Growing through Spinoffs. Corporate Governance, Entry, and Innovation

Abstract

New firms are often based on ideas developed within incumbent firms. We study the macroeconomic effects of spinoffs through a growth model of variety expansion, driven by entry, and product quality innovation. On the one hand, spinoffs raise aggregate productivity through the expansion of intermediate products and, if created voluntarily by incumbents, boost their return to equity. On the other hand, they erode incumbents' market share and, when stemming from conflicts between incumbents and their employees, drive up incumbents' internal cost of capital. We find that a priori investment protection has an ambiguous impact on spinoff activities. The calibrated model indicates that a broad legal reform that increases investment protection reduces the spinoff rate but boosts incumbents' product quality innovation, raising income growth and welfare. The trade-offs are consistent with firm-level evidence from Italy.

Keywords: Corporate Governance, Endogenous Growth, Spinoffs, Innovation.

JEL Codes: E44, O40, G30

1 Introduction

In several countries firms' spinoffs account for a large share of firm entries, totalling up to 30% of new firms according to firm-level surveys (see, e.g., Klepper and Sleeper, 2005; Bernardt et al., 2002).[1] The history of high-tech companies, indeed, abounds of anecdotes in which ideas developed within incumbent firms are used as the founding stones of new businesses. For example, many point at spinoffs as key for the development of the Silicon Valley (Moore and Davis, 2004) and of the rise of Detroit as the capital of the U.S. automobile industry at the onset of the 20th century (Klepper, 2002; Cabral et al., 2018). In spite of this fundamental role of spinoff activities in the dynamics of firm creation, the macroeconomics literature appears to lag behind the micro-oriented literature in investigating their aggregate consequences. Most studies treat firm entry as

[1] Klepper and Sleeper (2005) calculate spinoff rates (spinoff entries over total entries) around 20% for various U.S. industries from the 1960s to the 1990s. Bernardt et al. (2002) report spinoff rates of 5-8% for small Dutch firms and 40% for large Dutch firms in the 2000s. The estimated spinoff rate is 15% in Sweden for the 1993-2005 period (Andersson and Klepper, 2013), 12.3% in Denmark for 1981-2000 (Eriksson and Kuhn, 2006), and as high as 31% in Brazil for 1995-2001 (Muendler et al., 2012). See also Hvide (2009) for Norway and Rocha et al. (2015) for Portugal.

essentially undifferentiated, not distinguishing between firms created ex novo by new entrepreneurs and spinoffs created from incumbent firms. This can not only distort the conclusions about the aggregate effects of firm entry but also leave policy makers on uncertain grounds. A policy maker could be inclined to point out the social benefits of spinoffs, as these facilitate the dissemination of knowledge and accelerate firm creation. Yet, while many spinoffs are created voluntarily by incumbent firms, a significant share of spinoffs originate from conflicts between incumbent firms and their employees (Thompson and Klepper, 2005). The policy maker has then to face the preoccupation of incumbent firms that employees with access to firms' trade secrets would use the acquired knowledge to set up rival firms. Furthermore, the literature has pointed out that infringements of incumbent firms' proprietary knowledge associated with conflictual spinoffs dilute incumbents' incentive to invest in the innovation of their own products. Hence, the policy maker's aim of favoring knowledge dissemination through spinoffs could have the unintended consequence of slowing down the economy's pattern of investments.

The main objective of this paper is to develop an integrated, general equilibrium model of firm entry and knowledge investment that explains how spinoff activities affect income growth and welfare both in the short and in the long run. We assess quantitatively whether the benefits associated with the creation of startups that build on knowledge developed within existing firms are larger than the potential losses due to the dilution of shareholders' property rights. In the model, spinoffs can be created by managers on behalf of incumbent firms that seek to expand their product lines ("consensual spinoffs") or can stem from conflicts of interest between managers and shareholders of incumbents firms ("conflictual spinoffs"; Thompson and Klepper, 2005; Garvin, 1983; Brittain and Freeman, 1986).

