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The Rise and Evolution of the Innovative Firm: A Tale of Technology, Market Structure, and Managerial Incentives*

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Abstract

We develop a dynamic general equilibrium model in which firms choose whether and how extensively to delegate managerial functions. Owners use incentive contracts to elicit costly managerial effort, and delegation becomes viable as firm profitability rises. Management and innovative investment are complementary: higher profitability supports a larger managerial organization, which raises the return to innovation and feeds back into firm value and market structure. This mechanism amplifies the effects of policy and fundamentals and can generate multiple steady states. We calibrate the model to the U.S. economy and study nonlinear transition dynamics and structural stability. The results show how market structure, managerial organization, innovation, and growth are jointly determined, and how the extensive margin of managerial employment can change the qualitative structure of the equilibrium.

JEL Classification: E23; E24; E62; O30; O40.
Keywords: Technology; Market structure; Innovation; Management; Economic growth.

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1. Introduction

A fact of the Second Industrial Revolution from the late nineteenth to the early twentieth century is the emergence of business organizations with large-scale operations and the associated rise of the "managerial class." Business historians argued that the expansion of market size with associated technological progress drove the transition from an economy with owner-operated small businesses to an economy where some of the control over large-scale organizations is delegated to salaried managers (Chandler, 1962, 1977, 1990).

While all developed economies have made this transition, the extent to which they have done so varies substantially (Appelbaum and Batt, 2018; Bloom and Van Reenen, 2007, 2010; Chandler, 1977; Freeman and Lazear, 1995; Giorcelli, 2021). Large cross-country differences in market structure, in terms of the number and size of firms, and in firms' internal organization persist today, more than a century after the Second Industrial Revolution. Average growth rates and real per capita incomes vary considerably across countries, too. Studying the interaction between market structure and the firm's internal organization is thus paramount to gauge the mechanisms driving firms' growth and the factors impeding it.

In this paper, we develop a theory of managerial delegation and embed it in a dynamic general equilibrium model in which market size and structure, innovation, and the firm's internal organization are endogenous and jointly determined. We then use the model to examine how the economic environment shapes the relationship between managerial delegation and innovative investment, and to assess the implications of this relationship for the dynamics of firm organization and economic growth.

Market structure refers to the equilibrium number and size of firms. Markups are constant, but entry and firm size respond to fundamentals and policy, changing profitability and the incentives to delegate and innovate. The firm's internal organization refers to the allocation of managerial tasks between owners and salaried managers.

The idea driving the theory is that the firm's internal organization is the owners' choice variable and, like firm entry, employment, and investment, is influenced by the economic environment in which firms operate. Managerial services are essential to production, marketing, and innovation operations. Owners can supply the input on their own or hire the help of salaried managers when profitable. Both forms of organization have access to the same technology, so the owners' choice is about if and when to delegate and how many managers to employ.

We model delegation through a simple incentive contract with no informational asymmetries: the owner offers a compensation package paying a fraction of the gross cash flow to salaried managers to elicit costly effort. The compensation package must satisfy the incentive constraint for managers to remain in the contractual relationship and exert a level of effort that maximizes the objective function of the owner. The benefit of delegation is higher product quality and sales. The cost is the compensation needed to provide managers with the right incentives to exert effort. The delegation decision is dictated by which organizational structure delivers the higher rate of return to in-house innovative investment and, by no arbitrage, to shareholders.

We show that along the equilibrium path, the owner-managed form of organization prevails early when the size of the market is small. Delegating managerial functions becomes profitable only when the size of the market is large enough to make the incentive contract viable. When firms switch to the more complex form of internal organization, the economy experiences a productivity growth acceleration fueled by higher firm-specific innovative investment.

Managers contribute to the firm's product quality and sales, but are *not* the source of long-run growth. Managerial employment is finite at a finite steady-state profitability, while the contract produces constant effort. More precisely, int eh model long-run growth in real per capita income comes from sustained knowledge accumulation, not ever-expanding managerial services.

The model identifies a novel channel through which the owner's incentives to delegate and to undertake innovative investment reinforce each other. The higher the flow of managerial services due to more managers per firm at a constant effort per manager, the higher the rate of return to the firm's innovative investment. In turn, the higher the firm's investment and so the faster the growth of the stock of knowledge of the firm, the higher the effect of managerial services on product quality and sales. This positive feedback loop generates strong complementarity between management and innovation.

In equilibrium, the self-reinforcing feedback between management and the investment of incumbent firms interacts with endogenous firm entry. As firms employ more managers at the same effort, they invest more, which leads to a higher stock market valuation. At the same time, more managers subtract resources from dividend distribution. If the negative effect on distributed dividends dominates that on market valuation, in free-entry equilibrium there is less entry. This in turn implies that firm size is larger, which reinforces the incentives to invest. Following the same logic, a smaller number of

managers per firm reduces the incentives to invest, which lowers the firm's stock market valuation even though it raises dividend distribution. If the latter effect dominates, there is more entry and smaller firm size, which further reduces the incentives to invest.

This mechanism can substantially amplify the effects of distortions to firms' entry, such as those due to regulations that increase the cost of setting up a firm or distortions that alter the incentives to undertake innovative investments, such as business income taxation and investment tax credits or subsidies. More broadly, any policy that alters market structure affects firms' organization and investments, which feeds back on the number of firms and firm size, causing the final growth effect of the policy to be larger than the initial direct effect. Such a mechanism can also magnify cross-country differences in owners' managerial inputs or, more generally, country-specific or "country-embedded" factors that affect all firms in a country (Burstein and Monge-Naranjo, 2009).

The complementarity between management and innovation can be sufficiently strong to generate multiple equilibria. This property suggests a possible explanation of why some countries failed to become innovative, knowledge-based economies with large and complex organizations or why countries with arguably similar fundamentals converged to different growth paths. The mechanism governing these outcomes in our model is novel and provides a rationale for a theory of "convergence clubs,"with the associated bimodal or multi-modal distributions in relative per capita income levels (Howitt, 2000; Howitt and Mayer-Foulkes, 2005; Quah, 1996a,b, 1997), based on the interaction of market size, firm-specific innovation, and the firm's internal organization.

The model also has implications for the functional distribution of income, relative pay, and employment dynamics of managers versus non-managers. Consistent with one of the best documented empirical regularities in executive compensation, the compensation of the individual manager rises with firm size (Baker et al., 1988; Edmans et al., 2009; Edmans and Gabaix, 2016; Gabaix and Landier, 2008; Gabaix et al., 2014; Hall and Liebman, 1998; Murphy, 1999, 2013). Along a path with rising profitability, managers earn a higher share of total labor income. Their employment share rises after delegation begins but is generally hump-shaped, so matching the observed rising share also restricts the relevant part of the transition. These patterns are consistent with trends in managerial compensation and the managerial share of employment in the United States and other major industrialized countries.

The structure of the paper is as follows. We discuss the related literature in Section 2. In Sections 3, 4, and 5 we present the economic environment, the contracting problem,

and the model's general equilibrium. Section 6 discusses management as an amplification mechanism. We examine income distribution dynamics in Section 7. Section 8 takes the model to the data and quantifies its implications for growth. Section 9 concludes.

2. Related Literature

Our paper contributes to the understanding of the macroeconomic origins and effects of the firm's internal organization. By emphasizing the role of market structure, innovation, and growth, it provides a dynamic general equilibrium model well-suited to study questions that have been typically addressed in the realm of Organizational Economics and Industrial Organization (IO), and thus abstracting from macroeconomic dynamics.

To the best of our knowledge, ours is the first model in which the delegation decision itself, the number of managers per firm, effort per manager, and the growth rate of the economy are jointly determined as endogenous outcomes of a market equilibrium. The model points to an important and so far overlooked interaction between market size, technology, and the firm's internal organization that can naturally lead to growth accelerations and, possibly, to growth traps. The purpose is applied theory: the model takes as motivation the empirical and historical evidence on management and productivity discussed below and studies its implications for innovation, entry, and aggregate growth.

The model extends the class of endogenous growth models featuring vertical and horizontal innovation with an endogenous market structure (Peretto, 1996, 1998, 1999).[1] Two of the authors of this paper have previously examined the effects of corporate governance frictions in the form of managerial resource diversion and empire building (Iacopetta et al., 2019; Iacopetta and Peretto, 2021). In this paper, we retain the same endogenous growth core but modify the environment in two critical ways.

First, we consider an effort model in which managers choose costly effort that directly improves product quality and thereby firms' sales and profits. Managers do not steal or divert resources; they contribute to the firm's value and are remunerated with an incentive contract. In this sense, we take the "shareholder view" of executive compensation according to which managers are not rent extractors and contracts maximize shareholder value (Edmans and Gabaix, 2016). In contrast, Iacopetta et al. (2019) and Iacopetta and Peretto (2021) follow the "rent extraction view" (Edmans and Gabaix, 2016, p. 1232) and

[1] See Peretto (2027) and Chu and Peretto (2027) for two book-length treatments of this class of models and their numerous applications. See Atkeson et al. (2019) and Etro (2009) for two surveys with broader focus.

focus on the moral hazard of managers.

Second, we allow the owner of the firm to decide whether, when, and how many managers to employ. Consequently, the delegation decision is endogenous, and the number of managers per firm and effort per manager become two objects determined in general equilibrium. Absent the extensive margin of the number of managers per firm, the model exhibits a unique steady state. In this sense, the model that we present here is new and proposes a qualitatively different theory of the growth of the firm. The symmetric-firm specification also permits an analytical characterization of the delegation threshold, nonlinear transition dynamics, and the conditions for equilibrium multiplicity.

The paper builds on the vast literature on innovation-led growth. While this literature has studied several aspects of the growth process, research on the role of managers and the internal organization of the firm has been limited. Notable exceptions are Akcigit et al. (2021) and Celik and Tian (2023). Among many differences, arguably the most important one that distinguishes our work from those contributions is the focus on modeling the transition from the economy with small, owner-operated firms to the modern economy with large and complex business organizations. Specifically, we contribute to the debate by identifying a novel channel through which the interaction of market structure and the extensive margin of managerial employment gives raise to a growth acceleration and amplification, possibly, leading to multiple equilibria.

The paper also relates to Dessein and Prat (2022) and Terry (2023) who study how agency problems between the firm's owner and the managers who run it distort investment decisions in intangible assets. Both papers highlight the tension between short-term profit and long-term accumulation induced by agency frictions. We do not examine the phenomenon of "short-termism," but we also focus on the incentive problem between managers and owners and its impact on the accumulation of intangibles, knowledge in our case. Acemoglu and Newman (2002) study the effect of labor market conditions on the firm's internal structure in an efficiency-wage model where production workers can shirk, and the firm employs managers to monitor their efforts. While they share our interest in the macroeconomics of the firm's organization, we address a different question: the emergence of the managerial class, incumbent firms' innovative investment, the entry of new firms, and long-run growth.

By emphasizing the role of endogenous firm entry with sunk entry costs, some of the results in this paper relate to a long tradition in industrial organization that views sunk costs as a key determinant of market structure (Sutton, 1991, 2001). There is also a

literature that has studied the broad macroeconomic implications of entry costs for high-frequency movements in output (Alesina et al., 2005; Bertrand and Kramarz, 2002; Bilbiie et al., 2012; Blanchard and Giavazzi, 2003; Cacciatore and Fiori, 2016; Fiori et al., 2012; Hamano and Zanetti, 2017; Nicoletti and Scarpetta, 2003). However, this literature has not explored how such costs affect the internal organization of the firm. To the extent that entry costs capture aspects of the business regulatory environment and can be affected by government policy, our results can be helpful for policy analysis as they highlight the firm's internal organization's role as a significant transmission channel.

