that jointly determine the intensity of managers' tunneling and of active shareholders' monitoring, μ_M, μ_S, η_M, η_S, can hardly be identified separately. We then settled on a set of values that induce a level of tunneling ($\Sigma = 0.2\%$) of the order of magnitude of that estimated by Nikolov and Whited (2013) for the United States, to have active monitoring ($e_a > 0$), and to have an equity share $1 - e_m - e_a$ of minority (passive) shareholders of about 3/4. Supplementary Figure A1 in the Appendix helps understand how the steady state allocation of equity shares among managers, active and minority shareholders changes depending on a key parameter, μ_M, capturing active shareholders' monitoring efficiency. Finally, the values of ϕ and $\gamma\beta$ are chosen to match a balanced growth rate of per capita gross final output, $y = \dot{Y}/Y$, of 2% and a saving rate s of 10%, as suggested again by the U.S. experience (the saving rate is defined as the fraction of the GDP not consumed, i.e., $s = 1 - C/G$).[10] Since $z = y - \sigma n$ (see (31) and (32)), the baseline investment rate z is 1.60 percent, nearly the same as the net entry rate n (1.61 percent).

7.2 Response to shocks

We study the impulse responses to variations in the parameters that govern the intensity of the empire building friction or of the tunneling friction (in each experiment, we change only one parameter). Consistent with their interpretation as structural policy reforms, all the shocks are permanent and are perceived as such. For simplicity, we also assume they are not anticipated. We posit that the baseline parameter values are as in Table 1, Panel A. Our main objective is to disentangle the

[10] According to data from the Bureau of Economic Analysis the gross national saving rate in the post-war period fluctuated between 15% and 20%. Allowing for a depreciation rate of 5-10 percent, we obtain a net saving rate, as a ratio of GDP, in the interval of 5-15 percent. Our calibration delivers a saving rate in the middle of this interval.

short- and long-run consequences of an alteration of the friction parameters both on incumbents' investment and on the entry of new firms. An important result that emerges is that a given corporate governance shock can have asymmetric consequences on the two sources of growth (entry and investment): it may depress one but boost the other.

In interpreting the dynamic responses to the shocks presented below, it is important to keep in mind that the economy without corporate governance frictions is not a first-best environment. First, the presence of monopolistic power in the intermediate sector generates a classic static inefficiency that translates into a sub-optimal level of production. Second, an incumbent intermediate firm can appropriate only a fraction of the return of its own investment, while benefiting from the investment of other firms. Therefore, the decentralized equilibrium solution implies levels of investment lower than those that would be chosen by a social planner. In principle, corporate governance frictions can then be beneficial if they mitigate the inefficiency of the frictionless economy or harmful if they exacerbate it.

7.2.1 Empire building

In a first experiment, we reduce the parameter Ω that governs managers' empire building from 0.1% to zero. This shock can mimic the effect of a policy reform that tightens managerial discipline, for example. The pre-shock steady state of the economy is summarized in Panel B of Table 1. Figure 5, which plots the impulse responses, shows that an immediate consequence of the shock is a reduction of the quantity produced, due to a rise in the monopolistic price (recall that $P = \frac{1}{\theta(1+\Omega)}$). Because the price is brought to the optimal monopolistic level of the frictionless economy, profits expand. This is a positive development not only from the perspective of incumbent firms but also from that of potential entrants. Indeed, lured by the higher profits, households found more firms. The resulting expansion of the array of intermediate goods favors productivity growth in the final good sector. This entry effect can be strong enough to displace resources that incumbent intermediate firms would have allocated to investment in an economy affected by empire building. Specifically, there are two competing forces that shape the response of incumbents' investment. On the one hand, the elimination of the pricing distortion leads firms to produce the profit-maximizing quantity of intermediate goods. This raises the return to investment, boosting it. On the other hand, the greater intensity with which new firms flock in causes a reduction of firms' average size, prompting firms to slow down their investment. In this baseline economy, which has a relatively small initial empire building friction, the latter effect prevails both in the immediate aftermath of the shock and in the long run: investment drops in the immediate aftermath of the shock and thereafter exhibits a slow decline. The saving rate s goes up after the shock, reflecting the lower investment of incumbents which prevails over the additional resources absorbed by the greater number of new entries. Finally, because after the shock the size of the average firm shrinks, the rate of return on assets drops, as the bottom left graph of Figure 5 shows.

Equation (43) suggests that we can separate the components of the welfare effect of the shock. The top-left graph of Figure 10 plots the terms identified in the equation as "initial", "transition", and "long run" (as percentages of their pre-shock value). The bottom U-shaped line captures the negative long-run welfare effect due to the decline of incumbents' investment rate relative to the baseline economy: formally, it is the discounted log of the consumption ratio of the two economies growing on their respective long-run paths. Because the shock causes a long-run decline in the per capita output growth rate, this component of the welfare change is necessarily negative. The top hump-shaped curve reflects the other two components. The first, captured by the negative intercept of the curve, is the price increase of intermediate goods due to the drop of Ω (put differently, the elimination of Ω gives more bite to the monopolistic price distortion). Because of the higher cost of intermediates, final good producers contract their production and, as a result, consumers' welfare goes down (initial consumption component in (43)). But, as noted, the shock also favors the entry of new firms along the transition, meaning that consumers benefit from a greater variety of intermediate goods (transition component in (43)). In sum, the reduction in the intensity of empire building leads to a welfare improvement if the transition effect of more intense entry of new firms is greater than the sum of the long-run negative effect on investment and the initial negative effect caused by the price increase.[11] As Table 2 shows, in the baseline economy with a relatively small initial empire building distortion, the negative effects tend to prevail.

Next, we aim at gaining a broad picture of the adjustment process that can be expected in countries characterized by greater freedom of managers in pursuing empire building objectives (e.g., emerging countries where, as noted, government policies have often favored managers' empire building attitude). Dyck and Zingales (2004) show that the block premium (a proxy for the intensity of corporate governance frictions) exhibits pronounced variation, with countries such as Brazil and Indonesia having an average block premium dozens times larger than the United States. And La Porta et al. (2000) find a wide cross-country variation in the severity of corporate governance frictions. Figure 6 and Figure 7 plot the impulse responses as differences from the pre-shock steady state levels of the baseline economy and of two other economies that differ from the baseline only because the pre-shock value of Ω is higher by 50% and by 50 times, respectively. For comparison purposes, the figures also display the impulse responses for economies with a higher entry cost (higher β).[12] The long-run outcomes are collected in Table 2.

The top right plot of Figures 6 and 7 display the entry rate in the decades that follow the shock. Both in the economy with a slightly higher Ω and in the economy with high Ω the increase in firm entry is more pronounced than in the baseline economy and, consequently, the decline in firms' size is faster (in the economy with greater entry cost the outcome is instead more ambiguous). As for incumbents' investment, instead, in contrast with the baseline economy, in the economy with high initial Ω firms' investment rate increases (rather than dropping) in the aftermath of the shock and remains above the pre-shock steady state value for several years, only eventually dropping below

[11] Clearly, the slower the transition, the larger the weight we put on the transitional component and the more we tend to find a positive welfare effect of the drop of Ω.

[12] One consequence of the high entry cost is a greater saving rate, an implication in line with the observation that emerging countries save considerably more than the United States (in our example, a 50% increase in the entry cost leads to a 60% rise of the saving rate).

it (top left plot of the figures). Intuitively, the effect due to the better pricing and production decisions of managers gains importance, and this tends to boost investment initially (observe also the initial slight increase in the return on assets).[13] In a welfare perspective, in the economy with high initial Ω this initial boost to incumbents' investment adds to the bigger increase in the entry rate relative to the baseline economy. Together these effects lead to an acceleration of income growth for several decades implying that in the economy with high initial Ω the positive transitional welfare component dominates the negative welfare components (see the last three columns, middle row of Table 2). Thus, welfare increases when the original economy features an important empire building distortion. The left graph of Figure 11, Panel A, better illustrates this argument: the graph suggests that the welfare change due to the shock increases monotonically with respect to the initial level of the $\Omega-$friction, implying that economies further away from the United States along this dimension have the most to gain from policies that contrast managers' empire building.

Panel A of Figure 11 also provides a broader view of the welfare consequences of the empire building shock for economies that differ in two other dimensions, the entry cost and the intensity of tunneling. For example, the right graph of the panel considers the welfare change following the $\Omega-$shock for economies characterized by different levels of tunneling, $1-\Theta$. Interestingly, a greater exposure to tunneling implies again a larger welfare gain following a reduction in the intensity of empire building.

7.2.2 Tunneling

In a second set of experiments, we alter the intensity of tunneling by enhancing the efficiency of active shareholders' monitoring technology, μ_M. This could mimic the effect of a policy reform that empowers the monitoring activities of active shareholders, such as institutional investors (Aghion, Van Reenen and Zingales, 2013). The baseline parameters are again as in Table 1, Panel A. The size of the shock is chosen to produce a long-run change in the growth rate of output comparable with that obtained in the baseline $\Omega-$experiment. Therefore, by construction, the long-run effects on z, y, and r, shown in the first row of Table 3, are the same as in the baseline empire-building experiment. Unlike in the $\Omega-$experiment, the allocation of equity shares, the stealing and monitoring efforts, and more in general the tunneling activities, are now affected by the shock.

The improvement in their monitoring technology induces to allocate a greater equity share e_a to active shareholders, in the attempt to exploit their enhanced monitoring efficiency, and to reduce the share e_m awarded to managers. The outcome of this reshuffling of equity shares is an intensification of both monitoring and stealing efforts that, while leading to greater stealing (Σ grows from 0.2 to 0.42 percent), reduces the overall intensity of tunneling. In fact, the fraction $1-\Theta$ of profits surrendered by minority shareholders to managers and to active shareholders drops because minority shareholders retain a significantly larger equity share $1-e_m-e_a$. As Figure

[13] The economy with greater entry cost responds relatively more slowly to the shock. This benefits welfare for the slowdown of income growth is more modest at the beginning of the transition. The jump of the saving rate is more evident in the high-Ω and in the high-β economy than in the baseline economy.

8 shows, in terms of industry dynamics this reduction in the intensity $1 - \Theta$ of tunneling leads to faster firm entry, which, in turn, causes a downsizing of the average firm. As a result, firms' return on investment goes down. Note that, unlike in the empire-building experiment, in this case there is no alteration in the static inefficiency due to monopolistic power and, hence, no increase in the return to investment through this channel. In the long run, the economy will converge to an equilibrium with more firms of smaller size that devote a relatively smaller share of their sales to investment.

The welfare effects of the shock are displayed in the bottom-left graph of Figure 10. The decline of the long-run component of welfare is still caused by the drop of the investment rate, like in the empire-building experiment (bottom U-shaped line). The source of the welfare benefits is still the greater variety of intermediate goods due to more intense firm entry (top hump-shaped curve). In contrast with the empire-building experiment, the reduction in the intensity of tunneling does not alter directly the static inefficiency due to monopolistic power; therefore, the initial component of the welfare change is muted. Overall, in the baseline economy the long-run and the transitional components of the welfare change roughly balance each other (see Table 3). An increase in the cost of stealing (η_S) or a reduction in the cost of monitoring (η_M) or in the ease of stealing (μ_S) have similar qualitative effects.