To motivate the theoretical and quantitative analysis, we first present evidence for its mechanisms by exploiting rich, firm-level data from the Italian local (provincial) markets. In Italy, as in several other advanced countries, a large share of firms' entry occurs through spinoffs - it was more than 25% in recent years. Using data spanning the period from the mid-1990s to the early 2010s, we find that in Italian provinces with relatively poor judiciary and weak protection of incumbents' investments, there is a higher spinoff rate (spinoffs to total entries) and a larger incidence of conflictual spinoffs relative to consensual ones. The evidence also suggests that in provinces with poor judiciary, incumbent firms tend to invest less in innovations aimed at improving their own products. These empirical findings are robust to the inclusion of detailed sets of fixed effects and carry through when using an administrative reform of Italian courts as an exogenous shock to the quality of judiciary. The trade-offs highlighted by the empirical findings lie at the core of our theoretical and quantitative analysis.

In the model economy, growth is driven both by the foundation of new firms that offer new intermediate products and by the investment of incumbent firms in the improvement of their own intermediate products. New firms comprise businesses founded ex novo by households and spinoffs of incumbent firms. Spinoffs, in turn, can be created by firm managers on behalf of incumbents that seek to expand their product lines or in conflict with the shareholders of those firms. To model conflictual spinoffs, we draw from the literature that has extended endogenous growth theory to include corporate governance frictions (e.g., Terry, 2017; Iacopetta et al., 2019; Celik and Tian, 2018). Households can act as firm managers and shareholders; managers are in charge of executing investment plans. Managers, however, also develop side projects that consist of setting aside some resources that the firm had earmarked for its own product quality improvement or for the creation of consensual spinoffs in order to start up their own firms (i.e., to engage in conflictual spinoffs).

When created on behalf of incumbent firms, spinoffs can positively affect their return to equity. Additionally, they have a positive social effect by increasing the productivity of the final good sector through a wider range of intermediate products. On the other hand, spinoff activities can cause damages to incumbent companies. One damage occurs in case of conflictual spinoffs and consists of the loss of diverted resources which would otherwise be used to improve the quality of existing products or to expand product lines. This reflects both the direct diversion of resources and the surplus appropriation associated with managers' incentivizing contracts.[2]. The other damage is due to a classic business stealing phenomenon: the birth of rival firms takes a share of the market, eroding the return that parent companies expect from investing in product quality improvement.[3]

We evaluate the trade-offs and interpret the empirical evidence by calibrating the model with the technological and preference parameters of an advanced economy and matching the pattern

[2]The shareholders of parent companies offer managers incentivizing contracts aimed at reaching the planned investments (see, e.g., Nikolov and Whited, 2014

[3]Clearly, the distortion in product quality investment and the appropriation of surplus by managers also erode the returns to de novo entry.

of spinoff activities to the Italian data. We propose two sets of experiments. In a first set of experiments, we compare in the long run economies that differ in investment protection. We focus on two dimensions of investment protection: the protection of the results of R&D investments in product quality and of spinoff investments aimed at product variety expansion. We obtain that a priori an improvement of investment protection has ambiguous effects on spinoff creation and on incumbent' investment in product quality. Economies that protect strongly the results of incumbents' investments in product quality tend to depress spinoff creation and to boost firms' product quality. Managers, in fact, will be deterred from diverting R&D resources for the creation of conflictual spinoffs; and, as a result, incumbents will have stronger incentives to invest in product quality.[4] Investment protection can instead have sharply different consequences when the legal system is strong in protecting incumbents' spinoff activities. In such economies, managers will also be limited in using parent companies' resources for the creation of their own conflictual start-ups. Precisely for this reason, however, incumbent firms will invest more in the creation of consensual spinoffs. Our quantitative analysis reveals that the latter effect dominates over the former, boosting the overall spinoff rate. Even in this dimension of investment protection, however, the most important quantitative effect occurs on the intensive margin. In light of the stronger spinoff protection, incumbents will favor product variety expansion over internal firm growth. Put differently, a legal system focused on spinoff protection, while boosting spinoff creation, will tend to crowd out incumbents' investment in product quality, driving down their internal growth.