Finally, the paper relates to the literature on "development traps" that emphasizes increasing returns (Matsuyama, 1991), externalities, technological complementarities, endogenous markups (Gali, 1994, 1995), and non-convexities from fixed costs (Ciccone and Matsuyama, 1996), as potential sources of multiple equilibria (see also Azariadis and Stachurski (2005) and Matsuyama (1995) for review articles). Relatedly, Garicano and Rossi-Hansberg (2012) show that in response to improvements in communication technology, organizations in the form of knowledge-based hierarchies may lead to lower growth and even to stagnation. This happens because the return to exploiting available technologies through organizations increases relative to developing new technologies.[2] While some of the qualitative features of our model resemble those highlighted in this literature, the mechanism of multiplicity in our paper is to the best of our knowledge new.

3. Environment

Time, indexed by $t \in [0, \infty)$, is continuous and lasts forever. Variables are continuous functions of time, but to simplify notation we will omit the time argument unless needed for clarity.

3.1. Households

The economy is populated by a representative household with $\Lambda(t) = \Lambda_0 e^{\lambda t}$ infinitely-lived members. We set $\Lambda_0 = 1$ and $\lambda > 0$ so that population grows over time at a constant and exogenous rate. Each household member is endowed with one unit of time, supplied inelastically as labor services. Labor supply is thus $\Lambda(t)$. The household also owns a fixed factor Ω, e.g., land, and supplies its services inelastically.

[2] See Garicano and Rossi-Hansberg (2015) for a survey of the literature on knowledge-based hierarchies.

The household's preferences over per capita consumption are

$$U(0) = \int_0^\infty e^{-\rho t} \left[\Lambda(t) \log \left(\frac{C(t)}{\Lambda(t)} \right) \right] dt, \quad \rho > \lambda, \tag{1}$$

where 0 is the arbitrary point in time at which decisions are made, ρ is the intertemporal discount rate, and $C(t)$ is total household consumption.

The household's flow budget constraint is

$$\dot{A} = rA + w \left(\Lambda - \int_0^N m_i di \right) + \int_0^N m_i a_i \Pi_i di + p_\Omega \Omega - C. \tag{2}$$

Here, (i) A is household's wealth, which consists of equity shares of firms whose mass N is determined in free-entry equilibrium, (ii) $\int_0^N m_i di$ is the mass of managers employed by firms, with m_i denoting the mass of managers per firm, (iii) $\Lambda - \int_0^N m_i di$ is the mass of production workers or non-managers, (iv) $\int_0^N m_i a_i \Pi_i di$ is managerial income, and (v) $p_\Omega \Omega$ is income from renting the services of the fixed factor. The rate of return on wealth, r, the wage, w, and the rental price of the fixed factor, p_Ω, are determined competitively.

The consumption plan that maximizes (1) subject to (2) satisfies the standard Euler equation

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

and the usual boundary conditions.

3.2. Production

The production side of the economy consists of a two-tiered vertical structure with a final good and an upstream intermediate goods sector. The latter is where the corporate governance relevant to the paper's research question takes place.

3.2.1. Final Producers

A competitive representative firm produces a final good Y that can be consumed, used to produce intermediate goods, invested in improving the quality of existing intermediate goods, and invested in creating new intermediate goods. The final good is the numéraire so its price is $P_Y \equiv 1$.

The production technology is $Y = \int_0^N X_i^\theta \left(Q_i L_i^\gamma \Omega^{1-\gamma} \right)^{1-\theta} di$, with $0 < \theta, \alpha, \gamma < 1$, where N is the mass of intermediate goods and L_i and Ω are, respectively, services of

labor and of the fixed factor. The subscript i under labor says that the technology features full dilution of labor across intermediate goods, reflecting the property that both labor and intermediate goods are rival inputs. The fixed factor, instead, is non-rival across intermediate goods and labor. Quality, Q_i, is the good's ability to raise the productivity of the other factors.

Profit maximization yields an isoelastic demand curve for intermediate goods, $X_i = (\theta/p_i)^{\frac{1}{1-\theta}} Q_i L_i^{\gamma} \Omega^{1-\gamma}$, where p_i is the price of good i, and a demand curve for labor, $L_i = \gamma(1-\theta)(p_i X_i/\theta w)$. Final producers pay $\int_0^N p_i X_i di = \theta Y$, $\int_0^N w L_i di = \gamma(1-\theta) Y$, and $p_\Omega \Omega = (1-\gamma)(1-\theta) Y$, to the suppliers of intermediate goods, labor, and the fixed factor, respectively, so that total compensation to the factors of production equals output.

Each intermediate good is used in a separate production activity. Goods are therefore not perfect substitutes in final-good production. Intermediate producers compete in prices, facing the downward-sloping demand generated by the final-good technology.

3.2.2. Intermediate Producers

Here, we discuss intermediate producers' technologies and constraints abstracting from managerial delegation. The following section compares the two regimes with and without delegation to obtain our main results.

Technology and management We view firms as organizations that develop and apply specialized knowledge. Specifically, we write quality as

$$Q_i = M_i Z_i^{\alpha} Z^{1-\alpha}. \tag{4}$$

In words, the contribution of good i to factor productivity downstream depends on the technological component, $Z_i^{\alpha} Z^{1-\alpha}$, and the managerial component, M_i. The technological component depends on the knowledge stock of firm i, Z_i, and on the average knowledge of all firms, $Z = \int_0^N (Z_j/N)\, dj$.

We draw a sharp distinction between knowledge and management. While firm's knowledge, Z_i, can grow without bound, management is an input subject to natural bounds that apply along an extensive and an intensive margin. Formally,

$$M_i = \int_0^{m_i} f(h_{ij})\, dj + \mu, \tag{5}$$

where m_i is the number of managers employed by firm i, $h_{ij} \in [0,1]$ is effort of manager

j in firm i, and μ is the owner's managerial input.[3] The natural bound on m_i stems from the finite size of the workforce; the natural bound on h_{ij} stems from well-understood arguments developed by the literature on effort models.

This additive specification allows the owner to supply managerial services without hiring salaried managers. Delegation is therefore a choice. In contrast, a Cobb–Douglas specification with owner and hired managerial inputs both essential implies an unbounded marginal product of hired management at zero. It would rule out the owner-managed regime.

In-house innovation The firm's technology requires one unit of final output per unit of intermediate good and a fixed operating cost, ϕZ_i, also in units of final output. The firm accumulates knowledge according to the technology $\dot{Z}_i = I_i$, where I_i is in-house investment in units of final output. To characterize this decision, we use the demand schedule for intermediate goods to write the firm's gross cash flow as $\Pi_i \equiv (p_i - 1) X_i = (p_i - 1) (\theta / p_i)^{\frac{1}{1-\theta}} Q_i L_i^{\gamma} \Omega^{1-\gamma}$. The traditional approach to this class of models operates with $M_i \equiv 1$ and postulates that the firm chooses the time path of its product's price, $p_i(t)$, and its investment, $I_i(t)$, to maximize the value of the firm

$$V_i(0) = \int_0^{\infty} e^{-\int_0^t r(s)ds} \left[\Pi_i(t) - \phi Z_i - I_i(t)\right] dt, \tag{6}$$

subject to $\dot{Z}_i = I_i$, taking as given the path of average quality, Z. The characterization of the firm's decisions yields

$$r = \frac{\partial \Pi_i}{\partial Z_i} - \phi, \tag{7}$$

which is the return to in-house quality innovation.

3.3. Entry

To start operations a new firm must sink βZ units of final output. Because of the sunk setup cost, for the new firm is never profitable to supply an existing good in Bertrand

[3] We make three simplifying assumptions in (5). (1) The firm's owner exerts constant effort. Extending the model with an owner's effort choice does not alter in any substantive way our conclusions. (2) The owner remains involved in the firm. Allowing the owner to delegate and walk away does not change the analysis in any substantive way. It only changes the minimum level of hired managerial services from zero (see below) to a positive value. (3) There are no informational asymmetries: the effort of each manager is observable. This simple incentive structure allows us to embed managerial delegation in the full general equilibrium structure of endogenous growth while preserving tractability.

competition with the incumbent monopolist, rather it introduces a new good that expands product variety. The new firm enters at the average quality level.[4] Free entry requires $V_i = \beta Z$. Taking logs and time derivatives of the free-entry condition and of the valuation equation (6) yields the return to entry as

$$r = \frac{\Pi_i - \phi Z_i - I_i}{\beta Z} + \frac{\dot{Z}}{Z}, \tag{8}$$

where the first term on the right-hand side is the dividend/price ratio and the second term is capital gains.

4. The Organization of the Firm

This section describes the owner's delegation decision and the managers' incentives to exert effort.

4.1. No-Delegation Benchmark: Owner-Manager

We begin with our benchmark case of no delegation. Households finance the foundation of intermediate firms covering the entry cost. To make things concrete, we say that households assign the task of setting up and running the firm to a household member, whom we call the "owner" for brevity, who solves the same problem as in the original models that abstract from managerial delegation and incentive contracting.

Specifically, the owner operates at the baseline level of management services, so that $M_i = \mu \geq 0$. This setup yields the rates of return to quality and variety innovation that we obtained above, see (7)-(8). The term that captures the specific role of management is the marginal gross profit, $\partial \Pi_i / \partial Z_i = \alpha \Pi_i / Z_i$, which once substituted into (7), after rearranging terms, yields

$$r = \alpha \frac{\Pi_i}{Z_i} - \phi. \tag{9}$$

This expression for the return to in-house quality innovation under no delegation shows that the quality-adjusted gross profit of the firm, Π_i / Z_i, is the key channel of the effects that we study.

According to this formulation, owners perform their functions without leaving final production. Thus, one feature of the model is that the entrepreneurial input is distinct

[4] This simplifying assumption preserves symmetry of equilibrium at all times.

from labor in the sense that assigning one household member to setting up and running a firm does not remove that member from the labor supply. This assumption is essentially the one used in general equilibrium theory when we postulate that "firms" are set up and run by risk-neutral agents who maximize shareholder value. Such agents never show up explicitly in the model accounting precisely because they do not exert effort, do not earn compensation, do not consume, and are not removed from the labor force. We deviate from this characterization when we introduce delegation because we want our managers to exert effort, earn compensation, and consume.[5]

4.2. Delegation: Owners and Salaried Managers

We leave the dynamic investment decision in the hands of the owners and postulate that when they employ managers, they delegate control solely over middle- and lower-level management functions. Moreover, since exerting effort is costly, the owner has to provide the right incentives through appropriate compensation. We restrict attention to a simple contract in which the manager's compensation is proportional to the gross cash flow of the firm (revenues minus variable costs). The joint choice of compensation and managerial employment subject to an effort-response relation follows the familiar logic of the original efficiency-wage models, beginning with Solow (1979). Here, the key decision is whether to employ salaried managers at all: the owner can operate without delegation, but above an endogenous scale threshold, delegation becomes profitable. To determine the threshold, we compare the solution for the owner-manager with that for the delegating owner. Delegation allows the owner to concentrate on higher-level strategic concerns (i.e., formulating the firm's growth strategy). In contrast, managers who do not have such concerns concentrate on lower-level operational functions—setting the price, overseeing production and marketing, and so on—more productively than if they had them. Therefore, one way to think about delegation in our setup is that it achieves a more efficient division of labor within the firm.[6]

[5]Moreover, removing the owner-manager from the workforce does not change the important properties of the model with delegation since it simply adds the time endowment of the owner-manager to the total subtracted from the population size to determine employment in the final sector. That is, we would subtract $\int_0^N (m_i + 1)\, di$ instead of $\int_0^N m_i di$.

[6]See Edmans and Gabaix (2016) for a discussion of why real-world boards of directors may prefer simple to sophisticated fully "optimal" incentive contracts, even if such contracts are designed to maximize shareholder value.