As with the set of Ω-experiments, especially motivated by the experience of emerging countries, Figure 9 compares the impulse responses to a monitoring shock in the baseline economy (solid lines) with the impulse responses of an economy characterized by lower initial monitoring efficiency μ_M (dotted lines); for comparison, we also consider the impulse responses (dashed lines) for an economy with higher initial entry cost (β larger by 50% than the baseline). The long-run changes caused by the monitoring shock in each scenario are in Table 3. As Figure 9 reveals, when the economy features a higher initial intensity of the tunneling friction (active shareholders' monitoring initially less efficient), the improvement in the monitoring technology produces qualitatively similar but quantitatively smaller effects on the aggregate variables of interest. Specifically, an economy with a lower initial μ_M exhibits a relatively smaller increase in the entry rate, a slower decline in firms' size, and a smaller drop in the investment rate of incumbents. As in the baseline case, the long-run and the transitional components of the welfare change roughly balance each other (see Table 3). But, interestingly, the right graph of Figure 11, Panel B, shows that the lower is the initial efficiency of the monitoring technology, μ_M, the more welfare-enhancing (or the less welfare-reducing) the shock. Thus, similar to what observed for the empire-building shock, reforms that improve corporate governance benefit more economies with poor initial corporate governance than economies with strong governance.

8 Feedback effects

An important tenet of the literature is that the corporate governance frictions explored in this paper tend to be more severe in larger firms (see, e.g., Jensen and Meckling, 1976). For example, active shareholders' monitoring can be more difficult in larger, hence more complex, businesses. To grasp the implications of this argument, in this section we allow the cost of active shareholders' monitoring to increase with the profits to be monitored ($\kappa > 0$ in Example 1) and revisit the economy's adjustment process following a permanent reduction of the intensity of empire building (Ω). The dynamic response is now more complex because the tunneling activities are a function of both the investment rate z and firms' size x. To ease the exposition, we assume that during the transition the consumption-output ratio and the shadow value of q are locked to their respective pre-shock steady state values.[14] Under this restriction, (34)-(36) still describe the dynamic system in the state space where there is investment ($z > 0$) and entry ($n > 0$). However, the intensity of tunneling $1 - \Theta$ is no longer constant; it now depends on the profit rate π, as detailed in (19), and thus on x and z. Because of this dependence, the dynamic system can no longer be reduced to a single differential equation in x as in Proposition 4. Instead, we solve numerically the three differential equations (34)-(36) without any further transformation. For an arbitrary initial value of $x(t)$ we find the value of $z(t)$[15] that solves (34). Then (35) delivers the entry rate $n(t)$. Finally, $x(t+1)$ is obtained through (36).

The solid lines of Figure 12 represent the experiment of reducing the intensity of empire building, Ω, from the baseline value of 0.1% to 0. In these simulations, changes in firms' profit rate π feed back on the net return on active shareholders' monitoring. In addition to the behavior of the investment rate, of the entry rate and of firms' size, the figure also plots the adjustment of firms' equity shares among managers, active and minority shareholders. In the immediate aftermath of the shock, firms' profitability increases and so do monitoring costs, for a given size of the firm. In the previous section, we observed that when monitoring becomes more costly, minority shareholders try to deter managers' tunneling by allocating them a greater equity share. At the same time, because it is anticipated that active shareholders will opt for a lower monitoring effort, it is optimal to reduce their equity share in the firm. The two top right plots display these adjustments with a up and a downward jump of managers' and active shareholders' equity shares, respectively. Overall, minority shareholders retain a smaller equity share, which explains the worsening of the tunneling effect.

In the long run, the reduction in the empire building friction induces the economy to adjust towards a smaller size of firms. During the transition, the profit rate declines, implying a gradual reduction in the marginal monitoring cost. Hence, during the transition the equity shares are readjusted in the opposite direction relative to the adjustment observed in the immediate aftermath of the shock. As a result, the intensity of tunneling progressively becomes less severe as the economy converges to its long-run equilibrium, further promoting the entry of new firms and reducing firms' size. Thus, a mutually reinforcing interaction (multiplier effect) arises between the degree of consolidation of the market structure and the intensity of corporate governance frictions.

[14] In experiments available upon request we observed that even when C/Y is allowed to adjust endogenously, its variation generates negligible effects on the impulse responses of z, n and x.

[15] We set up a search on a grid of size 10^{-7}.

To emphasize the qualitative differences between the current specification of the monitoring technology and the specification of the previous section, the figure plots in dashed lines the impulse responses when the feedback from firms' profit rate to the cost of monitoring is muted. Specifically, along the dynamics we set the marginal cost of monitoring equal to the value observed in the pre-shock steady state. Clearly, there is no readjustment of the equity shares in this case. The downward adjustment of the firm's size and of the entry rate are somewhat faster when the feedback effect is present, because during the transition active shareholders' monitoring becomes more efficient and managers' tunneling becomes less severe. This gives an extra kick to the firm's downsizing relative to what would be observed in the absence of the feedback effect.

9 Long run

In the previous two sections, we investigated the effects of shocks to corporate governance frictions in the region where both entry and investment take place ($n > 0$ and $z > 0$). In this section, we study the effect of the frictions on the long-run pattern of development of the economy. As demonstrated in Section 6, the economy can go through three subsequent stages of development: a first stage with no entry and no investment, a second stage with only entry, and a third stage with both investment and entry.

9.1 Empire building

Figure 13 compares the long-run evolution of two economies that differ only in the intensity of the empire building friction. We use the same parameters of Table 1 for the low-friction economy (solid lines). The intensity of empire building (Ω) is ten times higher in the alternative, high-friction economy (dashed lines). Both economies start from the same initial firm size x_0. At first, they simply produce the final good using an exogenously given variety of intermediate goods: there is no entry and no investment. Specifically, (24) and (25) hold as inequalities because both the return to entry and the return to investment are too low relative to the discount rate. The whole net output is consumed and there is no saving. In this phase, therefore, the only source of dynamics is the enlargement of the population that causes a gradual increase of firms' size x and thereby of firms' profitability. As the (quality-adjusted) profit rate rises, at a certain point firm entry becomes profitable. The trigger point is reached first in the low-friction economy, where profits tend to be higher, for a given firm size x (which is the same in the two economies during the first phase of development).[16] Afterwards, the paths of development of the two economies are no longer the same. The delay in turning on entry in the high-friction economy results in relatively larger firms. Indeed, from that time onwards the two economies systematically differ in the market structure.

[16] The baseline parameters generate a sequence of development in which entry precedes investment by incumbents. In principle, under an alternative parametrization, the model allows for an inverted sequencing in which incumbents' investment kicks in first.

The high-friction economy will have larger firms, and fewer of them, and will use a smaller variety of intermediate goods to produce the final consumption good.

In the second phase of development, incumbent firms do not yet invest because it is not profitable to do so — formally, the right-hand-side of equation (24) is smaller that the right-hand-side of equation (25). Because the firms that populate the low-friction economy are of smaller size, their rate of return on investment is systematically lower than in the high-friction economy. Consequently, the low-friction economy enters the investment phase of development (third phase) later than the high-friction economy, and has a relatively lower investment rate even when investment is profitable in both economies. In brief, the low-friction economy grows at a faster pace in the second phase of development, but in the third phase it is outpaced in terms of growth by the high-friction economy, in which incumbent firms invest more aggressively.

9.2 Tunneling

We next compare the transition paths of two economies characterized by a different monitoring efficiency μ_M. In Figure 14 the solid lines represent the same baseline economy as in Figure 13. In the alternative, low-friction economy (dashed-lines) the monitoring technology is more efficient. As noted earlier, in the economy where active shareholders are more efficient monitors, managers' tunneling is less intense. The key variable that explains the different transitional experiences of the high- and the low-friction economy is the size Θ of the firms' profits that remains in the hands of minority shareholders. Because this is greater in the low-friction economy, entry occurs earlier and thereafter is systematically more intense. As a result, firms' size is always smaller, which explains the relatively less aggressive investment of incumbent firms. Despite these differences in the market structure, our calculations suggest that the two economies enjoy about the same level of welfare, evaluated from the initial viewpoint: the low-friction economy benefits relatively more on the variety dimension, whereas the high-friction economy reaps relatively more benefits from the faster pace at which incumbents invest in their intermediate products. During the transition neither economy systematically outperforms the other with respect to the per capita output growth rate.

10 Conclusion

This paper has investigated the impact of financial market imperfections, in the form of corporate governance frictions, on growth and industry dynamics. Following prior literature, we have posited two forms of frictions: an empire building issue, such that managers enjoy private benefits from expanding firms' size, and a tunneling issue, such that managers can divert resources from firms. We have also posited that, while firm active shareholders can monitor and mitigate managers' tunneling activities, they cannot commit to monitoring managers. The design of monitoring incentives for active shareholders allows them to extract rents from minority shareholders. The analysis reveals that both corporate governance frictions tend to increase the concentration of the market structure and depress the entry rate of new firms. By contrast, the frictions have contrasting effects on the investment of incumbent firms and in the long run tend to make incumbents invest more aggressively.

When the economy is hit by a shock to the intensity of the tunneling or of the empire building friction, the mechanisms described above contrast each other in shaping the welfare impact of the shock. For example, following a reduction in the intensity of tunneling, the positive welfare effects associated with the acceleration in firms' entry can be dumped down by the slower rate of investment of incumbents. When the friction corrected is instead managers' empire building, it is more likely that the positive welfare effects prevail. Importantly, the analysis predicts that policy reforms that enhance corporate governance benefit economies with poor corporate governance more than economies with good governance.

The analysis leaves interesting questions open for future research. The paper does not make explicit the conditions on the supply side of the financial market that could exacerbate or alleviate corporate governance frictions. However, it is often argued that lax credit policies of financial institutions have allowed large businesses to pursue empire building objectives. Furthermore, such policies, and the resulting firm leverage build up, have allegedly influenced managers' ability to divert resources from firms. Thus, explicitly accounting for the role of financial institutions as creditors could yield important insights into the relation between corporate governance and growth. We leave this and other issues for future research.

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Table 1: Baseline Economy, Steady State

Panel A: Parameters

Production and Entry					Households		Corporate Governance				
α	σ	θ	ϕ	$\gamma\beta$	ρ	λ	μ_M	μ_S	η_M	η_S	Ω
0.167	0.25	0.768	0.567	2.2	0.03	0.0121	0.07	1.068	0.0001	0.7975	0.001

Panel B: Steady State

Ratio	Percentages											
x^*	z	n	y	r	s	e_a	e_m	$1-e_a-e_m$	Θ	$c_S(S)$	$c_M(M)$	$\sum$
27.91	1.60	1.61	2	5	10.51	5.35	18.43	76.23	76.07	7.37	0.27	0.20

Table 2: Reduction of Empire Building Friction

	Δ Steady State (%)			Δ Welfare (%)		
	x^*	z, y, r	s	Trans	LR	Tot
Baseline	-0.28	-0.04	-0.04	0.39	-0.51	-0.12
50% higher Ω	-0.28	-0.04	-0.03	0.40	-0.51	-0.11
high Ω	-0.55	-0.08	0.03	0.80	-0.76	0.04
50% higher β	-0.61	-0.13	0.05	0.82	-0.88	-0.06
high β	-1.57	-0.64	0.10	1.81	-1.84	-0.03

– Note: The value of Ω drops by 0.001 in all five scenarios. In the second and third row from the top, the initial value of Ω is 50% higher and 50 times higher than the baseline value of Table 1, respectively. In the following two rows, the entry cost β is 50% and twice higher than the baseline value. Only variables listed in Table 1 that displayed some change are reported here. The last three columns summarize the transitional (Trans), long- run (LR) and total (Tot) welfare effects of the shock (see text or note of Figure 10).