The two dimensions of investment protection are inherently intertwined in legal systems. We then study the impact of a "broad legal reform" that protects both margins of incumbents' investment, such as a general improvement in legal protection. Our quantitative analysis indicates that such a broad improvement of investment protection results in overall lower spinoff creation but in a more intense R&D investment in product quality, ultimately leading to higher income growth. Quantitatively, an economy with half the R&D and spinoff diversion compared to the baseline economy is characterized by a spinoff rate that is 0.72% lower but a firm knowledge rate of growth around one-tenth faster. The empirical estimates for the effect of Italian courts efficiency suggest a similar trade-off.

[4] Although the base from which managers subtract resources is larger, overall there are fewer spinoffs.

In a subsequent series of experiments, we employ the model's dynamics to analyze the short- and long-term effects of such a broad legal reform that enhances investment protection for both R&D and spinoff activities. In the short run, there is a decrease of the spinoff rate and of the overall rate of firm entry. Conversely, the product quality of incumbents improves at a quicker pace. The reduction in firm entry progressively leads to an expansion of incumbents' size, further motivating them to invest in product quality. Upon the implementation of a reform that reduces investment diversion by half (from a baseline of 4%), our analysis reveals a decrease in the spinoff rate comparable to the long-term decline (0.72%). On the other hand, there is an increase in the investment in product quality by 0.017%, which constitutes approximately three-quarters of the long-term increase. The remaining quarter is due to the transition to the new long-term equilibrium. In line with the "rule of law view", we find that, following such a broad legal reform, welfare improves both in the short and in the long run. Interestingly, along the transition, the welfare improvement induced by incumbents' higher investment in product quality would be outweighed by the welfare loss due to the lower spinoff creation. However, de novo entry intensifies thanks to incumbents' higher investment profitability and this partly offsets the welfare damage of lower spinoff creation.

To get a better sense of the quantitative effects of investment protection policies, in the last part of the paper we compare them with those of subsidy policies (pairwise comparisons are designed to have the same long-run effect on per capita output growth). In the short and medium run, a change in R&D protection that loosens up the barriers to conflictual spinoffs is about one-third as effective as an entry subsidy in promoting firm entry while it reduces incumbents' growth and overall welfare significantly more than an entry subsidy. On the other hand, an improvement of R&D protection produces similar effects on entry, incumbents' growth and welfare as an R&D subsidy.

The paper unfolds as follows. Section 2 relates the analysis to the literature. Section 3 presents the empirical evidence. Section 4 lays out the model and Section 5 solves for the equilibrium. Section 6 examines the steady state and the dynamics. Sections 7 and 8 analyze the effects quantitatively. Section 9 concludes. Proofs and details on the data are relegated to the Online Appendix.

2 Prior Literature

The paper relates to two main strands of literature. A first strand investigates the role of firm entry, and its interaction with incumbents' investment decisions, in driving growth (see, e.g., Peretto, 1999; Young, 1998; Howitt, 1999; and, for a survey, Etro, 2009). This literature does not focus on the distinction between firm de novo entries and corporate spinoffs. This is perhaps due to the limited emphasis of the growth literature on the corporate governance issues surrounding the creation of spinoffs.[5] A second related strand of literature has recently started to incorporate corporate governance frictions into endogenous growth models. Studies in this strand comprise Akcigit et al. (2021), Caselli and Gennaioli (2013), Cooley et al. (2014), Terry (2017), and Iacopetta et al. (2019). In Akcigit et al. (2021) conflicts between managers and shareholders affect firms' investment decisions and limit the growth of product variety because of a span of control problem. In Iacopetta et al. (2019) conflicts between managers and shareholders influence the returns to de novo firm entry and to incumbents' investment. In their setting, de novo entry and incumbents' investment interact with each other through the structure of the industry. These papers do not focus on the role of spinoff entry in innovation and growth.[6]