4.2.1. Decisions: Manager-Agent

Manager j of firm i chooses effort, h_{ij}, to maximize

$$U_{ij}^{\text{manager-agent}}(0) = \int_0^{\infty} e^{-\int_0^t r(s)ds} \left[a_{ij}\Pi_i - s\left(h_{ij}\right) Z \right] dt, \tag{10}$$

where a_{ij} is the contractually stipulated fraction of the firm's gross cash flow constituting manager j's remuneration. Effort entails a utility cost, $s\left(h_{ij}\right)$, which is increasing and convex, with $s(0) = 0$, $\lim_{h_{ij}\to 1} s\left(h_{ij}\right) = +\infty$, and $\lim_{h_{ij}\to 1^-} s'\left(h_{ij}\right) = +\infty$. The manager's problem has no dynamic constraint and yields the intratemporal first-order condition for managerial effort:

$$a_{ij} \cdot \frac{\partial \Pi_i}{\partial M_i} \cdot \frac{\partial M_i}{\partial h_{ij}} = s'\left(h_{ij}\right) Z. \tag{11}$$

Managerial effort is observable, and there is no informational asymmetry between the owner and the manager. The incentive constraint does not arise from hidden action. It describes the manager's effort choice under the revenue-sharing contract.

Looking ahead, (11) will play a key role in the optimal contracting problem below as the owner strategically takes managers' effort schedules as constraints in choosing I_i and a_{ij}.

To streamline notation, we define the composite variable

$$\pi_i \equiv \frac{\Pi_i}{ZM_i} = \frac{(p_i - 1) X_i}{ZM_i} = (p_i - 1) \left(\frac{\theta}{p_i}\right)^{\frac{1}{1-\theta}} \left(\frac{Z_i}{Z}\right)^{\alpha} L_i^{\gamma} \Omega^{1-\gamma}, \tag{12}$$

and use it to write (11) in the more compact form

$$a_{ij}\pi_i f'\left(h_{ij}\right) = s'\left(h_{ij}\right), \tag{13}$$

which implicitly defines the effort function of manager j as $h_{ij} = \tilde{h}\left(a_{ij}\pi_i\right)$. The variable π_i captures the dependence of the managerial incentives to exert effort on the "baseline" profitability of the firm as driven by: (i) the Lerner index, $p_i - 1$; (ii) the scale of use of the product, which depends on the pricing decision, the term $(\theta/p_i)^{\frac{1}{1-\theta}}$, and the final producer's employment, the term L_i^{γ}; (iii) the firm's relative knowledge, $(Z_i/Z)^{\alpha}$.

For our purposes, the key property of this variable is that it abstracts from (or nets out) the managerial input, M_i. It thus provides information on how profitability depends on the traditional forces identified by the previous literature that abstracts from the orga-

nizational aspects we study here. One of the owner's decisions is determining the firm's internal organization in response to baseline profitability. We now turn to this problem.

4.2.2. Decisions: Owner-Principal

The owner maximizes

$$V_i(0) = \int_0^\infty e^{-\int_0^t r(s)ds} \left[\Pi_i(t) - \phi Z_i(t) - I_i(t) - \int_0^{m_i(t)} a_{ij}(t) \Pi_i(t) dj \right] dt, \quad (14)$$

subject to the demand and technology constraints specified above and the manager's effort function (11), thus internalizing $h_{ij} = \tilde{h}(a_{ij}\pi_i)$. The owner jointly chooses compensation, employment, and investment. It is helpful to discuss these components of the model in a few steps.[7]

Incentives and effort The owner's compensation decision is described by the first-order condition for the fraction of the gross cash flow paid to the manager,

$$(1 - \int_0^{m_i} a_{i\ell} d\ell) \frac{\partial \Pi_i}{\partial M_i} f'(h_{ij}) \frac{\partial \tilde{h}(a_{ij}\pi_i)}{\partial a_{ij}} = \Pi_i. \quad (15)$$

Since the technology for managerial services (5) treats managers symmetrically and they have identical utility cost of effort, the compensation decision reduces to a symmetric structure where managers exert identical effort and are paid the same amount. We can therefore drop the subscript j and aggregate across managers. Using $\partial \Pi_i / \partial M_i = \Pi_i / M_i$, we rewrite (15) as

$$(1 - m_i a_i) f'(h_i) \frac{\partial \tilde{h}(a_i \pi_i)}{\partial a_i} = M_i, \quad (16)$$

which is the owner's demand schedule for the managers' effort; it describes the owner's willingness to pay to elicit effort, taking the manager's effort function defined by (13) as an incentive constraint. The contract must also satisfy the participation constraint $a_i \Pi_i - s(h_i) Z > w$. By accepting employment as a manager at intermediate firm i, the individual household member forgoes employment as a worker in final production. The wage is a general equilibrium object that both parties take as given.

[7] The following conditions characterize these choices when participation is slack. See the Online Appendix for further details.

Employment and investment Given the symmetry across managers, the dividend flow accruing to the owner becomes $(1 - m_i a_i)\,\Pi_i - \phi Z_i - I_i$. The employment and investment decisions are then described by the following two first-order conditions:

$$m_i: \quad a_i \Pi_i = (1 - m_i a_i)\,\frac{\partial \Pi_i}{\partial M_i} \cdot \frac{\partial M_i}{\partial m_i}; \tag{17}$$

$$1 = q_i \quad (I_i > 0), \qquad r q_i - \dot{q}_i = \frac{d[(1 - m_i a_i)\Pi_i]}{dZ_i} - \phi. \tag{18}$$

Here, q_i is the marginal value of firm knowledge. Nonnegative investment satisfies $q_i \leq 1$, $I_i \geq 0$, and $(1 - q_i) I_i = 0$. With positive investment, $q_i = 1$ and its time derivative is zero. The derivative of retained cash flow includes the incentive-induced changes in effort and contractual payments. The employment condition reduces to

$$a_i = \frac{1 - m_i a_i}{M_i} f(h_i), \tag{19}$$

which we interpret as the equation that determines the shareholder-value-maximizing number of managers that the delegating owner wants to hire.

4.2.3. Incentive Contract and Delegation

It is helpful to separate the contract offered to managers and the resulting internal organization of the firm from the firm's investment decision.

Incentive contract (16) and (19) describe the owner's tradeoff in setting compensation. Together with the manager's effort condition (13), they determine managerial employment, the compensation fraction, and effort. To obtain a tractable structure, we specify managerial services as

$$M_i = m_i h_i^{\xi} + \mu$$

and the utility cost of effort as

$$s(h_i) = -\varepsilon \log(1 - h_i).$$

The three first-order conditions become

$$\frac{(1 - m_i a_i)\xi h_i^{\xi}}{1 - \xi + h_i/(1 - h_i)} = a_i (m_i h_i^{\xi} + \mu), \tag{20}$$

$$(1 - m_i a_i) h_i^{\xi} = a_i (m_i h_i^{\xi} + \mu), \tag{21}$$

and

$$\frac{h_i^{1-\xi}}{1 - h_i} = \frac{\xi}{\varepsilon} a_i \pi_i. \tag{22}$$

Their solution is remarkably simple.

We divide (20) by (21) and obtain

$$h_i = h^* \equiv 1 - \frac{1}{2\xi}.$$

Thus, an interior delegation solution requires $1/2 < \xi < 1$, and effort per manager is independent of profitability. The contract responds to profitability through compensation and managerial employment rather than through effort. Using $h_i = h^*$ in (22), we then obtain

$$a_i = \frac{2\varepsilon {h^*}^{1-\xi}}{\pi_i}.$$

Substitution in (21) shows that delegation is viable only when profitability exceeds the delegation threshold

$$\pi_D \equiv \frac{2\varepsilon\mu}{{h^*}^{2\xi-1}}. \tag{23}$$

For $\pi_i > \pi_D$, the contract is

$$m_i = \frac{\mu}{2{h^*}^{\xi}} \left(\frac{\pi_i}{\pi_D} - 1 \right), \qquad a_i = \frac{{h^*}^{\xi}}{\mu} \frac{\pi_D}{\pi_i}, \tag{24}$$

and therefore

$$m_i a_i = \frac{1}{2} \left(1 - \frac{\pi_D}{\pi_i} \right), \qquad M_i = \frac{\mu}{2} \left(1 + \frac{\pi_i}{\pi_D} \right). \tag{25}$$

At $\pi_i = \pi_D$, managerial employment is zero and $M_i = \mu$.

Equations (24)–(25) make the comparative statics transparent. As profitability rises above the delegation threshold, the firm hires more managers while the fraction of gross cash flow paid to each manager falls. Total managerial compensation nevertheless rises and approaches one half of gross cash flow. Since $a_i \pi_i$ is constant, effort per manager remains equal to h^*. Thus the expansion of managerial services occurs entirely through the extensive margin of managerial employment.

Proposition 1 (The Incentive Contract) *Suppose* $1/2 < \xi < 1$ *and managerial participation is slack. For* $\pi_i \leq \pi_D$*, the owner does not delegate and* $M_i = \mu$*. For* $\pi_i > \pi_D$*, the contract*

is given by (24)*, effort is* $h_i = h^*$*, and managerial services and total managerial compensation are given by* (25)*. Managerial employment and total managerial compensation increase with profitability, the compensation fraction per manager decreases, and effort per manager is constant.*

Proof. See the Online Appendix. ■

Incentives and innovation Delegation affects innovation because managerial services raise the gross cash flow generated by the firm's knowledge stock. In particular, (25) implies

$$(1 - m_i a_i) M_i \pi_i = \frac{\mu}{4\pi_D} (\pi_i + \pi_D)^2.$$

Its derivative with respect to π_i is

$$\frac{\mu}{2\pi_D} (\pi_i + \pi_D) = M_i.$$

Since $d\pi_i / dZ_i = \alpha \pi_i / Z_i$, the investment condition reduces to

$$r = \alpha \frac{\Pi_i}{Z_i} - \phi. \tag{26}$$

Thus, delegation does not change the form of the return to in-house quality innovation (i.e., knowledge accumulation), but it increases the magnitude of the return by activating a positive feedback loop between managerial services and profitability. As stated, the mechanism operates through managerial employment, not through effort per manager.

Delegation decision: dynamic interpretation To compare organizational regimes, we determine which structure delivers the higher return to investment and, under no arbitrage, firm ownership. Without delegation,

$$r_i^{ND} = \alpha \mu \pi_i \frac{Z}{Z_i} - \phi.$$

With delegation,

$$r_i^D = \alpha M(\pi_i) \pi_i \frac{Z}{Z_i} - \phi, \qquad M(\pi_i) = \frac{\mu}{2} \left(1 + \frac{\pi_i}{\pi_D} \right).$$

For $\pi_i \leq \pi_D$, the delegation contract is not viable and managerial services are just μ. For $\pi_i > \pi_D$, managerial employment becomes positive and managerial services are a linear

function of profitability. A sufficiently large and profitable operation therefore supports delegation, and further increases in profitability expand the organization by increasing the number of managers while leaving effort per manager unchanged.

5. General Equilibrium

Since the equilibrium is symmetric, henceforth, we drop the i subscript so that, for example, $X \equiv X_i$ denotes both firm-level and average intermediate good production.[8]

5.1. Key elements of the equilibrium dynamical system

The general equilibrium system has three core components: the relation between population size, total output, and a measure of firm's profitability, where the latter turns out to be our key state variable; the viability of the incentive contract given that state of the economy, which requires us to verify the manager's participation constraint given the wage; and no-arbitrage in the financial market that requires equalization of the rates of return to investment in quality and variety.