Table 3: Improvement of Monitoring Technology

	Δ Steady State (%)										Δ Welfare (%)		
	x^*	z, y, r	s	e_a	e_m	1-e_a-e_m	Θ	$c_S(.)$	$c_M(.)$	$\sum$	Trans	LR	Tot
Baseline	-0.32	-0.05	-0.04	0.21	-0.75	0.54	0.38	0.80	0.03	0.21	0.53	-0.58	-0.05
lower μ_M	-0.31	-0.04	-0.03	0.20	-0.72	0.52	0.36	0.77	0.03	0.21	0.51	-0.56	-0.05
low μ_M	-0.29	0.04	-0.03	0.19	-0.68	0.49	0.34	0.73	0.02	0.20	0.48	-0.53	-0.05
higher β	-0.71	-0.15	0.02	0.21	-0.75	0.54	0.38	0.80	0.03	0.21	0.98	-1.01	-0.03
high β	-1.80	-0.73	0.07	0.21	-0.75	0.54	0.38	0.80	0.03	0.21	2.09	-2.11	-0.02

– Note: The value of μ_M increases by 3% in all five scenarios. In the second and third row from the top, the pre-shock value of μ_M is respectively 98% and 95% of the baseline value. In the forth and fifth row, the entry cost β is 50% and 100% higher than the baseline value. The last three columns summarize the transitional (Trans), long- run (LR) and total (Tot) welfare effects of the shock.

Figure 1: Investor Protection and Firm Entry

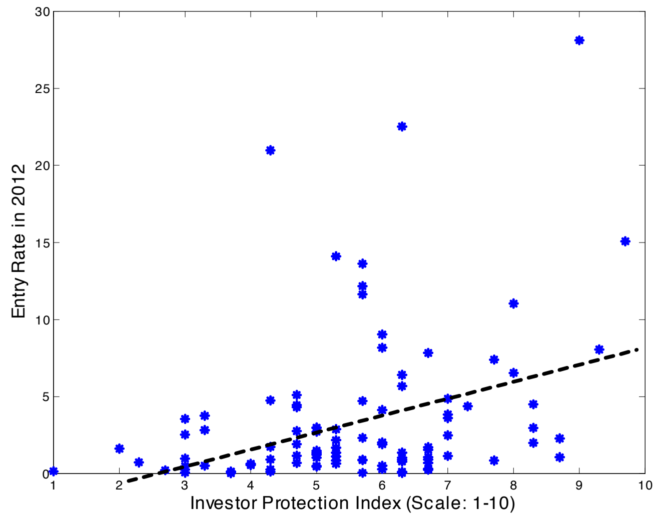


Figure 2: Steady-State Effect of an Increase in Tunneling

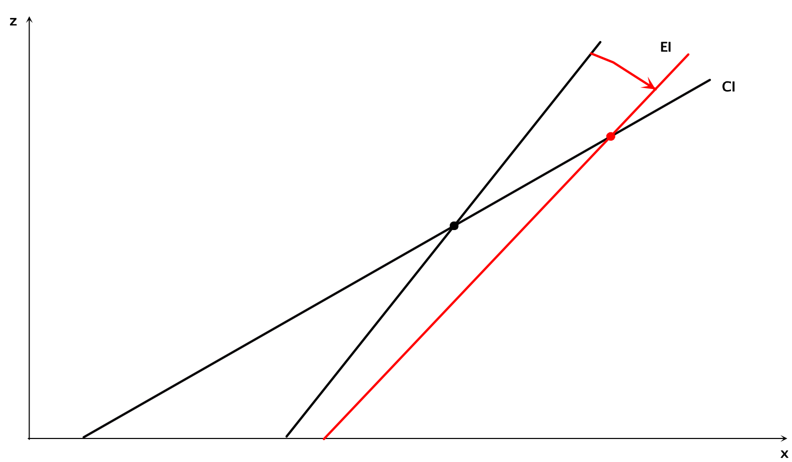


Figure 3: Steady-State Effect of an Increase in Empire Building

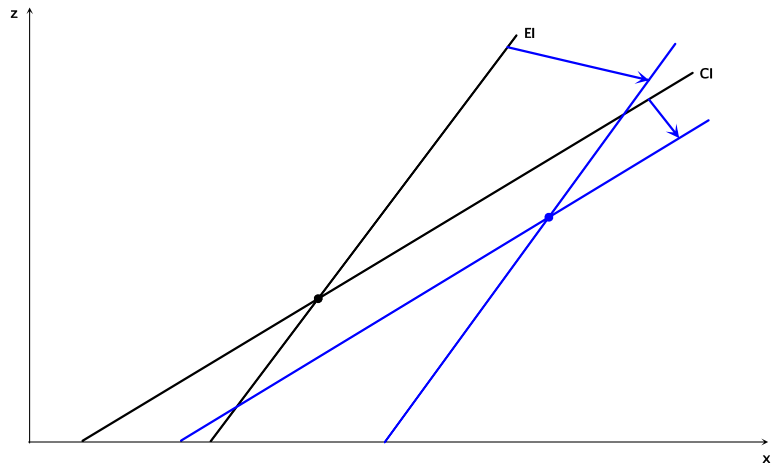


Figure 4: Equilibrium Dynamics

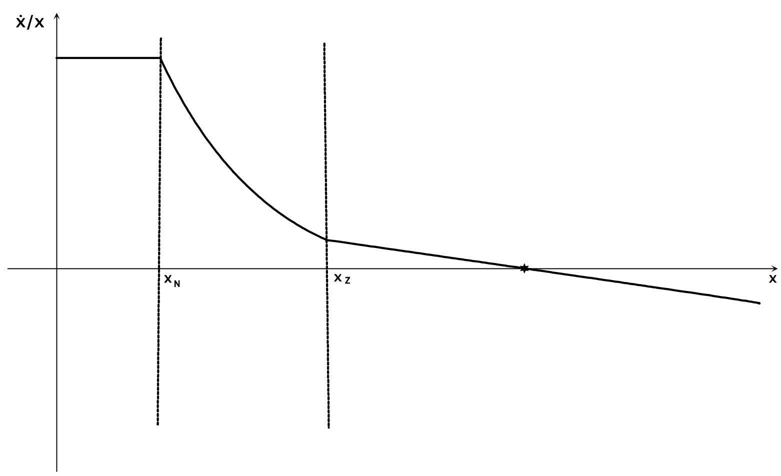
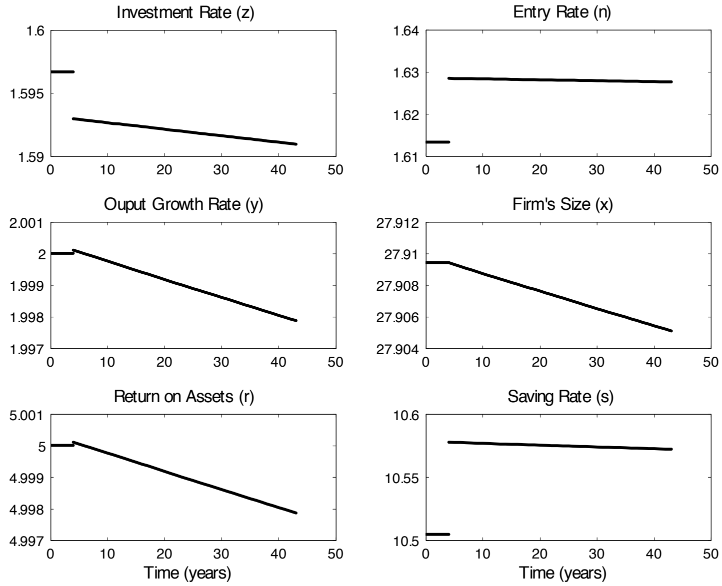
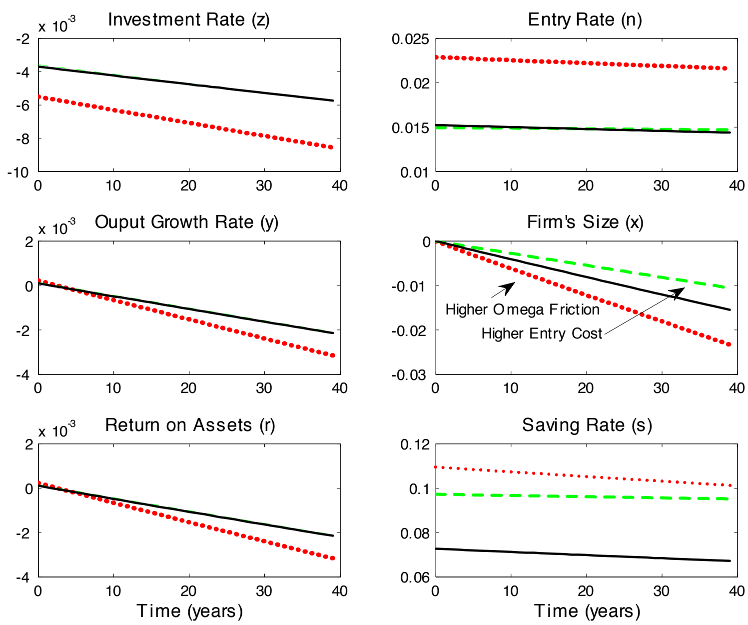


Figure 5: Impulse Responses to Empire Building Shock



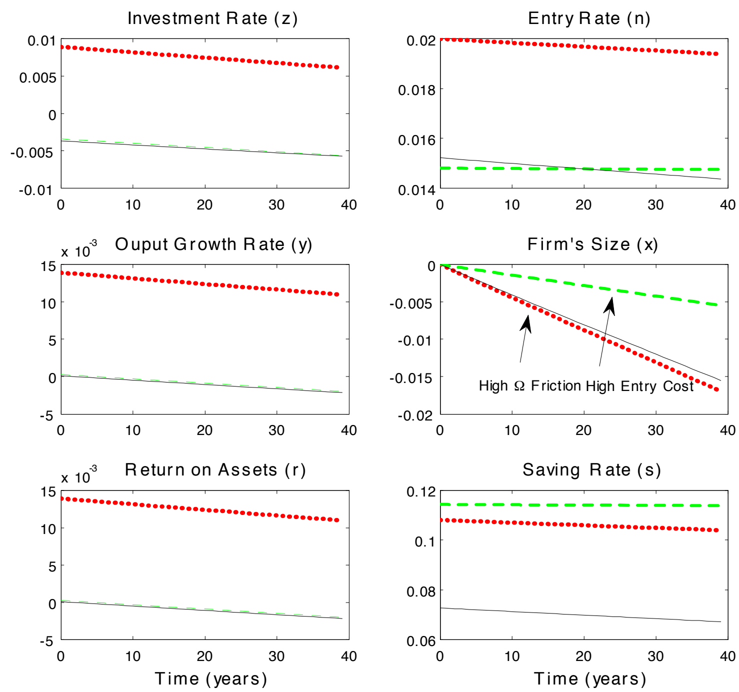
– Note: The rates are in percentage. The parameter Ω is lowered from 0.001 to 0. Underlying parameters are shown in Table 1, Panel A. For steady state values before the shock see Table 1, Panel B.