Besides the analysis of the aggregate impact of spinoffs, another element that distinguishes our paper from previous works on the macroeconomic effects of corporate governance is that the conflicts of interest between managers and shareholders are not modelled as managers' unproductive objectives (e.g., perks, tunneling, or a "quite life"). In fact, in our economy managers employ diverted resources to establish new firms in a more efficient way than de novo entrepreneurs. This insight builds on a typical theme of the micro-oriented literature that spinoffs are more common when workers feel that parent companies resist the development of new ideas and products (Hellmann and Thiele, 2011; Garvin, 1983; Brittain and Freeman, 1986). Chatterjee and Rossi-Hansberg (2012) investigate managers' decision to create spinoffs or sell innovative ideas to incumbent firms in an industry where managers have private information on the quality of their ideas. Thompson and Klepper (2005) observe that managers who spawned new firms often had conflicting views with parent companies about the development of new projects. Franco and Filson (2006), Baslandze

[5] For a discussion of the literature on the growth effects of knowledge spillovers see, e.g., Aghion and Howitt (1998).

[6] For studies on financial markets and growth see, e.g., Aghion et al. (2005) and Cooley and Quadrini (2001).

(2022), and Sohail (2021) study how managers' decision to leave incumbent firms and create spinoffs changes as the distribution of know-how in the industry evolves. While these works focus on how firm size, in terms of employment or knowledge capital, conditions the creation of spinoffs, our work emphasizes the role of corporate governance in accounting for spinoffs. In line with these studies, in our economy managers can divert resources earmarked to product improvement or to the creation of new product lines with the intent to develop new products in their own new enterprises (conflictual spinoffs). In doing so, managers exploit knowledge they acquired while working for incumbent firms. Thus, spinoffs contribute to variety expansion and do not replace parent companies which continue to operate existing product lines. Christensen (1993), for instance, finds that spinoffs in the disk drive industry developed new, smaller disk drives relative to those produced by parent companies.[7] In this dimension, our paper also broadly relates to a strand of studies that contrast the benefits of the patent protection of inventors against the hurdle that such protection poses to the diffusion of ideas (see, e.g., Boldrin and Levine, 2013, and Stiglitz, 2014).

Relative to prior studies on the microeconomic determinants of spinoffs and on their impact on the industry equilibrium, the main contribution of our work is that it investigates the macroeconomic implications of spinoff activities for the investment, entry and growth dynamics of the economy in a unified, general equilibrium framework. This proves to be useful when carrying out a welfare analysis. As noted, while some argue that spinoffs are beneficial because they spur new technologies that might have stayed dormant in parent companies, others are concerned that conflictual spinoffs infringe the investors' rights of parent companies by taking away valuable resources. Our analysis allows to investigate this trade-off offering insights into the policies that can better promote growth and welfare. Although Baslandze (2022) and our work both aim to quantify the aggregate productivity effects of spinoffs through the lens of endogenous growth models, they differ in the underlying mechanisms and model. In our framework, the key drivers of growth are incumbent firms' investment in quality and horizontal expansion, whereas in Baslandze (2022) the main source of growth is creative destruction. Baslandze (2022) emphasizes the role of incumbents' heterogeneity, whereas we collapse the distribution of firms to have an analytical solution for the equilibrium dynamics.

[7] Samaniego and Sun (2019) develop a model where a weak rule of law leads to the proliferation of substandard intermediate goods by incumbent firms.

3 Empirical Evidence

The model presented in the next section will show that the protection of investors conditions the number of consensual and conflictual spinoffs from incumbent firms and the propensity of incumbents to spend in in-house investments. This section shows that these key relationships emerge from an empirical analysis on Italian data. Italy is an ideal testing ground to investigate the role of investment protection in the creation of new firms and in the incidence of spinoffs. While the same laws apply across the Italian territory, judicial efficiency exhibits marked heterogeneity across Italian provinces (World Bank, 2013; Carmignani and Giacomelli, 2009).[8]

3.1 Innovation, spinoff activities, and investment protection in Italy

It is useful to first review the patterns of spinoff activities, firms' innovation, and judicial efficiency in the Italian context. For this overview, we rely on recent cross-sectional data compiled by the Italian National Institute of Statistics (for incumbents' innovation and judicial efficiency) and by the Italian Ministry for Economic Development (for firms' spinoff activities).