The driving force: π Market size—total sales of intermediate goods—is a crucial determinant of the dynamics of market structure and, thereby, of firm size and the incentives to delegate managerial functions and undertake innovative investment. To determine it, we note that in symmetric equilibrium, the sales of the typical firm are $pX = \theta Y/N$, where using the final output technology we obtain

$$\frac{Y}{N} = \theta^{\frac{2\theta}{1-\theta}} M(\pi) Z \left(\frac{\Lambda}{N} - m(\pi)\right)^{\gamma} \Omega^{1-\gamma}. \tag{27}$$

In this expression, managerial services, $M(\pi)$, and the mass of managers per firm, $m(\pi)$, are the functions of π, that we characterized above. Moreover, given its definition (12),

[8]The symmetric equilibrium follows from the standard assumptions of this class of Schumpeterian models. Firms face the same demand, use the same technologies, and make the same investment decisions, starting with equal initial stocks of knowledge, so that at any point in time $Z_i = Z$ and $X_i = X$ for all i. Entrants start at the average stock of knowledge, preserving symmetry as the mass of firms expands. The paper does not study convergence to symmetry from an arbitrary initial distribution of firm-specific knowledge. For a discussion of such process, see Peretto (2027).

the firm's profitability reduces to

$$\pi = \left(\frac{1}{\theta} - 1\right) \theta^{\frac{2}{1-\theta}} \left(\frac{\Lambda}{N} - m\left(\pi\right)\right)^{\gamma} \Omega^{1-\gamma}. \tag{28}$$

We thus have two equations, (27) and (28), that show the intimate link between population size, Λ, output, Y, and the model's composite variable, π, at the core of the endogenous growth block of the model. For a given mass of firms, N, an increase in population raises the total output of the final good producers, increasing demand for intermediate goods and sales. As a result, intermediate producers face a larger market size, raising the rates of return to knowledge accumulation and entry.

Although a larger population initially raises profitability and innovation incentives, the resulting entry expands the number of firms and the aggregate resources devoted to firm-specific R&D. Along a balanced growth path, the population-to-firm ratio remains constant, so population size and population growth do not independently determine the long-run rate of knowledge accumulation.

Manager's participation constraint Next, we verify that the incentive contract satisfies the manager's participation constraint in general equilibrium. We use (27) and (28) to obtain the equilibrium wage and rewrite the participation constraint as

$$a\left(\pi\right)\pi - \frac{s\left(h\left(\pi\right)\right)}{M\left(\pi\right)} > \pi^{1-\frac{1}{\gamma}} \left[\left(1-\theta\right)\theta^{\frac{1+\theta}{1-\theta}}\Omega^{1-\gamma}\right]^{\frac{1}{\gamma}} \frac{\gamma}{\theta}. \tag{29}$$

This is the manager's participation constraint, $a\pi M - s(h^*) > w/Z$, after substituting the equilibrium wage implied by (27) and (28). On the unconstrained delegation branch, effort is constant at h^*, $a(\pi)\pi = 2\varepsilon {h^*}^{1-\xi}$, and managerial services increase with profitability. Since $s(h^*) > 0$, the left-hand side of (29) is strictly increasing in π. The right-hand side is strictly decreasing for $0 < \gamma < 1$. Participation therefore holds for every $\pi > \pi_D$ if and only if it holds weakly at the delegation threshold, where $M(\pi_D) = \mu$. The corresponding restriction on the structural parameters is

$$2\varepsilon {h^*}^{1-\xi} - \frac{s(h^*)}{\mu} \geq \frac{\gamma}{\theta} \left[(1-\theta)\theta^{\frac{1+\theta}{1-\theta}}\Omega^{1-\gamma}\right]^{1/\gamma} \pi_D^{1-1/\gamma}. \tag{30}$$

Here $h^* = 1 - 1/(2\xi)$ and $\pi_D = 2\varepsilon\mu/{h^*}^{2\xi-1}$ are determined by the contract. Even equality in (30) implies strictly slack participation for every $\pi > \pi_D$. In the baseline calibra-

tion, the left- and right-hand sides at $\pi_D \simeq 0.0780$ are 0.02492 and 0.02048, respectively. Thus the unconstrained contract satisfies participation throughout the delegation region, including along transition paths. If the parameter restriction fails, participation nevertheless holds for all sufficiently high profitability, with a unique participation threshold above π_D. The Online Appendix provides a separate sufficient condition ensuring slack participation at every possible steady state.

No-arbitrage We now turn to no-arbitrage as the key concept driving our equilibrium. Let $z \equiv \dot{Z}/Z$ denote the growth rate of knowledge. With positive in-house investment, the rates of return to innovation and entry are the following two functions of π:

$$r = \alpha M(\pi)\,\pi - \phi; \tag{31}$$

$$r = \frac{[1 - m(\pi)\,a(\pi)]\,M(\pi)\,\pi - \phi - z}{\beta} + z. \tag{32}$$

We study the model under the assumption that entry is always active. When the return to in-house investment is too low, on the other hand, we have the corner solution $z = 0$ and the return to entry alone determines the interest rate as

$$r = \frac{[1 - m(\pi)\,a(\pi)]\,M(\pi)\,\pi - \phi}{\beta}. \tag{33}$$

There thus exists a threshold π_Z, which is the value of profitability at which the in-house investment condition changes from the corner $z = 0$ to the interior solution with $z > 0$. To determine it, we note first that the rate of return to in-house investment (31) rises more than linearly with π. This positive relationship captures the property that managerial services, $M(\pi)$, are increasing in the firm's profitability. The contract raises managerial employment with profitability while keeping effort per manager constant. At a given knowledge-growth rate, the return to entry increases with the cash flow, which is increasing and convex in π. This shape captures the positive feedback loop between profitability, in-house knowledge accumulation, and managerial employment, and creates the possibility of multiple equilibria.

5.2. Two Equations Governing Equilibrium Dynamics

While we can reduce the model's general equilibrium to a dynamical system of two ODEs, the transition dynamics generated by such a system are rich, encompassing qualitatively

different types of equilibrium paths: the first type describes an economy in which firms remain owner-operated along all the transition, eventually converging to a low-growth steady state without a managerial class; the second type describes an economy that experiences the endogenous transition to delegation, converging to a high-growth steady state in which firms operate with the help of salaried managers. Additional transition configurations are possible when multiple equilibria arise.

The 2x2 dynamical system To derive the dynamical system, we define consumption per effective person, $c \equiv C/Z\Lambda$. Log-differentiating c with respect to time, and using the expressions for the rates of return and quality growth, we obtain the equilibrium Euler equation

$$\frac{\dot{c}}{c} = r(\pi) - z(\pi) - \rho, \tag{34}$$

which links the growth rate of c to the interest rate, $r(\pi)$, and the rate of knowledge growth, $z(\pi)$, which are both functions of the state variable, π. Using asset market clearing, $A = NV$, and the free-entry condition, $V = \beta Z$, gives equilibrium household wealth as $A = \beta NZ$, which after substituting in the household's budget constraint and using (28) to eliminate Λ/N, gives the growth rate of the mass of firms,

$$\begin{aligned} n(\pi, c) = r(\pi) - z(\pi) + \frac{M(\pi)\pi}{\beta\theta} + \frac{m(\pi)a(\pi)M(\pi)\pi}{\beta} \\ - \frac{c}{\beta}\left\{\pi^{1/\gamma}\left[(1-\theta)\theta^{(1+\theta)/(1-\theta)}\Omega^{1-\gamma}\right]^{-1/\gamma} + m(\pi)\right\}. \end{aligned} \tag{35}$$

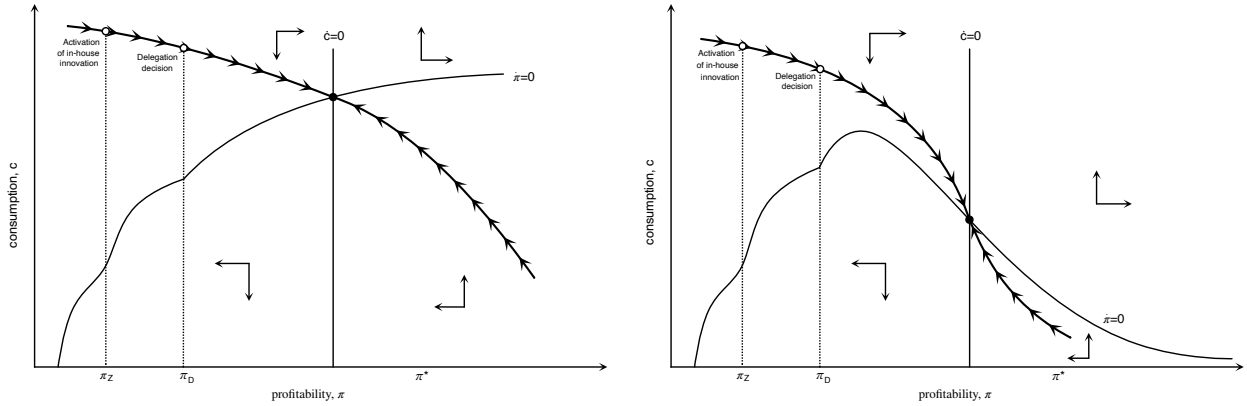
Finally, differentiating (28) with respect to time yields the equilibrium dynamics of the state variable:

$$\dot{\pi} = \gamma\left[\lambda - n(\pi, c)\right] \frac{\pi^{\frac{1}{\gamma}}\left[(1-\theta)\,\theta^{\frac{1+\theta}{1-\theta}}\Omega^{1-\gamma}\right]^{-\frac{1}{\gamma}} + m(\pi)}{\pi^{\frac{1}{\gamma}-1}\left[(1-\theta)\,\theta^{\frac{1+\theta}{1-\theta}}\Omega^{1-\gamma}\right]^{-\frac{1}{\gamma}} + \gamma m'(\pi)}. \tag{36}$$

We have thus reduced the equilibrium dynamics of our model to a tractable system in (π, c) space.[9] Note that the functions $z(\pi)$ and $r(\pi)$ have three branches determined

[9] The domain of π must take into account the non-negativity constraint on flow profit, i.e., when profit is too low, firms shut down R&D and for $[1 - m(\pi)\,a(\pi)]\,M(\pi)\,\pi - \phi \leq 0$, they exit. Moreover, as π becomes smaller and smaller, not only firms shut down R&D, but their owners do not delegate and run things themselves. The viability boundary is determined by $(1 - ma)M\pi = \phi$, evaluated on the applicable contract branch; it equals ϕ/μ only without delegation. Exit regions are excluded from the free-entry dynamics considered here.

by the two profitability thresholds, π_Z, and π_D, that trigger the activation of in-house investment and the adoption of the organizational structure with managers.



(a) Increasing $\dot{\pi} = 0$ locus

(b) Decreasing $\dot{\pi} = 0$ locus

Figure 1: Equilibrium dynamics with increasing and decreasing $\dot{\pi} = 0$ loci

Notes: The two panels display the $\dot{\pi} = 0$ and $\dot{c} = 0$ loci in (π, c) space, with $c = C/(Z\Lambda)$, together with the R&D activation threshold π_Z and the delegation threshold π_D. Panel (a) shows the case in which the $\dot{\pi} = 0$ locus is increasing at the larger steady state; panel (b) shows the case in which it is decreasing.

Phase diagram and local stability Figure 1 illustrates the two shapes of the $\dot{\pi} = 0$ locus that are relevant for the model's local dynamics. The $\dot{c} = 0$ locus is vertical because (34) depends on π but not on c. The $\dot{\pi} = 0$ locus is defined by $n(\pi, c) = \lambda$, where $n(\pi, c)$ in (35) is the growth rate of the mass of firms. Since $\partial\dot{\pi}/\partial c > 0$, the slope of the $\dot{\pi} = 0$ locus determines the trace of the Jacobian. The Online Appendix establishes analytically that the smaller root of a two-root positive-R&D configuration is a saddle. At the larger root, the determinant is positive and the slope of the $\dot{\pi} = 0$ locus determines whether the steady state is locally stable or unstable. The two panels illustrate these alternative configurations and provide the phase-diagram interpretation of the analytical results.

5.3. The Model's Steady State(s)

The number and stability of steady states depend on parameter values and branch admissibility. We examine the mechanism and implications of such multiplicity in the next section and the Online Appendix. In this subsection, we discuss basic model properties shared by all steady states, which depict an economy growing at a constant exponential rate. Along such an equilibrium path, (i) the mass of firms grows at the same rate of popu-

lation growth so that the ratio of the mass of firms to population is constant, (ii) per capita income and consumption grow at the same rate of knowledge, z, and (iii) the growth rate of knowledge with managers is higher than that without managers.