Figure 6: Empire Building – Comparing Impulse Responses



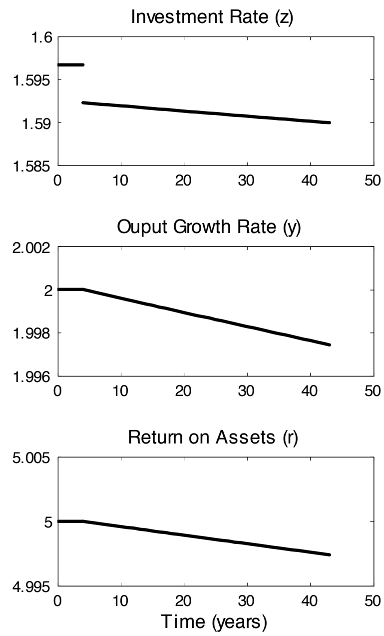
– Note: The rates are in percentage. Deviations of x from its pre-shock steady state are also in percentage. The solid lines represent the impulse responses (in differences with respect to the pre-shock level) of the same experiment depicted in Figure 5. The dashed lines and dotted lines show similar experiments with a 50% higher initial level of β and of Ω, respectively.

Figure 7: Empire Building – Comparing Impulse Responses (cont.)



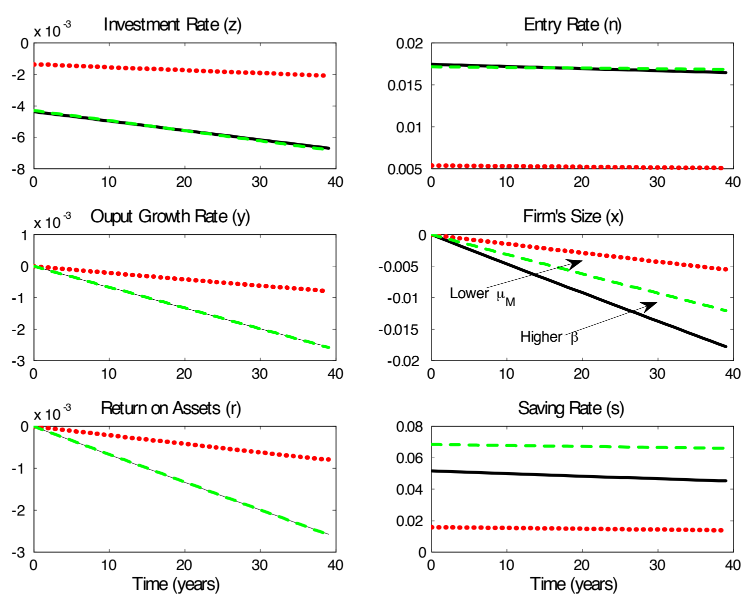
– Note: The solid lines are the impulse responses of the baseline $\Omega-$experiment (in differences with respect to the pre-shock level). The dotted lines represent a similar experiment in an economy in which the initial value of Ω equals 0.05. The dashed lines are the impulse responses of an economy where the entry cost, β, is double relative to the baseline economy.

Figure 8: Impulse Responses to Tunnelling (Monitoring) Shock



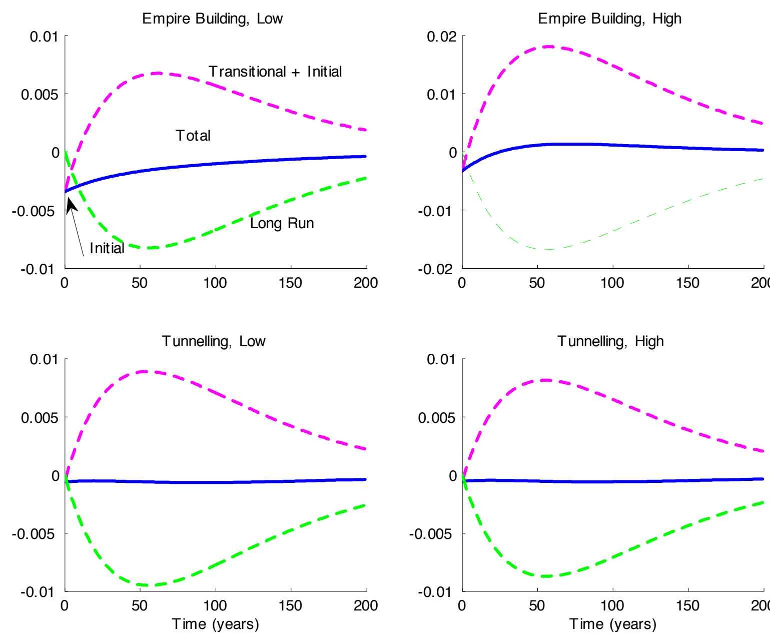
– Note: The rates are in percentage. The parameter μ_M governing the efficiency of active shareholders' monitoring is raised by 3% from its baseline value of Table 1, Panel A. For steady state values before the shock see Table 1, Panel B.

Figure 9: Tunnelling – Comparing Impulse Responses



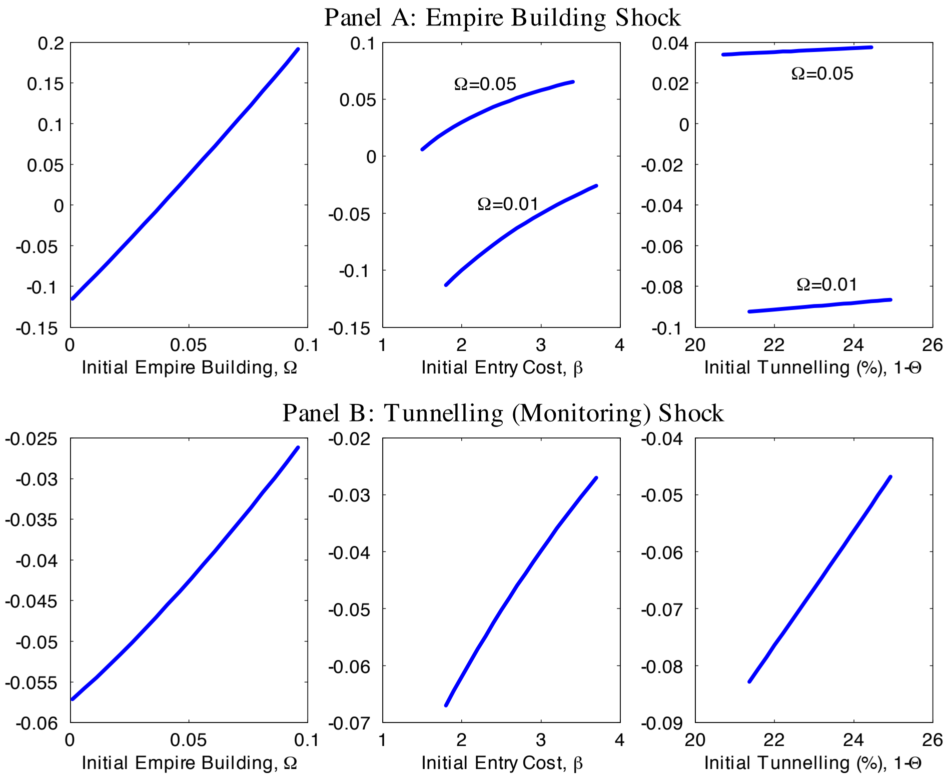
– Note: The solid lines represent the impulse responses (in differences with respect to the pre-shock level) due to a 3% increase in the efficiency of the monitoring technology (μ_M) relative to its baseline value (the same baseline experiment is depicted in Figure 8). The dotted lines show a similar experiment when the pre-shock efficiency of the monitoring technology, μ_M, is 98% of the baseline case. The dashed lines show a similar experiment for an economy where the entry cost, β, is 50% higher than the baseline.

Figure 10: Welfare Effects and Decomposition



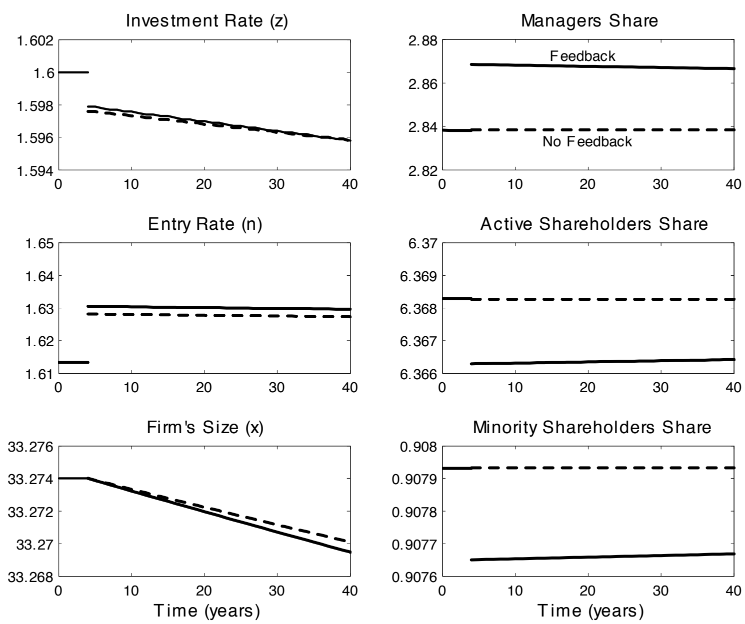
– Note: The top two graphs decompose the welfare effects of a reduction of Ω by 0.001, starting from its baseline value of 0.001 (left) and from a value of 0.05 (right). The bottom two graphs show a similar decomposition associated with a rise of μ_M by 3%, from its baseline value (left) and from 95% of its baseline value (right). The solid line is the difference between the discounted log of per capita consumption after the arrival of the shock and what would have been attained with the pre-shock consumption growth rate. Its integral is the total welfare effect of the shock. The bottom plot is the difference between the discounted log of per capita consumption calculated with the post-shock consumption steady state growth rate and what would have been attained with the pre-shock steady state growth rate. Its integral is the long-run welfare effect of the shock. The top line is the difference between the two lines. It captures the transitional effect and any initial, level effect. In last three columns of the top row of Tables 2 and 3, we report the overall transitional, long-run, and total effects as a percentage of the welfare U of the pre-shock steady state.