Appendix Figure (A1), Panel A, displays the spinoff rate (ratio of spinoffs to total firm entries) in the Italian local (provincial) markets in 2015. The data are drawn from the "Rilevazione sul Sistema delle Start-up Innovative", a survey of start-ups carried out by the Italian Ministry of Economic Development. In line with prior literature, spinoffs are defined as newly created firms whose founders were previously full-time managers or employees of incumbent firms operating in the sector (see, e.g., Andersson and Klepper, 2013, for a similar definition). This comprises both instances in which managers carried out spinoffs on behalf of incumbent firms and instances of conflictual spinoff creation. Figure (A1), Panel B, displays the proportion of innovative firms in the Italian provinces, sourced from the "Survey of Italian Manufacturing Firms" conducted by the Italian banking group UniCredit. Further, Figure (A1), Panel C, shows the number of research and development (R&D) workers, normalized by the population size, using data from the survey of innovative firms conducted by the Italian National Institute of Statistics (ISTAT).[9] Overall, Figure (A1) yields two main insights. First, spinoffs constitute a large share of new firm entries in Italian

[8]Italian provinces are geographical entities similar in size to U.S. counties.
[9]ISTAT data on R&D workers are at the regional level. An Italian region comprises one or multiple provinces.

local markets, accounting for about 28% of firm entries on average and for more than 35% of entries in several provinces. Second, both the incidence of spinoffs and the incidence of innovative firms (including their R&D activities) vary greatly across local markets.

Drawing data from ISTAT, Figure (A1), Panel D, displays indicators of judicial efficiency in the Italian provincial markets. As noted, there is significant heterogeneity of judicial efficiency across provinces. For example, the cost of bankruptcy court procedures as a share of firms' assets goes from 2.4% for the courts of the northern province of Trieste to 33.9% for the courts of the southern province of Lecce. And heterogeneity exists even across provinces within the same geographical area. For instance, the cost of court procedures in the provinces of Brindisi and Taranto - both located in the South - are equal to 3.7% and 29.3% of firms' assets, respectively.

3.2 Data and measurement

To conduct our empirical analysis, we exploit detailed data from the Italian business sector from 1995 to the late 2000s (with the exact terminal year of the sample depending on specifications and data availability). The analysis combines data from three main sources: the MET survey of Italian businesses, which is the largest firm survey conducted in a single European country; the "Survey of Italian Manufacturing Firms"carried out by the Italian banking group UniCredit; data of ISTAT on judicial efficiency at the provincial level. We complement these databases with other sources, including ISTAT data on institutional and economic characteristics of the Italian provinces, Bank of Italy data on the structure of provincial banking sectors, and data of the Institute Guglielmo Tagliacarne on provincial infrastructures. More details on the data are in the Appendix.

In studying the incidence of spinoffs among firm entries, we treat the Italian provinces as our geographical unit of observation. Information on the share of spinoffs in a given province and period is drawn from the MET survey, which covers about 25,000 firms in each of its waves. The MET survey is ideally suited for this purpose as it asks each firm a precise question regarding the personal background of its founders, namely whether they were previously full-time managers or employees of incumbent firms operating in the sector. Exploiting this question, for each province and three-year time period from 1995 to 2009 (hence, for a total of 5 time windows), we compute the share of newly created firms whose founders were previously full-time employees of a firm operating in the same sector, relative to the total number of newly created firms. Observe that, as stressed by the survey questionnaire, the MET information captures all types of spinoffs, conflictual or consensual; we will return later to the task of distinguishing between the two types of spinoffs. Firm-level information on the investments in innovation of incumbent firms is drawn from the Capitalia Survey of Italian Manufacturing Firms. This survey targets the universe of publicly listed companies and a large representative sample of non-listed firms with no less than 10 employees. This threshold number of employees implies that the survey naturally focuses on incumbent businesses: the mean age of the firms is 22 years, and the first age decile is 6 years. To proxy for in-house innovation we use a dummy that takes the value of one if a firm declares that during the period it introduced any type of innovation aimed at the improvement of its products, zero otherwise. In addition to this binary indicator, we also consider the firm's ratio of R&D expenditures over sales. The information on firms' innovation activities is available for four three-year time windows, from 1995 to 2006.