The 2x2 steady-state system Using (34)-(36), we obtain:

$$\dot{c} = 0: \quad r(\pi) - z(\pi) = \rho; \tag{37}$$

$$\dot{\pi} = 0: \quad n(\pi, c) = \lambda. \tag{38}$$

To visualize the possibility of multiple steady states, it is useful to substitute the rate of return to in-house investment (31) into (37) to obtain an equilibrium relationship between the knowledge growth rate, z, and π, which we refer to as *general equilibrium locus*:

$$z_{GE}(\pi) = \alpha M(\pi)\pi - \phi - \rho, \qquad z > 0. \tag{39}$$

At the zero-R&D corner, this locus is replaced by the corner conditions $[(1 - ma)M\pi - \phi]/\beta = \rho$ and $\alpha M\pi - \phi \leq \rho$.

Next, focusing on the case in which delegation comes after the activation of in-house innovation, the growth rate of knowledge is

$$z_{NA}(\pi) = \begin{cases} 0 & \phi/\mu \leq \pi \leq \pi_Z \\ \frac{\beta\alpha - 1}{\beta - 1}\mu\pi - \phi & \pi_Z < \pi \leq \pi_D \\ \frac{\beta\alpha - 1 + m(\pi)a(\pi)}{\beta - 1} M(\pi)\pi - \phi & \pi > \pi_D \end{cases}, \tag{40}$$

where $\pi_Z = \frac{\beta - 1}{\beta\alpha - 1}\frac{\phi}{\mu} < \pi_D$ is the activation threshold for in-house investment. If delegation occurs first, $\pi_D < \pi_Z$, the activation threshold instead lies on the delegation branch and is the positive solution of

$$(2\beta\alpha - 1)\pi_Z^2 + 2(\beta\alpha - 1)\pi_D\pi_Z - \pi_D^2 - \frac{4(\beta - 1)\phi\pi_D}{\mu} = 0. \tag{41}$$

Given its construction, we refer to (40) as the *no-arbitrage locus*. (See the Online Appendix for more discussion on the timing of delegation and innovation.)

Finally, the steady state is the intersection in (π, z) space of the no-arbitrage locus (40)

with the general equilibrium locus (39):

$$\pi^* = \arg\operatorname{solve}\left\{\frac{1-\alpha-m(\pi)\,a(\pi)}{\beta-1}M(\pi)\,\pi=\rho\right\}. \tag{42}$$

Equation (42) applies to positive R&D. Existence requires a positive, branch-admissible solution with $z > 0$ and positive consumption. For $\beta > 1$ and $\alpha \leq 1/2$, its left-hand side is increasing across the unconstrained no-delegation and delegation branches. A positive-R&D solution lies on the delegation branch if

$$\frac{1-\alpha}{\beta-1}\mu\pi_D < \rho. \tag{43}$$

For $\alpha > 1/2$, the delegation expression is concave and can have two roots. The zero-R&D corner and binding-participation regimes require their own admissibility checks, as detailed in the Online Appendix.

Growth with and without managers The steady-state growth rate of knowledge with managers is

$$z^* = \frac{\beta\alpha-1+m(\pi^*)\,a(\pi^*)}{1-\alpha-m(\pi^*)\,a(\pi^*)}\rho-\phi. \tag{44}$$

For an admissible positive-R&D solution with $1-\alpha-ma > 0$, this expression exceeds the no-delegation benchmark with the same $\rho, \alpha, \beta, \phi$:

$$\frac{\beta\alpha-1+m(\pi^*)\,a(\pi^*)}{1-\alpha-m(\pi^*)\,a(\pi^*)}\rho-\phi > \frac{\beta\alpha-1}{1-\alpha}\rho-\phi. \tag{45}$$

In other words, the delegation decision boosts steady-state growth.

6. Management as an Amplification Mechanism

Management and innovative investment reinforce each other through the extensive margin of delegation. This complementarity can amplify changes in fundamentals even when the steady state is unique. With a sufficiently high own-knowledge elasticity, the model can also produce multiple admissible steady states. The Online Appendix characterizes the number of admissible steady states and their local stability.

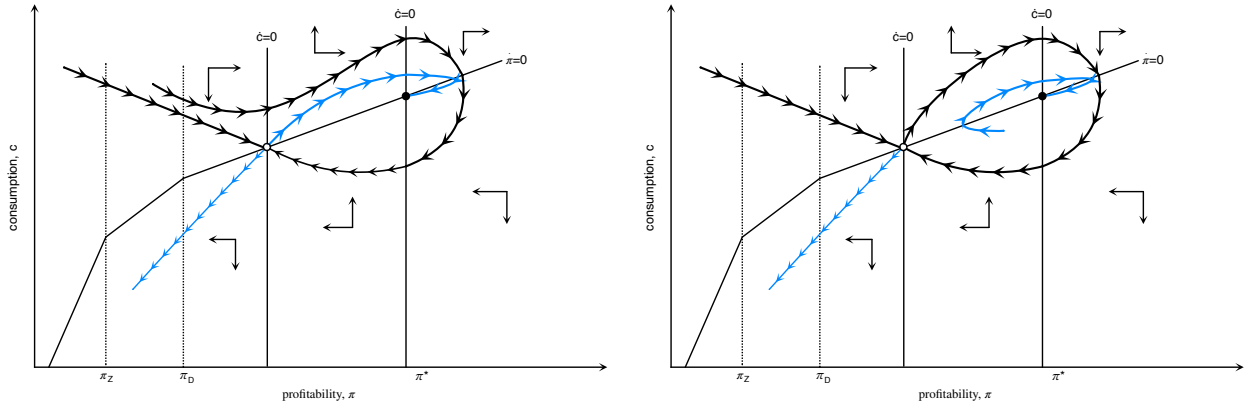
6.1. Multiple Equilibria

The complementarity between management and innovation can generate multiple steady states. When the feedback from profitability to managerial employment and innovation is sufficiently strong, the positive-R&D steady-state condition can have two solutions. The lower steady state is a saddle, whereas the higher steady state can be locally stable. Figure 2 illustrates the resulting global dynamics.

Panel (a) shows a heteroclinic configuration[10]: a branch of the unstable manifold leaving the low-profitability saddle converges to the high-profitability steady state, thereby connecting two distinct steady states. The stable manifold of the low-profitability saddle is a separatrix: initial conditions on one side generate trajectories that converge to the high-profitability steady state, whereas those on the other side eventually violate the conditions for an equilibrium. Panel (b) shows the limiting homoclinic configuration. Here the same branch of the unstable manifold returns to the low-profitability saddle along its stable manifold, so the orbit connects the saddle to itself rather than to the high-profitability steady state. The blue trajectory inside the homoclinic orbit remains in the basin of attraction of the high-profitability steady state and converges to it.

The figure illustrates the economic significance of multiplicity in this model. Identical fundamentals can support distinct long-run outcomes because the complementarity between management and innovation reinforces differences in profitability and organizational structure. Comparing the two panels gives a direct interpretation of the global dynamics: as fundamentals change, the unstable branch leaving the low-profitability saddle can switch from converging to the high-profitability steady state to returning to the saddle itself. The Online Appendix derives the conditions for multiplicity and local stability and discusses additional configurations, including the case in which the high-profitability steady state is an unstable focus.

[10] A heteroclinic orbit is a trajectory connecting two distinct steady states: it approaches one steady state in backward time and another in forward time. A homoclinic orbit instead leaves and returns to the same steady state, following its unstable and stable manifolds.



(a) Heteroclinic configuration

(b) Homoclinic configuration

Figure 2: Multiple steady states and global equilibrium dynamics

The extensive margin of managerial organization is essential for multiplicity. If a delegating firm is restricted to employing one manager, profitability can still raise managerial services through the manager's effort, but this intensive-margin response is not sufficiently strong to generate multiple steady states under the calibrated parameterization. Multiplicity in the baseline model therefore originates in the stronger extensive-margin response: higher profitability induces firms to employ more managers, amplifying the complementarity between management and innovation. The Online Appendix solves the one-manager model, establishes uniqueness on the economically relevant delegation branch, and reports its calibration.

6.2. Amplification Without Multiplicity

The mechanism that generates complementarity between management and investment can substantially amplify the effects of policy even without multiplicity. Consider the case in which the steady state is unique and the economy is in the neighborhood of such steady state so that we can safely rely on local analysis. Around the steady state implied by (39)-(42), a simple expression describes how changes in the state variable π map into changes in the knowledge growth rate:

$$\frac{dz(\pi^*)}{d\pi^*} = \alpha\mu\left(\frac{1}{2}+\frac{\pi^*}{\pi_D}\right) = \underbrace{\alpha\mu\left(\frac{\pi^*}{\pi_D}-\frac{1}{2}\right)}_{\text{amplification from management}} + \alpha\mu > 0, \qquad \pi^* > \pi_D. \tag{46}$$

This expression shows that management acts as an amplification mechanism of

changes in π. The first term of the right-hand side is positive on the delegation branch since managerial employment increases with profitability while managerial effort is constant, and the second term $\alpha\mu$ is the value of $dz(\pi^*)/d\pi^*$ that would prevail in a steady state without managers.

For a given change in steady-state profitability, the positive-R&D general-equilibrium locus (39) is steeper with delegation. The total growth response to a policy also depends on the induced change in profitability and must be evaluated in general equilibrium. The set of policies that can affect π^* is large, including business income taxation and distortions affecting firms' entry decisions. For example, changes in the parameters governing sunk entry costs, β, and fixed operating costs, ϕ, lead to different steady-state values of π^* and thereby $z(\pi^*)$. Thus, to the extent that the policy or regulatory environment affects the cost of setting up and running a business, as captured by β and ϕ, the presence of management can substantially amplify the impact of entry regulations, taxes and subsidies.

Further, business taxation in the form of distorting taxes on dividends and capital gains can have a potentially significant impact on π^*, too, as they operate through changes in the rate of return to investment and entry (Ferraro et al., 2020, 2023; Peretto, 2003, 2007). Similar logic applies to business tax credits, depreciation allowances, and R&D expensibility. Overall, management plays a critical role in the model above and beyond multiple equilibria.

7. Income Distribution Dynamics

The functional distribution of income and the firm's internal organization are jointly determined. The delegation decision determines the number of managers employed by each firm, the share of gross cash flow paid to each manager, and managers' compensation relative to that of non-managers. In the US, managers' relative pay and employment share have increased substantially since 1950.

All these objects can be expressed as functions of profitability, π, which summarizes the market forces that determine firm size and the value of managerial services. A path for π therefore maps directly into paths for managerial employment and compensation. The mapping is especially transparent on the delegation branch because the contract implies

$$h = h^*, \qquad a(\pi) = \frac{h^{*\xi}}{\mu}\frac{\pi_D}{\pi}, \qquad m(\pi) = \frac{\mu}{2h^{*\xi}}\left(\frac{\pi}{\pi_D} - 1\right), \qquad \pi > \pi_D, \tag{47}$$

and hence

$$m(\pi)a(\pi) = \frac{1}{2}\left(1 - \frac{\pi_D}{\pi}\right). \tag{48}$$

7.1. The Marginal Product of Managerial Effort

Before turning to managerial compensation and relative pay, consider the relation between firm sales—a commonly used measure of firm size—and managerial effort. Define the marginal product of effort as the change in sales generated by an additional unit of managerial effort. From the firm's revenue function,

$$\frac{\partial(p_i X_i)}{\partial h_i} = \theta^{\frac{1+\theta}{1-\theta}} Z_i^{\alpha} Z^{1-\alpha} L_i^{\gamma} \Omega^{1-\gamma} \frac{\partial M_i}{\partial h_i}. \tag{49}$$

It is increasing in the firm's stock of knowledge, Z_i^{α}, and in symmetric equilibrium grows proportionally with the average stock of knowledge, Z. Thus, in a positive-growth steady state, the marginal contribution of managerial effort to sales grows at the same constant rate as knowledge.