Figure 11: Welfare Change – Wide Range of Economies



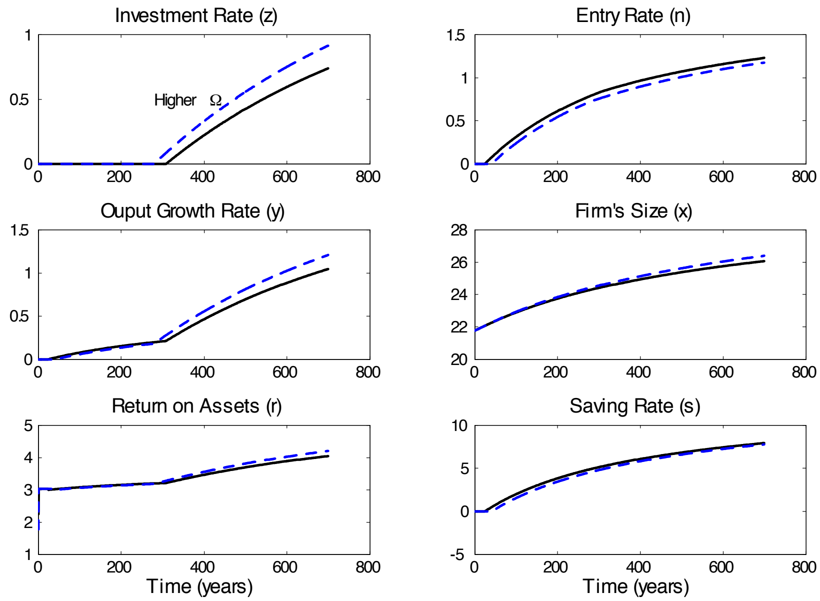
– Note: The top three graphs (Panel A) plot the total welfare effect of a reduction of Ω by 0.001, against different initial values of Ω, β, and $1-\Theta$. The variation in tunneling, $1-\Theta$, is generated through variations of μ_M. The bottom three graphs (Panel B) plot the total welfare effect when the efficiency of the monitoring technology, μ_M, improves by 3%. The baseline parameters are in Table 1, Panel A. In all the graphs, the welfare change on the vertical axis is in percentage.

Figure 12: Empire Building Shock with Feedback Effect



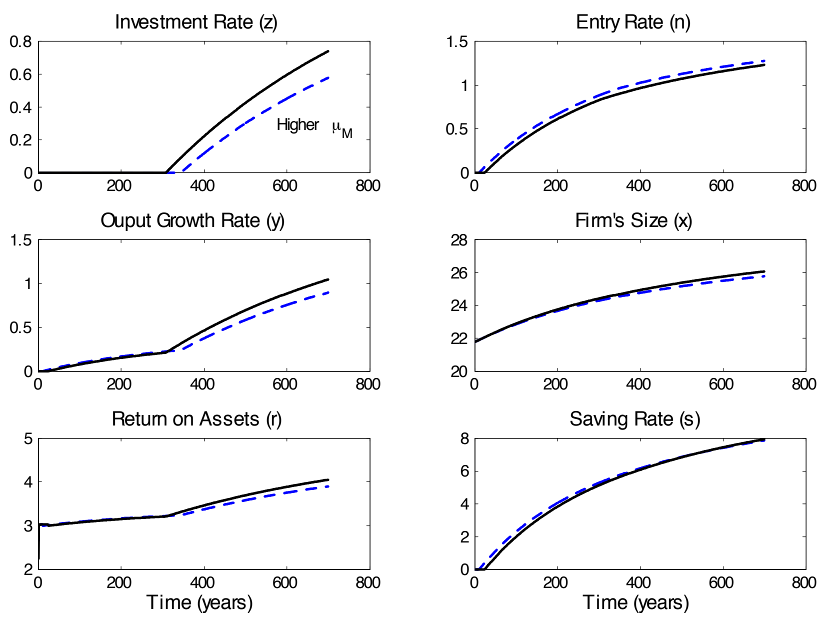
– The solid lines represent the impulse responses to a reduction of Ω from 0.001 to 0. The cost of monitoring is $c(M) = (\eta_M + \kappa\pi(x))M$. The value of $\eta_M = 0.001$ as in Table (1) while $\kappa = 0.05$. To maintain the baseline target of income growth rate of 2% and of stealing of 0.2%, some of the parameter values in Table (1) are altered. In particular, μ_S is normalized to 1, $\mu_M = 0.15$, $\eta_S = 0.77$ and $\phi = 0.61$. To gain intuition on how firms' size interacts with the corporate governance frictions, the dashed lines plot the impulse responses under the constraint that the variable component of the monitoring cost is kept constant to the pre-shock level, that is $\kappa\pi(x) = \kappa\pi^*$, where π^* is the pre-shock steady state value of the profit rate π.

Figure 13: Empire Building and Phases of Development



– Note: The solid lines represent the dynamics of an economy characterized by the parameters values in Table 1, Panel A. The dashed lines refer instead to an economy with an intensity of the empire-building friction, Ω, ten times higher than the baseline economy. The two economies have the same initial condition on x.

Figure 14: Tunnelling and Phases of Development



– Note: The solid lines represent the dynamics of an economy characterized by the parameter values in Table 1, Panel A. The dashed lines refer instead to an economy with a 20% better monitoring efficiency μ_M. The two economies have the same initial condition on x.

Online Technical Appendix to:
Financial Markets, Industry Dynamics, and Growth
(Not Intended for Publication)

Maurizio Iacopetta, OFCE (Sciences-Po) and SKEMA
Raoul Minetti, Michigan State University   Pietro F. Peretto, Duke University

This Appendix provides the proofs of all propositions and statements in the paper.

A Managers' First Order Conditions

The manager's Hamiltonian is

$$H_i = \left[e_{m,i}\left(1 - \Sigma_i\left(M_i, S_i\right)\right) + \Sigma_i\left(M_i, S_i\right) - c^S(S_i)\right] \cdot \left[\Pi_i + \Omega P_i X_i\right] + q_i I_i, \tag{A.1}$$

where q_i is the shadow value of the marginal increase in product quality. The first-order conditions with respect to P_i, I_i, Z_i and S_i are (dropping the s index of calendar time for simplicity):

$$\left[e_{m,i}\left(1 - \Sigma_i\left(M_i, S_i\right)\right) + \Sigma_i\left(M_i, S_i\right) - c^S(S_i)\right] \cdot \left[\frac{\partial \Pi_i}{\partial P_i} + \Omega \frac{\partial\left(P_i X_i\right)}{\partial P_i}\right] = 0; \tag{A.2}$$

$$\left[e_{m,i}\left(1 - \Sigma_i\left(M_i, S_i\right)\right) + \Sigma_i\left(M_i, S_i\right) - c^S(S_i)\right] \cdot \frac{\partial \Pi_i}{\partial I_i} + q_i = 0; \tag{A.3}$$

$$\left[e_{m,i}\left(1 - \Sigma_i\left(M_i, S_i\right)\right) + \Sigma_i\left(M_i, S_i\right) - c^S(S_i)\right] \cdot \frac{\partial \Pi_i}{\partial Z_i} = -\dot{q}_i + r q_i; \tag{A.4}$$

$$\frac{\partial\left[e_{m,i} + \left(1 - e_{m,i}\right)\Sigma_i\left(M_i, S_i\right) - c^S(S_i)\right]}{\partial S_i} \cdot \left(\Pi_i + \Omega P_i X_i\right) = 0. \tag{A.5}$$

Manipulating these expression gives us equations (11), (12) and (13) in the text.

B Derivation of the Interior Solution of Example 1

Let the stealing function and the cost of stealing and monitoring, respectively be:

$$\Sigma_i\left(M_i, S_i\right) = \mu_S \log\left(1 + S_i\right) - \mu_M \log\left(1 + M_i\right); \tag{B.1}$$

$$c^M(M_i) = (\eta_M + \kappa \pi_i) M \text{ and } c^S(S_i) = \eta_S S_i. \tag{B.2}$$

The first-order conditions for manager and active shareholder are:

$$(1-e_{m,i})\frac{\partial\Sigma_i\left(M_i\left(e_{m,i},e_{a,i}\right),S_i\left(e_{m,i},e_{a,i}\right)\right)}{\partial S_i}=\frac{\partial c^S(S_i)}{\partial S_i}\Rightarrow\mu_S\frac{1-e_{m,i}}{1+S_i}=\eta_S;$$

$$-e_{a,i}\frac{\partial\Sigma_i\left(M_i\left(e_{m,i},e_{a,i}\right),S_i\left(e_{m,i},e_{a,i}\right)\right)}{\partial M_i}=\frac{\partial c^M(M_i,\pi_i)}{\partial M_i}\Rightarrow\mu_M\frac{e_{a,i}}{1+M_i}=\eta_M+\kappa\pi_i.$$

We thus have

$$\begin{aligned}\Sigma_i\left(M_i\left(e_{m,i},e_{a,i}\right),S_i\left(e_{m,i},e_{a,i}\right)\right) &= \mu_S\log\left(1+S_i\right)-\mu_M\log\left(1+M_i\right) \\ &= \mu_S\log\left(1-e_{m,i}\right)+\mu_S\log\left(\frac{\mu_S}{\eta_S}\right) \\ &\quad -\mu_M\log\left(e_{a,i}\right)-\mu_M\log\left(\frac{\mu_M}{\eta_M+\kappa\pi_i}\right).\end{aligned}\tag{B.3}$$

Then, the minority shareholders' problem is

$$\max_{e_{a,i},e_{m,i}}\left\{\left(1-e_{m,i}-e_{a,i}\right)\left[1-\mu_S\log\left(1-e_{m,i}\right)-\mu_S\log\left(\frac{\mu_S}{\eta_S}\right)+\mu_M\log\left(e_{a,i}\right)+\mu_M\log\left(\frac{\mu_M}{\eta_M+\kappa\pi_i}\right)\right]\right\},$$

which yields

$$1-\mu_S\log\left(1-e_{m,i}\right)-\mu_S\log\left(\frac{\mu_S}{\eta_S}\right)+\mu_M\log\left(e_{a,i}\right)+\mu_M\log\left(\frac{\mu_M}{\eta_M+\kappa\pi_i}\right)=\mu_S\frac{1-e_{m,i}-e_{a,i}}{1-e_{m,i}};\tag{B.4}$$

$$1-\mu_S\log\left(1-e_{m,i}\right)-\mu_S\log\left(\frac{\mu_S}{\eta_S}\right)+\mu_M\log\left(e_{a,i}\right)+\mu_M\log\left(\frac{\mu_M}{\eta_M+\kappa\pi_i}\right)=\mu_M\frac{1-e_{m,i}-e_{a,i}}{e_{a,i}}.\tag{B.5}$$

Taking the ratio, we obtain

$$\left(1-e_{m,i}\right)\frac{\mu_M}{\mu_S}=e_{a,i}.$$

Substituting back in (B.4) and rearranging terms, we obtain

$$1-\left(\mu_S-\mu_M\right)-\mu_S\log\left(\frac{\mu_S}{\eta_S}\right)+\mu_M\log\left(\frac{\mu_M}{\mu_S}\right)+\mu_M\log\left(\frac{\mu_M}{\eta_M+\kappa\pi_i}\right)=\left(\mu_S-\mu_M\right)\log\left(1-e_{m,i}\right).\tag{B.6}$$

Assuming

$$\mu_S>\mu_M\quad\text{and}\quad 1-\left(\mu_S-\mu_M\right)-\mu_S\log\left(\frac{\mu_S}{\eta_S}\right)+\mu_M\log\left(\frac{\mu_M}{\mu_S}\right)+\mu_M\log\left(\frac{\mu_M}{\eta_M+\kappa\pi_i}\right)<0$$

we can solve (B.6) for:

$$e^*_{m,i}=1-\exp\left\{\frac{1-\left(\mu_S-\mu_M\right)-\mu_S\log\left(\frac{\mu_S}{\eta_S}\right)+\mu_M\log\left(\frac{\mu_M}{\mu_S}\right)+\mu_M\log\left(\frac{\mu_M}{\eta_M+\kappa\pi_i}\right)}{\mu_S-\mu_M}\right\}\in(0,1);$$

$$e^*_{a,i}=\left(1-e^*_{m,i}\right)\frac{\mu_M}{\mu_S}\in(0,1).$$

Note that $e^*_{m,i}$ is increasing in π_i.