To measure investment protection in the local (provincial) markets, we consider widely used proxies for judicial (court) efficiency in the provinces. Using ISTAT data, as an inverse measure of court efficiency, we consider the average duration of trials (in days) in the courts of the province. As an alternative measure, we also use the clearance rate of the courts in the province, defined as the ratio of trials concluded during the time period over the flow of new trials.

In the regressions, we control for a broad array of possible determinants of firm entry and of firm innovation (more details below). In addition, by exploiting the cross-sectional and time variation of our data, we include both time and geographical area fixed effects.

3.3 Empirical models

To study the effect of legal protection on spinoff creation, we estimate the following empirical model at the province level:

$$Spinoff_{jt} = \alpha + \beta Court_{jt} + \gamma^{\top} X_{jt} + \eta_j + \zeta_t + \varepsilon_{jt}. \tag{1}$$

In equation (1), $Spinoff_{jt}$ is the spinoff rate (ratio of spinoffs over total newly created firms) in province j during a (three-year) period t; $Court_{jt}$ is the measure of court efficiency in province j and period t; X_{jt} is a comprehensive vector of province-level time-varying controls, including economic conditions (unemployment rate), population growth, banking development and concentration, trade openness, and material infrastructures; η_j and ζ_t are respectively geographical area and time (three-year period) fixed effects; and ε_{jt} is the error term. The maximum sample on which we estimate the model in (1) consists of 515 province-time observations over the 1995-2009 period.[10]

To investigate the impact of legal protection on incumbents' innovation in product quality, we instead estimate the following empirical model at the firm level:

$$Innov_{ijt} = \alpha' + \beta' Court_{jt} + \gamma'^{\top} X_{jt} + \delta'^{\top} Z_{it} + \eta'_j + \zeta'_t + \varepsilon'_{ijt}. \tag{2}$$

In equation (2), $Innov_{ijt}$ is a dummy that takes the value of one if firm i in province j introduced innovations aimed at product improvement in period t; $Court_{jt}$ and X_{jt} are respectively the measure of court efficiency and the vector of province-level time-varying controls also included in equation (1); Z_{it} is a vector of firm-level time-varying controls comprising the firm's age, size and profitability; η_j and ζ_t are respectively geographical area and time fixed effects; and ε_{ijt} is the error term. The maximum sample on which we estimate the model in (2) consists of 17,000 firm observations for 1995-2006.

3.4 Estimates

In Table 1, Panel A, we present the coefficient estimates for the effect of local court efficiency on the spinoff rate in a province and time period.[11] Regardless of whether we use the duration of court trials as an inverse measure of court efficiency or the clearance rate as a direct measure of court efficiency, we find that in provinces where courts are more efficient the incidence of spinoffs in firm entry is lower. The estimated coefficient $\widehat{\beta}$ suggests that a 10 percent decrease in the duration of provincial court trials is associated with a 0.4 percentage point decrease in the spinoff rate in the province (about 1.5 percent of the average spinoff rate).

In Panel B of Table 1, we examine the impact of judicial efficiency on incumbent firms' in-house innovation. The regressions show a positive association between judicial efficiency and the

[10] This sample size refers to specifications using the courts' clearance rate, while we experience the loss of some observations when using the duration of trials.

[11] In all the regressions, standard errors are heteroskedasticity robust and clustered at the provincial level.

innovation activities of incumbents, whether this is measured by a binary innovation outcome or by the R&D to sales ratio of the firms. The estimated coefficient $\widehat{\beta'}$ in column 5 suggests that a 10 percent decrease in the duration of court trials is associated with a 5.8 percentage point increase in the probability that a firm innovates (about 0.8 percent of the mean probability of innovation). And column 6 suggests that a 10 percent decrease in the duration of court trials is associated with a 0.4 percent increase in the R&D to sales ratio. Overall, the estimates thus suggest that higher court efficiency is associated with significantly lower spinoff rates and higher in-house innovation rates.