The contract separates this productivity effect from the firm's organizational response. Conditional on delegation, effort per manager is constant at h^*, while managerial employment responds to profitability. At a finite steady-state value of π, both managerial employment and managerial services are finite. Sustained growth in firm sales then comes from knowledge accumulation. Management affects the return to innovation and therefore the steady-state growth rate, but it is not an independent engine of perpetual growth.

7.2. Managers' Relative Pay

The compensation of a manager relative to the wage of a non-manager is

$$\frac{a\Pi}{w} = \frac{\theta}{\gamma} a(\pi) \left[(1-\theta)\theta^{\frac{1+\theta}{1-\theta}} \Omega^{1-\gamma}\right]^{-\frac{1}{\gamma}} \pi^{\frac{1}{\gamma}}. \tag{50}$$

On the delegation branch, substitution of (47) yields

$$\frac{a\Pi}{w} = \frac{\theta}{\gamma} \frac{h^{*\xi} \pi_D}{\mu} \left[(1-\theta)\theta^{\frac{1+\theta}{1-\theta}} \Omega^{1-\gamma}\right]^{-\frac{1}{\gamma}} \pi^{\frac{1}{\gamma}-1}. \tag{51}$$

Because $0 < \gamma < 1$, relative compensation per manager increases monotonically with profitability even though the contractual compensation share $a(\pi)$ decreases. The reason

is that firm size, and therefore the value of managerial input, rises sufficiently rapidly with profitability to dominate the decline in the share of cash flow paid to each manager. This positive relation between managerial pay and firm size is one of the best documented empirical regularities in executive compensation (Baker et al., 1988; Edmans et al., 2009; Edmans and Gabaix, 2016; Gabaix and Landier, 2008; Gabaix et al., 2014; Hall and Liebman, 1998; Murphy, 1999, 2013).

7.3. Managers' Share of Labor Income

Let labor income be the sum of managers' income, $Nma\Pi$, and non-managers' income, $w(\Lambda - mN)$. The ratio of non-managerial to managerial labor income is

$$\frac{w(\Lambda - mN)}{Nma\Pi} = \frac{\gamma/\theta}{m(\pi)a(\pi)}. \tag{52}$$

Using (48), on the delegation branch this becomes

$$\frac{w(\Lambda - mN)}{Nma\Pi} = \frac{2\gamma/\theta}{1 - \pi_D/\pi}. \tag{53}$$

Accordingly, the managers' share of labor income is

$$\frac{Nma\Pi}{Nma\Pi + w(\Lambda - mN)} = \frac{\frac{\theta}{2\gamma}\left(1 - \frac{\pi_D}{\pi}\right)}{1 + \frac{\theta}{2\gamma}\left(1 - \frac{\pi_D}{\pi}\right)}. \tag{54}$$

It is zero at the delegation threshold, rises monotonically with profitability, and converges to the finite upper bound $\theta/(\theta + 2\gamma)$. Thus, along a transition with rising profitability, managers can receive an increasing share of labor income even though the compensation share paid to each individual manager falls. Equation (54) also separates two determinants of this share: profitability relative to the delegation threshold, π/π_D, and the production parameters θ and γ. Since managerial technology and innovation affect both the threshold and equilibrium profitability, their total effects must be evaluated using the general-equilibrium conditions.

The employment share of managers has a different shape. Using the labor-market

clearing condition and (47),

$$\frac{mN}{\Lambda} = \frac{\frac{\mu}{2h^{*\tilde{\xi}}}\left(\frac{\pi}{\pi_D} - 1\right)}{\left[(1-\theta)\theta^{\frac{1+\theta}{1-\theta}}\Omega^{1-\gamma}\right]^{-\frac{1}{\gamma}}\pi^{\frac{1}{\gamma}} + \frac{\mu}{2h^{*\tilde{\xi}}}\left(\frac{\pi}{\pi_D} - 1\right)}. \tag{55}$$

The managerial employment share is zero when delegation begins. It initially rises because managerial employment increases from zero, but eventually falls: $m(\pi)$ grows linearly in π, whereas non-manager employment grows proportionally to $\pi^{1/\gamma}$, with $1/\gamma > 1$. Hence the managerial employment share has an interior maximum and converges to zero as $\pi \to \infty$.

The model therefore distinguishes four margins of managerial compensation and employment that need not move together. As profitability rises on the delegation branch, the compensation share per manager $a(\pi)$ falls, compensation per manager relative to the non-manager wage rises, the product $m(\pi)a(\pi)$ and the managerial share of labor income rise toward finite limits, and the managerial employment share follows a hump-shaped path. These differences are important when mapping the model into data on occupational employment, executive compensation, and the functional distribution of income.

8. Numerical Illustrations of the Effects of Management

We use nonlinear numerical simulations to illustrate how managerial organization affects innovation, market structure, and growth. We first calibrate the model to long-run U.S. evidence and then examine its transition dynamics and the effects of organizational restrictions.

8.1. Calibration

We set the firm-specific knowledge elasticity $\alpha = 0.33$, following Iacopetta and Peretto (2021). We set $\theta = 0.45$, which is the average share of intermediate inputs in gross output over 1980–2024 reported in Massari and Peretto (2026). Table 1 reports the main parameterization, which we use for both the full-economy impulse responses and the three-economy comparison.

The calibration has a nearly triangular structure: parameters identified at one stage enter the equilibrium restrictions used at the next. External evidence determines popu-

lation growth, the intermediate-input share, and the firm-specific knowledge elasticity. The growth and real-return targets determine the discount rate; wealth, growth, and incumbent R&D determine the entry cost. The entry and innovation restrictions then determine operating costs and managerial compensation. Managerial effort and employment identify the contract parameters and the owner's managerial input, while the aggregate labor share and managerial employment share identify the labor technology and fixed-factor endowment. This ordering gives a clear mapping from targets to parameters. It also identifies which parameters must be recalibrated when an organizational restriction changes the relevant equilibrium conditions. The Online Appendix presents the targets, accounting definitions, and identifying equations.

Table 1: Main calibration: $\theta = 0.45$

Parameter	Value	Source of discipline
λ	0.0110	Population growth
θ	0.4500	Intermediate-input share
α	0.3300	Evidence on knowledge spillovers
ρ	0.0350	Growth and real return
β	5.4054	Wealth, growth, incumbent R&D
ϕ	0.0929	Wealth and innovation return
ξ	0.8000	Managerial effort
μ	1.0326	Managers per firm and contract
ε	0.0210	Managerial effort condition
γ	0.7352	Aggregate labor share
Ω	0.0111	Managerial employment share

The growth and real-return targets are $z = 0.02$ and $r = 0.055$. The managerial targets are $m = 2.12$ managers per firm, effort $h^* = 0.375$, and a managerial employment share of 0.075; the aggregate labor share is 0.65. Once these steady-state targets discipline the parameters, the equilibrium laws of motion determine the transition paths without additional parameters chosen to fit them.

8.2. Transition Dynamics

Using the main parameterization in Table 1, we compute nonlinear saddle-path transitions after permanent one-percent changes in five parameters: the sunk entry cost β, the elasticity of firm-level knowledge α, the owner's managerial input μ, the curvature of managerial effort ξ, and the cost of managerial effort ε. The experiments hold all other structural parameters fixed. They therefore ask how the economy moves from the calibrated steady state to the new steady state implied by each structural change.

Figures 3–7 report profitability, normalized consumption, in-house innovation, the interest rate, managers per firm, and the managerial compensation share. The initial population and mass of firms are predetermined, while consumption adjusts to the new saddle path. When a change in managerial technology changes the employment schedule, initial profitability is determined by the unchanged employment per firm and the new labor-market allocation. The responses are nonlinear solutions of the equilibrium system.

A higher sunk entry cost β raises equilibrium profitability and managers per firm. The induced increase in firm size strengthens the incentive to innovate, so the in-house innovation rate and the interest rate rise along the transition. A higher α raises the private return to in-house innovation. The resulting equilibrium increase in profitability expands managerial organization, which further strengthens innovation incentives. The response illustrates the amplification mechanism generated by the interaction of organization, innovation, and entry. These experiments illustrate the general-equilibrium role of endogenous market structure: changes in entry and innovation incentives feed back into firm size and managerial organization.

The management parameters operate differently. A one-percent increase in the owner's managerial input μ reduces profitability, managers per firm, in-house innovation, and the managerial compensation share in the new steady state. A one-percent increase in ξ raises profitability but reduces managers per firm and slightly lowers long-run in-house innovation and the managerial compensation share. A one-percent increase in the cost of managerial effort ε also raises profitability, but it reduces managerial employment, in-house innovation, the interest rate, and the managerial compensation share. The higher effort cost raises the profitability threshold for delegation and weakens the contribution of delegated management at a given level of profitability. The transition paths therefore separate changes in profitability from changes in managerial organization and innovation. This distinction is precisely why the dynamic equilibrium restrictions provide information beyond steady-state comparative statics.

The figures reveal a common propagation pattern. Adjustment operates through entry: a structural change moves the entry rate away from population growth, and the resulting change in the number of firms gradually changes firm size, profitability, managerial organization, and in-house innovation. Around the baseline, the stable eigenvalue is about -0.13 per year across these experiments, implying a half-life of roughly 5.3 years; about 90 percent of the transitional gap is closed only after approximately 18 years. The managerial shocks have economically visible but moderate long-run effects on innovation for the one-percent changes considered here. A one-percent increase in μ lowers the annual innovation rate from 2.00 to 1.88 percent; the corresponding increases in ξ and ε lower it to 1.97 and 1.94 percent, respectively. The persistence of these effects is therefore more pronounced than their long-run magnitude, reflecting propagation through the entry process.

Steady-state response elasticities To assess the magnitude of the long-run responses relative to the size of each structural change, Table 2 reports finite-change elasticities. For an endogenous steady-state variable x^* and a parameter p increased by one percent, we compute

$$\mathcal{E}_{x,p}^{1\%} = \frac{\log\left[x^*(1.01p)/x^*(p)\right]}{\log(1.01)}. \tag{56}$$

The calculation solves the full steady-state system at the original and perturbed parameter values, holding all other parameters fixed. The innovation-rate elasticity refers to the proportional change in the positive annual rate z^*, not to a change in percentage points. These are local finite-change comparisons around the benchmark, not global elasticities; their magnitudes may differ elsewhere in the parameter space, especially near delegation or equilibrium bifurcation thresholds.

Table 2: Steady-state responses to one-percent parameter increases

Parameter	Profitability π^*	Innovation rate z^*
Entry cost β	0.990	12.109
Knowledge elasticity α	0.786	16.329
Owner's managerial input μ	-0.623	-6.261
Managerial effort curvature ξ	0.107	-1.723
Managerial effort cost ε	0.190	-3.077

Notes: Entries are finite-change elasticities defined in (56), computed using the calibrated steady-state equations and a one-percent increase in the indicated parameter. A value of -6.261, for example, means that a one-percent increase in μ reduces the annual innovation rate by approximately 6.3 percent of its initial value, not by 6.3 percentage points.

The elasticities highlight that apparently small changes in annual growth rates can represent sizeable proportional responses to modest structural changes. For example, a one-percent increase in the owner's managerial input μ lowers the steady-state innovation rate by about 6.3 percent relative to its baseline level. The responses to α and β are larger still. The table is complementary to the nonlinear transition paths: it measures the long-run proportional response, while the impulse responses describe its timing and adjustment dynamics.