C Steady State and Monitoring Technologies

We prove that a shock to any parameter that affects the intensity of tunnelling $1-\Theta_i(.)$ causes a larger shift of the EI locus when the marginal cost of monitoring is increasing in the profit rate π_i. For easy of notation we drop the index i. Assume that $\frac{\partial \Theta(\pi)}{\partial \pi} \leq 0$. Using the definition of π and that of $x \equiv \frac{L}{N^{1-\sigma}}$ we have

$$\pi = (P-1) - \left(\frac{\theta}{P}\right)^{-\frac{1}{1-\theta}} \left(\frac{z+\phi}{x}\right)$$

Therefore, $\frac{\partial \pi(.)}{\partial z} = -\frac{1}{x}\left(\frac{\theta}{P}\right)^{-\frac{1}{1-\theta}} < 0$, and $\frac{\partial \Theta(\pi(z);\boldsymbol{\omega})}{\partial z} \geq 0$, where $\boldsymbol{\omega}$ is a vector that collects the parameters that affect $\Theta(.)$. The EI locus is

$$z^* = \left[(P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}{\Theta(.)}\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\right] x^* - \phi. \tag{EI}$$

In order to apply the implicit function theorem, we define

$$T = \left[(P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}{\Theta(.)}\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\right] x^* - \phi - z^*$$

Let ω is a generic element of $\boldsymbol{\omega}$. Then,

$$\frac{\partial T}{\partial z} = \frac{\partial \Theta(.)}{\partial z}\xi - 1$$

and

$$\frac{\partial T}{\partial \omega} = \frac{\partial \Theta(.)}{\partial \omega}\xi,$$

where $\xi \equiv [\frac{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}{[\Theta(.)]^2}\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)x^*] > 0$.

It follows that

$$\frac{\partial z}{\partial \omega} = \frac{\xi}{1 - \frac{\partial \Theta(.)}{\partial z}\xi}\frac{\partial \Theta(.)}{\partial \omega}.$$

Because $\frac{\partial \Theta(.)}{\partial z} > 0$, $\frac{\partial z}{\partial \omega}$, which measures the displacement of the EI curve, is larger when the marginal monitoring cost depend on π. $\frac{\partial z}{\partial \omega}$ is also increasing in π, for any x^*.

Next, we prove that $\frac{\partial \Theta(.)}{\partial \pi} < 0$. Recall that

$$\Theta(.) \equiv [1 - e_a(\pi) - e_m(\pi)]\,[1 - \Sigma(.)]$$

we are interested in establishing the sign of

$$\left[-\frac{\partial e_a}{\partial \pi} - \frac{\partial e_m}{\partial \pi}\right][1-\Sigma] - [1 - e_a - e_m]\frac{\partial \Sigma}{\partial \pi}$$

In an interior equilibrium e_m, e_a, and Σ, are given by expressions (20)-(21) and (B.3). Assume that $\mu_M < \mu_S < 1-\Sigma$. It is easy to see that $\frac{\partial e_m}{\partial \pi} > 0$ and that $\frac{\partial e_a}{\partial \pi} = -\frac{\mu_M}{\mu_S}\frac{\partial e_m}{\partial \pi} < 0$. After some algebra one also obtains

$$\frac{\partial \Sigma}{\partial \pi} = \frac{\mu_M - \mu_S}{1-e_m}\frac{\partial e_m}{\partial \pi} + \mu_M\frac{\kappa}{\eta_M + \kappa\pi_i}$$

Using these last three derivations, $\frac{\partial\Theta(.)}{\partial\pi}$ becomes

$$\frac{\partial\Theta(.)}{\partial\pi} = \left[(\frac{\mu_M}{\mu_S} - 1)\frac{\partial e_m}{\partial\pi}\right][1-\Sigma] - [1 - e_a - e_m]\frac{\partial\Sigma}{\partial\pi}$$

Hence, the condition for $\frac{\partial\Theta(.)}{\partial\pi} < 0$ is that $\frac{\partial\Sigma}{\partial\pi}/\frac{\partial e_m}{\partial\pi} > -b$, where $b \equiv \frac{(1-\frac{\mu_M}{\mu_S})(1-\Sigma)}{1-e_a-e_m}$. Elaborating further, this condition becomes

$$\frac{\mu_M}{\frac{\partial e_m}{\partial\pi}}\frac{\kappa}{\eta_M + \kappa\pi} > (\mu_S - \mu_M)[\frac{1}{1-e_m} - \frac{1-\Sigma}{\mu_S(1-e_a-e_m)}]$$

Since $(\mu_S - \mu_M) > 0$ the above inequality holds as long as the expression inside the square brackets is negative, which is implied by the assumption $\frac{\mu_S}{1-\Sigma} < 1$.

D Proof of Proposition 1

We begin with some useful book-keeping. First, note that the PDV of the income flow accruing to the minority shareholders is not the market value of the firm, which is instead

$$V_i^{\text{market}}(t) = \int_t^{+\infty} e^{-\int_t^s r(v)dv}\left[1 - \Sigma_i\left(\left(e_{m,i}(s), e_{a,i}(s), \pi_i(s)\right)\right)\right]\Pi_i(s)ds.$$

Household wealth in our economy is $A = \int_0^N A_i di$, which is the aggregate of the wealth generated by each firm. The wealth generated by each firm, in turn, is the sum of three components that accrue, respectively, to managers, active shareholders and minority shareholders:

$$\begin{aligned}
A_i \quad = \quad & \int_t^{+\infty} e^{-\int_t^s r(v)dv}\left[e_{m,i}\left(1 - \Sigma_i\left(M_i, S_i\right)\right) + \Sigma_i\left(M_i, S_i\right)\right]\Pi_i ds \\
& + \int_t^{+\infty} e^{-\int_t^s r(v)dv}\left[e_{a,i}(s)\left[1 - \Sigma_i\left(M_i, S_i\right)\right]\right]\Pi_i(s)ds \\
& + \int_t^{+\infty} e^{-\int_t^s r(v)dv}\left[1 - e_{m,i}(s) - e_{a,i}(s)\right]\left[1 - \Sigma_i\left(M_i, S_i\right)\right]\Pi_i(s).
\end{aligned}$$

Consolidating:

$$A_i = \int_t^{+\infty} e^{-\int_t^s r(v)dv}\Pi_i ds = V_i.$$

Thus, wealth is the value of the N existing firms and our financial frictions affect the sharing of the pie among the various parties.

For $\kappa = 0$ the terms $e_{m,i}$, $e_{a,i}$, Σ_i are independent of π and thus constant.Accordingly, the value of Θ is also independent of π; see equation (15) and Example 1. For clarity, we refer to this baseline value of Θ, which remains constant throughout the transition, as Θ_0. When $n > 0$, the free entry condition yields

$$\gamma\beta X = V_i^{\text{minority}} = \Theta_0 V_i$$

so that, imposing symmetry,

$$V = \frac{\gamma\beta}{\Theta_0}\frac{\theta}{P}\frac{Y}{N}.$$

Consequently, assets market equilibrium requires

$$A = NV = \frac{\gamma\beta}{\Theta_0}\frac{\theta}{P} \cdot Y, \tag{D.1}$$

which says that the wealth ratio A/Y is constant. This result and the saving schedule,

$$r = \rho - \lambda + \dot{C}/C, \tag{D.2}$$

allow us to rewrite the household budget,

$$\dot{A} = rA + wL - C, \tag{D.3}$$

as the following differential equation in $c \equiv C/Y$

$$\frac{\dot{C}}{C} - \frac{\dot{Y}}{Y} = (-\rho + \lambda) - (1-\theta)\frac{1}{\varsigma} + \frac{1}{\varsigma}\frac{C}{Y}, \quad \varsigma \equiv \frac{\gamma\beta}{\Theta_0}\frac{\theta}{P}.$$

This differential equation indicates that the C/Y ratio has a unique steady state. In addition, becasue $\varsigma > 0$ it is also unstable, implying that an initial condition different form the steady state value will result in a tendency for the ratio to accelerate or decelarate and eventually violate the transversaility condition. Therefore, the equilibrium c must jump immediately to the constant value

$$c^*_{n>0} = \varsigma(\rho - \lambda) + 1 - \theta,$$

which is the bottom line of the function $c(x)$ in the text of the proposition.

When $n = 0$ assets market equilibrium still requires $A = NV$ but it is no longer true that $NV = \frac{\gamma\beta}{\Theta_0}\frac{\theta}{P} \cdot Y$ since by definition the free-entry condition does not hold. This means that the wealth ratio A/Y is not constant. However, the relation

$$r = \frac{\Pi_i}{V_i} + \frac{\dot{V}_i}{V_i} \tag{D.4}$$

holds, since it is the arbitrage condition on equity holding that characterizes the value of an existing firm regardless of how it came into existence in the first place. Imposing symmetry and inserting the definition of cash flow,

$$\Pi = \left[(P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}\frac{L}{N^{1-\sigma}} - \phi\right]Z - I,$$

(D.4), and (D.1) into the household budget (D.3) yields

$$\begin{aligned}
0 &= N\left[(P-1)X - \phi Z - I\right] + (1-\theta)Y - C \\
&= NZ\left[(P-1)\frac{X}{Z} - \phi - z\right] + (1-\theta)Y - C \\
&= \frac{NZ}{Y}\left[(P-1)\frac{X}{Z} - \phi - z\right] + 1 - \theta - \frac{C}{Y}.
\end{aligned}$$

The definition $x \equiv L/N^{1-\sigma}$ allows us to rewrite this expression as

$$c = 1 - \theta + \frac{\theta}{P}\left[(P-1) - \frac{\phi + z}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x}\right],$$

which is the top line of the function $c(x)$ in the text of the proposition.

E Proof of Proposition 2

We start with the expressions for the returns to investment and to entry, reproduced here for convenience

$$r_Z = \alpha\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x - \phi\right), \tag{E.1}$$

$$r_N = \frac{\Theta_0}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\phi+z}{x}\right) + z + \frac{\dot{x}}{x}. \tag{E.2}$$

Proposition 1 says that c is constant when there is entry, i.e., when $n > 0$, and that in such a case the return to saving becomes $r = \rho - \lambda + \dot{Y}/Y$. Therefore, we can use the expression for the return to entry (E.2) and the definition $x \equiv L/N^{1-\sigma}$ to obtain

$$n = \frac{\Theta_0}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} - \frac{\phi+z}{x}\right) - \rho + \lambda, \quad z \geq 0, \tag{E.3}$$

which holds for positive values of the right-hand side. The saving schedule (D.2) and the reduced-form production function,

$$Y = \left(\frac{\theta}{P}\right)^{\frac{\theta}{1-\theta}} N^{\sigma} Z L, \tag{E.4}$$

yield

$$r = \rho - \lambda + \dot{Y}/Y = \rho + z + \sigma n.$$

Combining this expression with the return to investment (E.1) yields

$$\alpha\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x - \phi\right) = \rho + z + \sigma n. \tag{E.5}$$

Setting $z = 0$ and solving for n, this expression yields the middle branch of the function $n(x)$ in the text of the proposition. Moreover, combining (E.5) with the rate of entry in (E.3) and solving for z yields

$$z(x) = \frac{\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x - \phi\right)\left(\alpha - \frac{\sigma\Theta_0}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}\right) - (1-\sigma)\rho - \sigma\lambda}{1 - \frac{\sigma\Theta_0}{\gamma\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}}, \tag{E.6}$$

which is the bottom branch of the function $z(x)$ in the text of the proposition. Substituting $z(x)$ back into (E.3) yields the bottom branch of the function $n(x)$ in the text of the proposition.

With these expressions in hand, we focus on the thresholds. The definition of x and the reduced-form production function (E.4) yield

$$\frac{\dot{x}}{x} = \dot{Y}/Y - n - z = \lambda - (1-\sigma)\, n(x).$$

Suppose that the threshold for entry is smaller than the threshold for investment. Then, according to (E.3), $n(x) > 0$ for

$$\frac{\Theta_0}{\beta}\left(P - 1 - \frac{\phi + z}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}\right) - \rho + \lambda > 0,$$

since $z=0$, which yields

$$x > x_N \equiv \frac{\phi\left(\frac{\theta}{P}\right)^{-\frac{1}{1-\theta}}}{P-1-\frac{\beta(\rho-\lambda)}{\Theta}}.$$

Assumption (34) in the text of the proposition guarantees that this value is finite. On the other hand, according to (E.6), $z(x)>0$ for

$$\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x-\phi\right)\left(\alpha-\frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x}\right) > (1-\sigma)\rho+\sigma\lambda,$$

because entry is already active, which yields

$$x > x_Z \equiv \arg\operatorname{solve}\left\{\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x-\phi\right)\left(\alpha-\frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x}\right)=(1-\sigma)\rho+\sigma\lambda\right\}.$$

This equation has always a finite solution x_Z and thus we do not need a condition equivalent to (34). The assumption

$$z(x_N)=\frac{\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x_N-\phi\right)\left(\alpha-\frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x_N}\right)-(\rho-\sigma\rho+\sigma\lambda)}{1-\frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x_N}}<0,$$

moreover, ensures that $x_N<x_Z$ because it says that at x_N the value of z that agents would need to choose to equalize returns is negative. The non-negativity constraint thus binds and agents choose $z=0$. This is assumption (35) in the text of the proposition.

To understand wheteher the solution just found is a stable Nash Equilibrium, we use (E.3) to rewrite (E.2) as

$$\begin{aligned}
r_N &= \frac{\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}-\frac{\phi+z}{x}\right)+z+\lambda-(1-\sigma)\,n(x)\\
&= \frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}-\frac{\phi+z}{x}\right)+z+\lambda+(1-\sigma)(\rho+\lambda).
\end{aligned}$$

Given x, an equilibrium with both entry and investment — that is stable in the Nash sense that agents have no incentives to deviate from it — exists if in the (z,r) space this line intersects the line given by (E.1) from below. This requires the the line just derived is positively sloped, that is, $1>\sigma\Theta_0/\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x$ for $x>x_Z$. A sufficient condition for this to be true is $1>\sigma\Theta_0/\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x_N$, which is assumption (36) in the text of the proposition.

F Proof of Proposition 3

For $x\le x_N<x_Z$ we have $\dot{x}/x=\lambda$ and the economy crosses the threshold for entry in finite time. For $x_N<x<x_Z$ we have, after rearranging terms,

$$\frac{\dot{x}}{x}=\sigma\lambda+(1-\sigma)\rho-(1-\sigma)\frac{\Theta_0}{\beta}\left((P-1)-\frac{\phi}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x}\right).$$

The economy, therefore, crosses the threshold for investment in finite time since firm profitability is still growing at $x = x_Z$ in light of assumption (40). To guarantee that a solution $\Psi(x) = 0$ exists, we assume

$$\begin{aligned}
\lim_{x\to\infty} \Psi(x) &= (1-\sigma)\cdot \lim_{x\to\infty}\left[\frac{\lambda}{1-\sigma} - n(x)\right] \\
&= (1-\sigma)\cdot \lim_{x\to\infty}\left[\frac{\lambda}{1-\sigma} - \frac{\Theta_0}{\beta}\left((P-1) - \frac{\phi + z(x)}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}\right) + (\rho - \lambda)\right] \\
&= (1-\sigma)\cdot \lim_{x\to\infty}\left[\rho + \frac{\sigma\lambda}{1-\sigma} - \frac{\Theta_0}{\beta}\left((P-1) - \frac{\phi}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x} - \frac{z(x)}{\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}\right)\right] < 0.
\end{aligned}$$

Since

$$\begin{aligned}
\lim_{x\to\infty} z(x) &= \lim_{x\to\infty}\frac{\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x - \phi\right)\left(\alpha - \frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}\right) - (1-\sigma)\rho - \sigma\lambda}{1 - \frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}} \\
&= \lim_{x\to\infty}\frac{\left((P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x - \phi\right)\left(\alpha - \frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x}\right) - (1-\sigma)\rho - \sigma\lambda}{1} \\
&= \alpha(P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} x,
\end{aligned}$$

we have

$$\lim_{x\to\infty}\Psi(x) = \lim_{x\to\infty}\left[\rho + \frac{\sigma\lambda}{1-\sigma} - \frac{\Theta_0}{\beta}(1-\alpha)(P-1)\right] < 0.$$

G Proof of Proposition 4

In this section, we derive (43) and (47). Let $\tilde{c}(t) \equiv \frac{C(t)}{L(t)}$ and $\tilde{y}(t) \equiv \frac{Y(t)}{L(t)}$ be the per capita level of consumption and of output at time t. We use the index "$'$" to denote the value of an object after the shock. From (1) it follows immediately that

$$U = \log(\tilde{c}(0)) + \int_0^{+\infty} e^{-(\rho-\lambda)t}\log\left(\frac{\tilde{c}(t)}{\tilde{c}(0)}\right)dt$$

Imagine that at time $t = 0$ the economy, while on its steady state, is hit by a shock. The change in welfare can then be decomposed as

$$\Delta U = \underbrace{\log(\tilde{c}'(0)) - \log(\tilde{c}(0))}_{\text{intial}} + \int_0^{+\infty}\underbrace{e^{-(\rho'-\lambda')t}[\log(\frac{\tilde{c}'(t)}{\tilde{c}'(0)}\exp(-g_{\tilde{c}}'^{*})]dt}_{\text{transition}} + \int_0^{+\infty}\underbrace{e^{-(\rho'-\lambda')t}(g_{\tilde{c}}'^{*} - g_{\tilde{c}}^{*})}_{\text{long-run}}dt, \tag{G.1}$$

In the case of $n > 0$ and $z > 0$, $\tilde{c}(t) = \bar{c}\tilde{y}(t)$, where $\bar{c} = 1 - \theta + \frac{(\rho-\lambda)\gamma\beta}{\Theta^*}\frac{\theta}{P}$ (see (43)). By using the production function (21) we have

$$\tilde{c}(t) = \Lambda N^{\sigma} Z. \tag{G.2}$$

Consider now a shock that affects a parameter in the economy. Since the shock does not affect the state variables, its initial welfare effect is $\log(\Lambda'/\Lambda)$. The long run effect tells us the gains or losses if the economy grew from right after the shock at its new long-run level. It is evident from (G.2) that

$$g_{\tilde{c}}'^{*} - g_{\tilde{c}}^{*} = \Delta z^{*} + (\frac{\sigma'}{1-\sigma'}\lambda' - \frac{\sigma}{1-\sigma}\lambda).$$

These observations allow us to rewrite (G.1) as

$$\begin{aligned}\Delta U &= \log(\frac{\Lambda'}{\Lambda}) + \int_0^{+\infty} e^{-(\rho-\lambda)t} \log[(\frac{N(t)}{N(0)})^{\sigma'} \frac{Z(t)}{Z(0)}] e^{-(z'^{*}+\frac{\sigma'}{1-\sigma'}\lambda')t}]dt + \\ &+ \int_0^{+\infty} e^{-(\rho-\lambda)t}[(z'^{*} - z^{*}) + (\frac{\sigma'}{1-\sigma'}\lambda' - \frac{\sigma}{1-\sigma}\lambda)]dt\end{aligned}$$

Because $\frac{N(t)}{N(0)} = \exp(\int_0^t n(x(s))ds)$ and $\frac{Z(t)}{Z(0)} = \exp(\int_0^t z(x(s))ds)$, the above expression depends only on $x(t)$. It can be written in a more compact way as

$$\Delta U = \underbrace{\log(\frac{\Lambda'}{\Lambda})}_{\text{initial}} + \int_0^{+\infty} \underbrace{e^{-(\rho-\lambda)t} \int_0^t \{\sigma' \Delta n'(s)ds + \Delta z'(s)]\}}_{\text{transition}} dt + \int_0^{+\infty} \underbrace{e^{-(\rho-\lambda)t}[\Delta z^{*} + \frac{\sigma'}{1-\sigma'}\lambda' - \frac{\sigma}{1-\sigma}\lambda]}_{\text{long-run}} dt \tag{G.3}$$

where $\Lambda \equiv [1-\theta+\frac{(\rho-\lambda)\gamma\beta}{\Theta}\frac{\theta}{P}]\left(\frac{\theta}{P}\right)^{\frac{\theta}{1-\theta}}$, $\Delta n'(s) \equiv n(x(s)) - n'^{*}$, $\Delta z'(s) \equiv z(x(s)) - z'^{*}$, $\Delta z^{*} \equiv z'^{*} - z^{*}$. The first term picks any immediate (and permanent) alteration of the consumpion/output ratio. The second term attributes the transitional effect to movements of the entry rate and of the investment rate, both detrended with their post-shock values. Finally, the last term accounts for the welfare change that would be observed if the adjustments were to occur immediately after the shock.