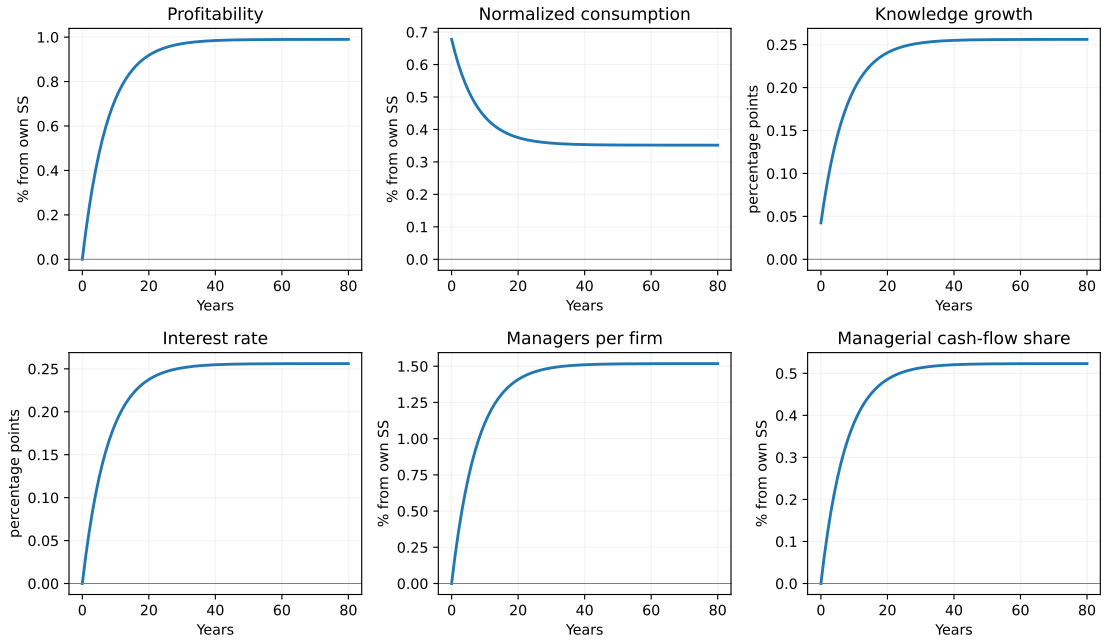


Figure 3: Transition after a permanent one-percent increase in the sunk entry cost β

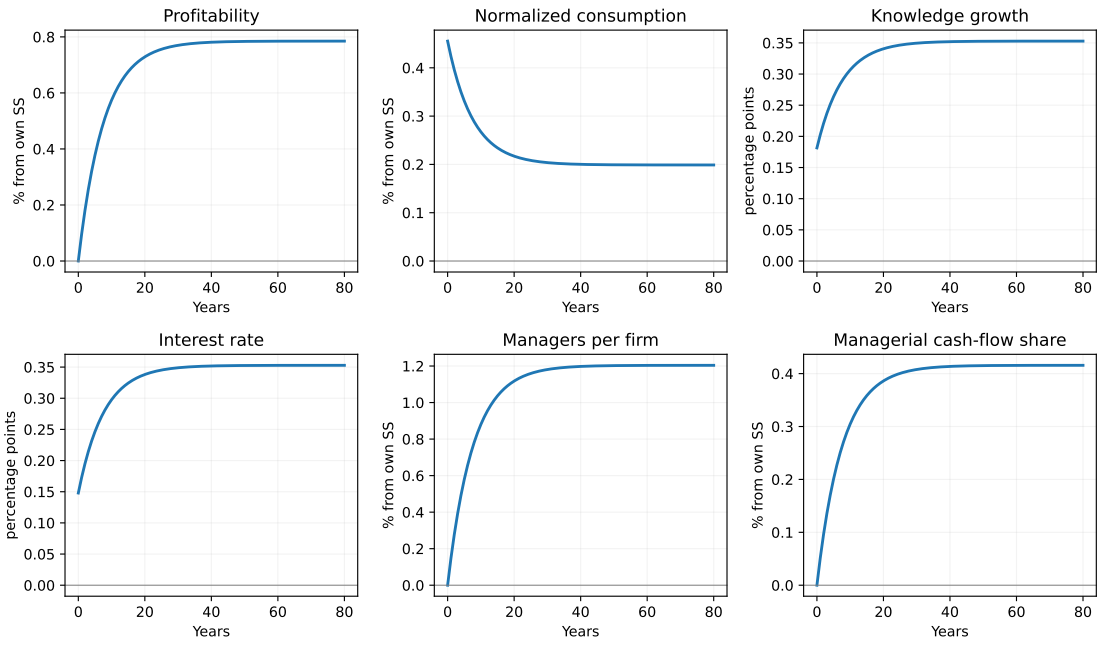


Figure 4: Transition after a permanent one-percent increase in the elasticity of firm-level knowledge α

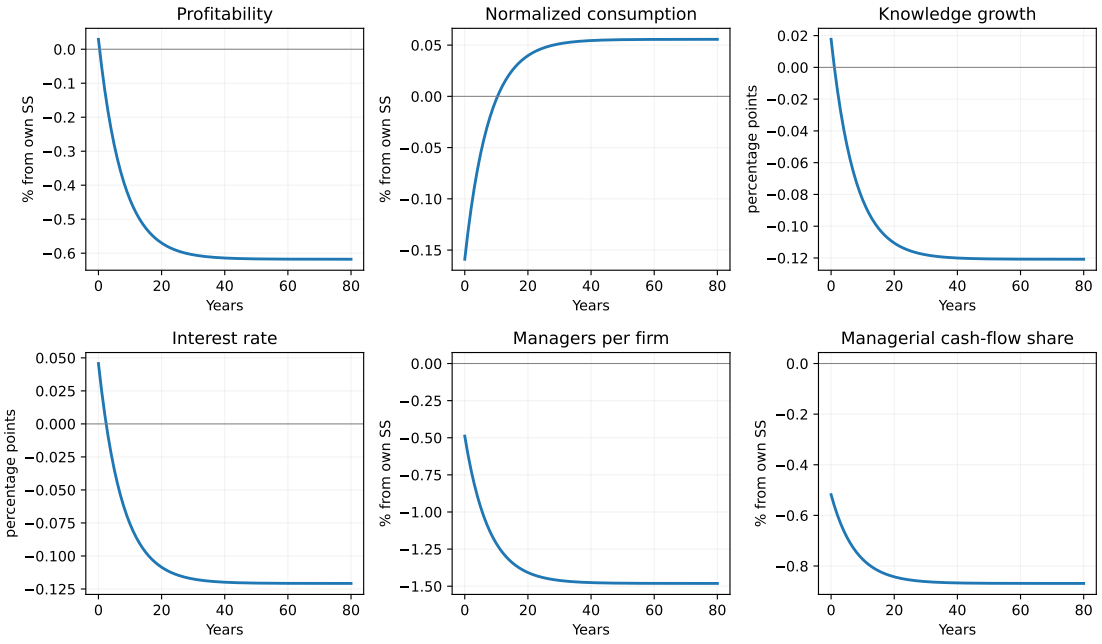


Figure 5: Transition after a permanent one-percent increase in the owner's managerial input μ

These exercises illustrate the cross-time restrictions implied by the same equilibrium structure used in the calibration. The steady state disciplines the parameters; the non-

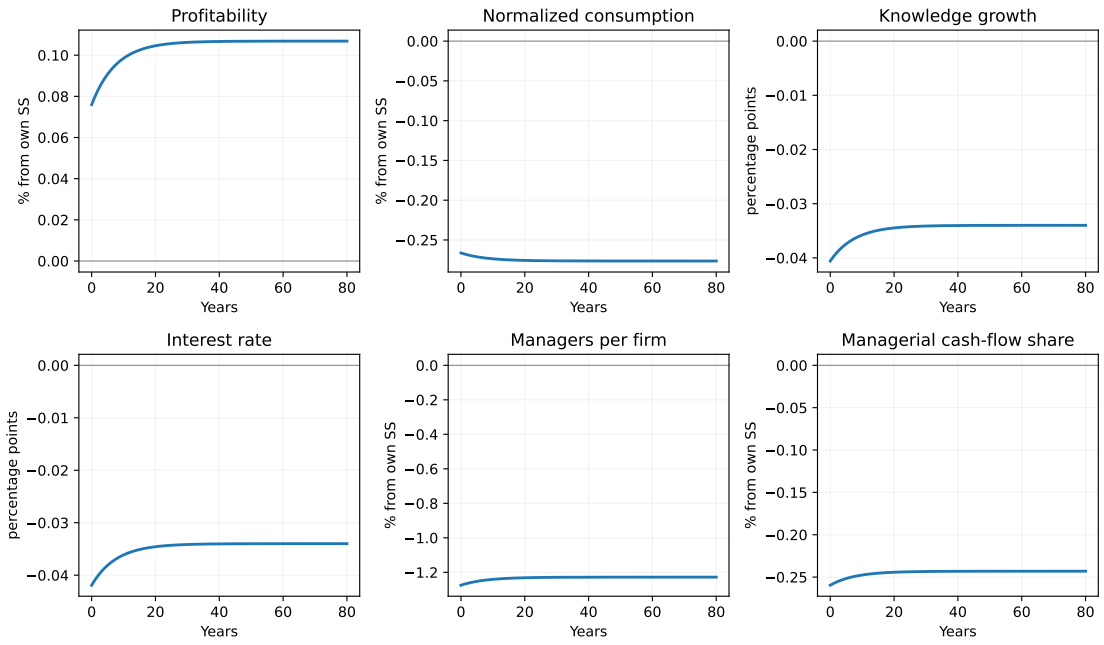


Figure 6: Transition after a permanent one-percent increase in the managerial-effort curvature parameter ξ

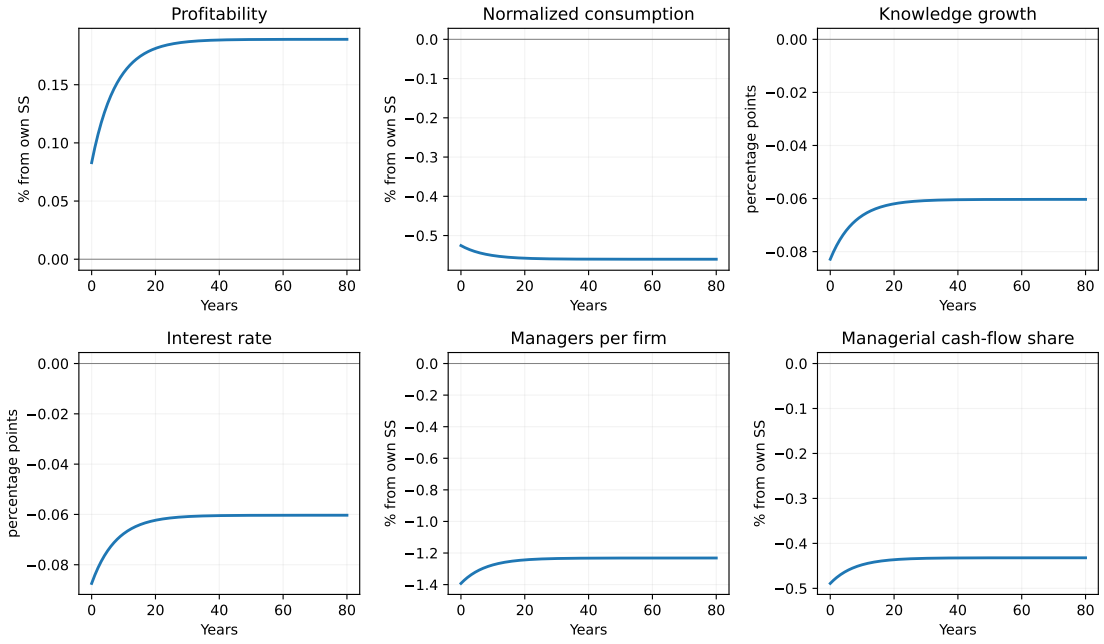


Figure 7: Transition after a permanent one-percent increase in the cost of managerial effort ε

linear laws of motion then determine how profitability, consumption, innovation, and managerial organization adjust jointly following a structural change.