We now prove that (G.3) can be solved analytically, yielding to (G.5). Let

$$\varphi_1 \equiv (P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}};$$

$$\varphi_2 \equiv \frac{\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}}.$$

Using the function $n(x)$, we write the law of motion of x as

$$\begin{aligned}\frac{\dot{x}}{x} &= (1-\sigma)\left[\frac{\lambda}{1-\sigma} - n(x)\right] \\ &= (1-\sigma)\left[\rho + \frac{\sigma\lambda}{1-\sigma} - \frac{\varphi_2}{x}(\varphi_1 x - \phi - z(x))\right].\end{aligned}$$

Using the function $z(x)$, after some algebra, we can rewrite this expression as

$$\begin{aligned}\dot{x} &= (1-\sigma)\left[\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)x - \varphi_2(\varphi_1 x - \phi - z(x))\right] \\ &= (1-\sigma)\frac{\varphi_2\left[\phi(1-\alpha) - \left(\rho+\frac{\sigma\lambda}{1-\sigma}\right)\right] - \left[\varphi_2\varphi_1(1-\alpha) - \left(\rho+\frac{\sigma\lambda}{1-\sigma}\right)\right]x}{1-\frac{\sigma\varphi_2}{x}}.\end{aligned}$$

This differential equation is linear if we approximate

$$\frac{\sigma\Theta_0}{\beta\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}}x} \cong 0$$

in the denominator. So, finally, we write

$$\dot{x} = (1-\sigma)\left[\varphi_2\varphi_1(1-\alpha) - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\right]\left[\frac{\phi(1-\alpha) - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)}{\varphi_1(1-\alpha) - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\frac{1}{\varphi_2}} - x\right]$$

and define

$$x^* \equiv \frac{\phi(1-\alpha) - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)}{\varphi_1(1-\alpha) - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\frac{1}{\varphi_2}} = \frac{\phi(1-\alpha) - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)}{(1-\alpha)(P-1) - \frac{\beta}{\Theta_0}\left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)}\left(\frac{\theta}{P}\right)^{-\frac{1}{1-\theta}};$$

$$\nu \equiv (1-\sigma)\left[\varphi_2\varphi_1(1-\alpha) - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\right] = (1-\sigma)\left[(1-\alpha)(P-1)\frac{\Theta_0}{\beta} - \left(\rho + \frac{\sigma\lambda}{1-\sigma}\right)\right].$$

This gives us the expression

$$\dot{x} = \nu \cdot (x^* - x),$$

and the solution

$$x(t) = x_0 e^{-\nu t} + x^*\left(1 - e^{-\nu t}\right).$$

To compute the utility flow, we proceed in three steps. For simplicity, we omit time arguments unless necessary. Consider first

$$\frac{C}{L} = \left[1 - \theta + \frac{(\rho-\lambda)\gamma\beta}{\Theta_0}\frac{\theta}{P}\right]\cdot\frac{Y}{L} = \left[1 - \theta + \frac{(\rho-\lambda)\gamma\beta}{\Theta_0}\frac{\theta}{P}\right]\left(\frac{\theta}{P}\right)^{\frac{\theta}{1-\theta}}\cdot N^{\sigma}Z.$$

Let

$$\left[1 - \theta + \frac{(\rho-\lambda)\gamma\beta}{\Theta_0}\frac{\theta}{P}\right]\left(\frac{\theta}{P}\right)^{\frac{\theta}{1-\theta}} \equiv \Lambda.$$

Then,

$$\log\left(\frac{C}{L}\right) = \log\Lambda + \sigma\log N_0 + \sigma\log\frac{N}{N_0} + \log Z.$$

From the definition of x we have

$$x = \frac{L}{N^{1-\sigma}} \Rightarrow N = \left(\frac{L}{x}\right)^{\frac{1}{1-\sigma}}.$$

Then, recalling our assumptions on population dynamics,

$$\begin{aligned}\log\left(\frac{C}{L}\right) &= \log\Lambda + \sigma\log N_0 + \frac{\sigma}{1-\sigma}\log\left(\frac{x_0}{x}\frac{L}{L_0}\right) + \log Z \\ &= \log\Lambda + \sigma\log N_0 + \frac{\sigma}{1-\sigma}\log\left(\frac{L_0e^{\lambda t}}{L_0}\right) + \frac{\sigma}{1-\sigma}\log\left(\frac{x_0}{x}\right) + \log Z \\ &= \log\Lambda + \sigma\log N_0 + \frac{\sigma\lambda}{1-\sigma}t - \frac{\sigma}{1-\sigma}\log\left(\frac{x}{x_0}\right) + \log Z.\end{aligned}$$

Also, we approximate

$$z = \left((P-1) \left(\frac{\theta}{P} \right)^{\frac{1}{1-\theta}} x - \phi \right) \alpha - (1-\sigma)\rho - \sigma\lambda.$$

Adding and subtracting z^* from $z(s)$,

$$\begin{aligned}
\log Z(t) &= \log Z_0 + \int_0^t z(s)\, ds \\
&= \log Z_0 + z^* t + \alpha \int_0^t [z(s) - z^*]\, ds \\
&= \log Z_0 + z^* t + \alpha (P-1) \left(\frac{\theta}{P} \right)^{\frac{1}{1-\theta}} \int_0^t [x(s) - x^*]\, ds \\
&= \log Z_0 + z^* t + \alpha (P-1) \left(\frac{\theta}{P} \right)^{\frac{1}{1-\theta}} (x_0 - x^*) \int_0^t e^{-\nu s} ds \\
&= \log Z_0 + z^* t + \frac{\alpha}{\nu} (P-1) \left(\frac{\theta}{P} \right)^{\frac{1}{1-\theta}} (x_0 - x^*) \left(1 - e^{-\nu t}\right).
\end{aligned}$$

Approximating the log, we can write

$$\begin{aligned}
\log \left(\frac{x(t)}{x_0} \right) &= \log \left(1 + \left(\frac{x(t)}{x_0} - 1 \right) \right) \\
&= \left(\frac{x(t)}{x_0} - 1 \right) \\
&= \frac{x(t) - x_0}{x_0} \\
&= \frac{x^* - x_0}{x_0} \left(1 - e^{-\nu t}\right).
\end{aligned}$$

These results yield, after rearranging terms,

$$\begin{aligned}
\log \left(\frac{C}{L} \right) &= \log \Lambda + \sigma \log N_0 + \log Z_0 \\
&+ \left(\frac{\sigma}{1-\sigma} \lambda + z^* \right) t \\
&+ \left[\frac{\alpha x_0}{\nu} (P-1) \left(\frac{\theta}{P} \right)^{\frac{1}{1-\theta}} + \frac{\sigma}{1-\sigma} \right] \left(1 - \frac{x^*}{x_0} \right) \left(1 - e^{-\nu t}\right).
\end{aligned} \tag{G.4}$$

Without loss of generality, we set

$$\sigma \log N_0 + \log Z_0 = 0.$$

This is just a normalization that does not affect the results. We then substitute the expression derived above into the welfare functional and integrate to obtain the level of welfare associated to the transition from a generic initial condition x_0:

$$U = \frac{1}{\rho - \lambda} \cdot \{ \ \log \Lambda + \ \frac{1}{(\rho - \lambda)} \left(\frac{\sigma\lambda}{1-\sigma} + z^* \right) - \ \frac{\alpha x_0 (P-1) \left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} + \frac{\sigma\nu}{1-\sigma}}{\rho - \lambda + \nu} \left(\frac{x^*}{x_0} - 1\right) \}.$$

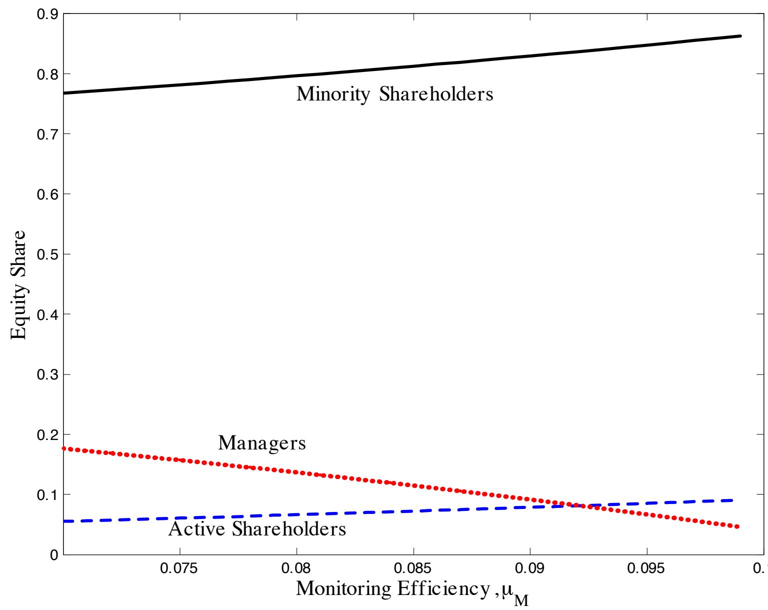
We can now compute the variation of welfare, ΔU, caused by a shock when the initial position of the economy is the steady state, that is, $x_0 = x^*$. From (G.4) it immediately follows that

$$
\begin{aligned}
\log(C/L)' - \log(C/L) &= \log(\Lambda') - \log(\Lambda) + \\
&+ \left(\frac{\sigma'}{1-\sigma'}\lambda' - \frac{\sigma}{1-\sigma}\lambda + (z'^* - z^*)\right) t \\
&- \left[\frac{\alpha x^*}{\nu'}(P-1)\left(\frac{\theta}{P}\right)^{\frac{1}{1-\theta}} + \frac{\sigma}{1-\sigma}\right]\left(1 - \frac{x'^*}{x^*}\right)\left(1 - e^{-\nu' t}\right)
\end{aligned}
$$

Integrating over time yields (G.5)

$$
\begin{aligned}
\Delta U &= \frac{1}{\rho' - \lambda'}\{\log(\frac{\Lambda'}{\Lambda}) + \left(\frac{\sigma'}{1-\sigma'}\lambda' - \frac{\sigma}{1-\sigma}\lambda + (z'^* - z^*)\right) + \\
&\quad - \frac{\alpha' x^* (P'-1)\left(\frac{\theta'}{P'}\right)^{\frac{1}{1-\theta'}} + \frac{\sigma'\nu'}{1-\sigma'}}{\rho' - \lambda' + \nu'}(\frac{x'^*}{x^*} - 1)\}.
\end{aligned}
\tag{G.5}
$$

In our quantitative section we focus on shocks that affect the corporate frictions or the entry rate. In particular, the following parameters are the same in the pre- and post-shock economy: ρ, σ, λ, α, and θ. Under such restriction, (G.3) and (G.5) reduce to the expressions (43) and (47).



– Note to Supplentary Figute A1: The graph plots the equity shares of active shareholders, minority shareholders and managers, against the efficiency of active shareholders' monitoring technology. The starting point from the left corresponds to the distribution of equity shares in the baseline economy (Table 1, Panel B).