8.3. Organizational Amplification: Three Calibrated EMS Economies

The increase in incumbent innovation following a higher sunk entry cost is a familiar implication of the basic constant-markup endogenous market structure (EMS) model. Higher entry costs reduce entry and increase the market size of incumbents, strengthening their incentives to accumulate firm-specific knowledge. Our question is how much delegated management and endogenous managerial employment amplify this mechanism. To answer it, we compare three organizational regimes: owner-managed firms ($m = 0$), firms with one salaried manager and endogenous effort ($m = 1$), and the benchmark economy with endogenous managerial employment and effort.

We use the calibration to the intermediate-input share introduced in Section 8.1. The organizational restrictions are nested in the equilibrium structure: the one-manager economy sets $m = 1$ and removes the managerial-employment first-order condition, while retaining endogenous effort and compensation; the owner-managed economy sets $m = 0$ and retains the owner's managerial services. The common parameters include $\alpha = 0.33$, $\theta = 0.45$, $\rho = 0.035$, $\beta = 5.4054$, and $\lambda = 0.011$. Recalibration is required for all three economies to meet the maintained growth, return, and labor-share targets. Section 8.4 reports an alternative exercise that imposes the organizational restrictions while holding all calibrated parameters unchanged.

The recursive calibration determines which parameters need to adjust under each restriction. With one manager, matching the managerial-effort and compensation restrictions requires recalibrating μ and ε, while the managerial employment share determines Ω. The innovation and aggregate labor blocks retain the full economy's ϕ and γ. Without salaried managers, matching the growth and real-return targets determines ϕ, and matching the labor share determines γ; we retain the full economy's μ and Ω. Manager-specific targets no longer apply. Table 3 reports the resulting parameters and steady states, and the Online Appendix gives the mapping. These adjustments allow the three organizational structures to support the common growth targets while keeping the calibration tied to the relevant equilibrium restrictions.

Table 3: Pre-shock steady states across organizational regimes

	Endogenous managers	One manager	Owner-managed
Fixed operating cost ϕ	0.0929	0.0929	0.0209
Labor technology γ	0.7352	0.7352	0.9159
Owner managerial input μ	1.0326	0.4871	1.0326
Effort cost ε	0.0210	0.0942	—
Fixed-factor endowment Ω	0.0111	1.5256	0.0111
Salaried managers per firm m	2.12	1	0
Managerial effort h	0.375	0.375	—
Knowledge growth z	0.020	0.020	0.020
Real return r	0.055	0.055	0.055

In each economy, we compute the nonlinear saddle-path transition following an unanticipated permanent one-percent increase in its own sunk entry-cost parameter, $\beta^{\text{new}} = 1.01\beta^{\text{old}}$. This experiment compares the responses to a common disturbance from steady states calibrated to common aggregate targets. The entry-cost shock leaves unchanged the relationship between profitability and employment per firm in (28), including the managerial-employment schedule in each regime. Since population and the mass of firms are predetermined, initial profitability remains at its pre-shock value, while consumption jumps to the new saddle path. Profitability thus summarizes the predetermined initial condition for the reduced dynamical system. This property depends on the parameter being perturbed: a change in production or managerial technology can alter that relationship and cause profitability to jump even though employment per firm is unchanged. Starting each economy at its calibrated steady state makes the comparison one of responses to higher entry costs, without an additional choice of initial conditions away from steady state.

Responses of levels are reported as percentages relative to the respective pre-shock steady states; growth and interest-rate responses are percentage-point differences. Figure 8 compares the three transitions. Table 4 reports the response of the firm-specific knowledge-growth rate at 20 and 80 years. The common targets describe the pre-shock steady states: $z = 0.02$ and $r = 0.055$ in all three economies. After the entry-cost increase, we hold all other parameters fixed within each economy; we do not recalibrate to restore those targets. The different innovation responses therefore lead to different post-shock steady-state growth and interest rates. Within each economy, the steady-state Euler con-

dition requires $r - z = \rho$, so the long-run changes in the two rates are equal. Table 4 also reports these exact long-run responses. The 80-year observations are finite-horizon values, with the owner-managed economy approaching its new steady state more slowly.

Table 4: Knowledge-growth response to a permanent 1% increase in sunk entry costs: common intermediate-input share $\theta = 0.45$ (percentage points)

Organizational regime	20 years	80 years	Long run
Endogenous managerial employment and effort	0.2406	0.2561	0.2561
One manager, endogenous effort	0.1302	0.1402	0.1402
Owner-managed, no salaried managers	0.0783	0.0928	0.0932

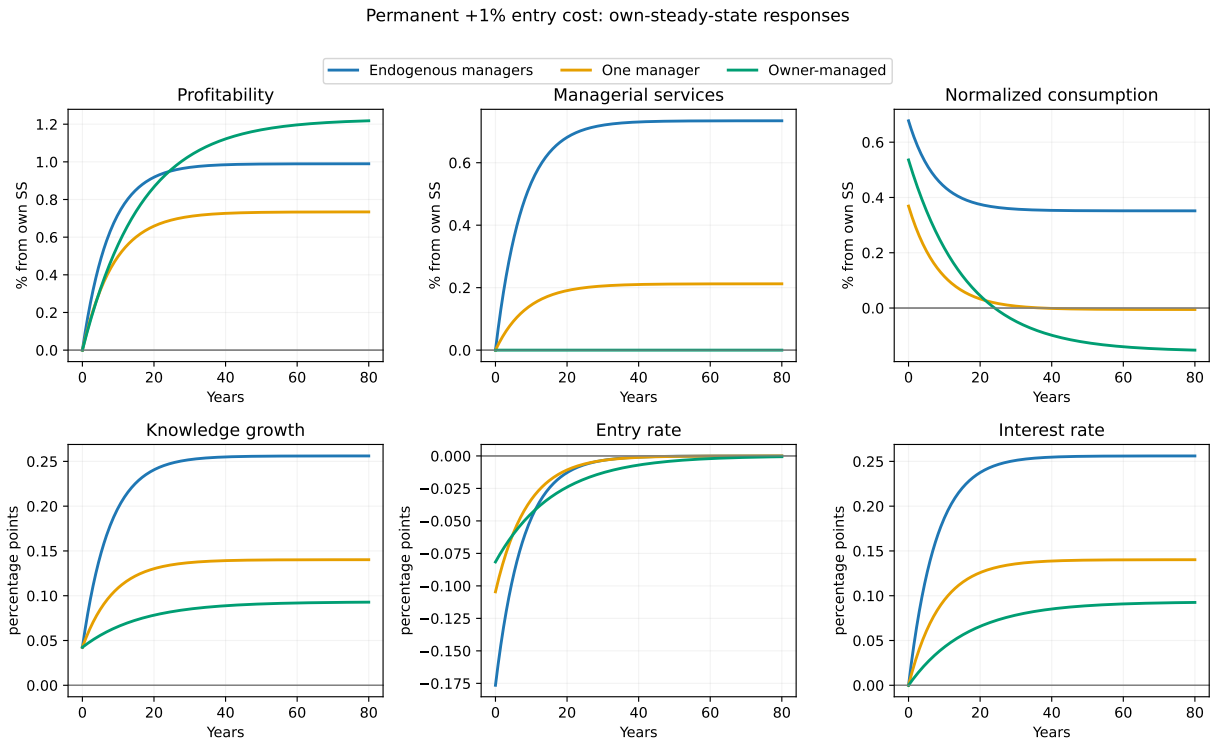


Figure 8: Nonlinear transition responses in three separately calibrated EMS economies after a permanent 1% increase in sunk entry costs, with $\theta = 0.45$. Each series is expressed relative to its own pre-shock steady state. All three economies start from the common growth and real-return targets; the other parameters remain fixed after the shock, and the post-shock steady states differ across regimes. The long-run growth and interest-rate responses coincide within each economy because $r - z = \rho$. The owner-managed economy retains the owner's managerial services; its zero salaried-manager response is therefore not zero managerial input.

The response is largest with endogenous managerial employment, smaller with one manager, and smallest in the owner-managed economy. At 80 years the full economy's knowledge-growth response is approximately 1.83 times the one-manager response and 2.76 times the owner-managed response. All three economies exhibit the EMS mechanism: higher entry costs increase incumbent market size and strengthen innovation incentives. Their paths illustrate how this mechanism operates under different managerial organizations, with the largest response when firms can expand managerial employment.

The comparison in Figure 8 asks how managerial organization affects the response to higher entry costs among three initially growing economies with the same aggregate growth, return, and labor-share targets. We maintain those targets by recalibrating the parameters identified by the equilibrium restrictions affected by each organizational constraint. This gives the three economies comparable pre-shock aggregate performance. Their response magnitudes reflect both their organizational margins and the parameter adjustments required to reproduce that performance.

8.4. Robustness Check without Recalibration

The Online Appendix reports the comparison obtained by imposing $m = 1$ and $m = 0$ on the full economy's calibrated parameters, starting from the same population, mass of firms, and knowledge stocks. Both restrictions shut down R&D immediately and converge to $z = 0$ and $r = 3.5\%$. The owner-managed economy also has an initial no-entry phase lasting about 0.84 years. Figure E.1 in the Online Appendix shows the resulting transitions. Under unchanged parameters, the organizational restrictions therefore change the growth regime.

This exercise shows why the restricted economies require recalibration to meet the maintained targets. With the full economy's parameters unchanged, neither restriction supports positive steady-state knowledge growth, and both fail to reproduce the growth and real-return targets. This is an implication of imposing the organizational constraints at the calibrated primitives. The target-preserving comparison in Section 8.3 instead illustrates amplification among three growing economies with comparable initial aggregate performance.

8.5. Markup-Based Robustness Check

As a robustness check, we set $\theta = 1/1.20 \simeq 0.8333$, consistent with the markup evidence in Flynn et al. (2019), and recalibrate the full economy to the same remaining targets. The long-run directions of the impulse responses remain unchanged: higher entry costs and a higher firm-specific knowledge elasticity raise innovation and the real return, while increases in the owner's managerial input, managerial-effort curvature, and effort cost lower them. Profitability falls with the owner's managerial input and rises with the other four parameters. The Online Appendix reports the recalibrated parameters, response elasticities, and transition figures.

The organizational restrictions reveal a difference in feasibility. The recalibrated one-manager economy remains admissible and supports the common $z = 0.02$ growth target. For the owner-managed economy, however, matching the same growth, return, and labor-share targets with the common α and β requires $\gamma \simeq 1.142$, outside the maintained range $0 < \gamma < 1$. The markup-based calibration therefore does not admit the same three-economy comparison under these targets. This is a restriction imposed jointly by the technology and the calibration targets: it does not imply that every owner-managed parameterization must have zero growth. The calibration to the intermediate-input share

permits all three growing economies to be compared under the target-preserving procedure in Section 8.3.

9. Conclusion

This paper develops a theory in which the internal organization of the firm is endogenous and jointly determined with innovation, firm size, and market structure. Owners can perform managerial functions themselves or delegate them to salaried managers. Delegation requires an incentive contract that compensates managers for costly effort and becomes viable only when the firm is sufficiently profitable. The resulting organizational choice links the internal structure of the firm to the same market forces that govern entry and innovative investment.

The central mechanism is a complementarity between delegation and innovation. Higher profitability supports a larger managerial organization; additional managerial services raise the return to innovation; and innovation feeds back into firm value, entry, and firm size. This interaction amplifies changes in policy and fundamentals even when the steady state is unique. When the feedback is sufficiently strong, it can also generate multiple steady states and qualitatively different transition dynamics. The model therefore provides a unified way to study the rise of the managerial firm, the response of innovation to changes in market structure, and the possibility of persistent differences in organization and growth across economies with similar fundamentals.

The quantitative analysis disciplines the model with long-run U.S. evidence using equilibrium restrictions that map observed moments into the structural parameters. The nonlinear transition exercises show that shocks to entry costs, the productivity of firm knowledge, and the technology and cost of managerial effort propagate jointly through profitability, managerial employment, innovation, and growth. These results underscore that the internal organization of the firm is not merely an outcome of development: it is also a mechanism through which changes in the economic environment affect innovative activity and aggregate performance.

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