In spite of the inclusion of granular fixed effects and control variables, the reader might still be concerned about possible endogeneity. For example, omitted variables could be correlated with the quality of local courts and also affect firm creation decisions. To mitigate this concern, in columns 3-4 of Panel A, we exploit a quasi-natural experiment associated with an exogenous change in the structural organization of Italian courts. A major reform of the court system occurred in 2012, becoming effective in September 2013. This reorganization led to the suppression of 26 of the 165 pre-existing courts. The district of each suppressed court was merged with an adjacent district of a surviving court. Such "court mergers" plausibly induced a heterogeneous shock to the quality of judicial enforcement in the provinces (Pezone, 2021). Notably, such reorganization was not made on a case-by-case basis, but was governed by ex-ante, mechanical criteria. All courts not located in provincial capitals had to be suppressed, under the constraint of keeping at least three courts for each appeals court. Importantly, courts' productivity or trends in productivity were not criteria used for deciding the courts to be suppressed. As a robustness check, we then exploit the exogenous shock induced by this court reform. For this robustness exercise, we focus on the analysis of spinoff creation, for which we also have data for the period surrounding the court reform (while in-house innovation data are not available for that period). In column 3 of Panel A we regress the provincial spinoff rate in 2014 on the difference between the average trial duration in the province post-reform (2014) and before the reform (2012). In column 4, we repeat the exercise by considering the difference in the clearance rate. Consistent with the baseline results, we find that an increase in judicial efficiency (presumably due to the reform) reduced the spinoff rate in the province.

3.5 Conflictual and consensual spinoffs

Thus far, we have not distinguished between spinoffs driven by conflicts between firm shareholders and managers and spinoffs that are voluntarily created by incumbent firms. The Capitalia Survey asks each firm a question whether in the past three years the firm deliberately spun off production lines externally to the firm, creating new business entities. Based on this question, we construct a proxy for voluntary spinoff creations on the part of incumbent firms: a dummy that takes the value of one if a firm created spinoffs voluntarily. Panel C of Table 1, columns 9-10, shows that the negative effect of court efficiency detected for the overall spinoff rate in Panel A does not carry through when using this (firm-level) proxy for voluntary spinoffs as the dependent variable. This is in line with the idea that voluntary spinoffs are not created in conflict with incumbent firms and, hence, should not be deterred by investment legal protection.

We then turn to construct a proxy of the ratio between consensual and total spinoffs in a province and time period. To this end, we combine information on the percentage of incumbent firms that create consensual spinoffs with the previously used data on the ratio of total spinoffs over entrants, as well as with province-by-time data on the ratio of entrants to incumbents. The constructed proxy suggests than on average, over the 1995-2006 period, consensual spinoffs represented about 76 percent of the total spinoffs occurred in a province. In columns 11-12 of Panel C, we re-run the regression in equation (1) using this proxy as the dependent variable. We observe that an improvement of judicial efficiency increases significantly the share of consensual spinoffs. Overall our results thus suggest that stronger investment protection reduces the total spinoff rate and raises the importance of consensual spinoffs relative to conflictual spinoffs.

4 The Model

We build on a large literature that sees delegation as a strategy to achieve better outcomes by assigning decision rights to better informed or more able parties (see Aghion et al., 2014 for a review). In our setting, firms' owners (shareholders) can delegate control over investment decisions to managers, who are more skilled than owners in operating firms. Delegation of control, however, generates a divergence of interests between owners and managers. Our paper follows the "rent extraction" approach of corporate finance and models the divergence of interests between managers and shareholders as diversion of firms' resources (see, e.g., Iacopetta et al., 2019; Iacopetta and Peretto, 2021; and Edmans and Gabaix, 2016 for a review). In our setting, managers subtract resources earmarked by incumbent firms to product quality improvement or product line expansion (consensual spinoffs) and use them to set up new firms, that is, to spinoff new entities of which they are the owners (conflictual spinoffs). These rival with incumbent firms in product markets.

The model economy has the following structure. Time is continuous and runs up to infinity. All variables are functions of time but we omit the time argument unless necessary to avoid confusion. The mass of households, L, expands at a constant rate λ. Each household supplies inelastically one unit of time to a final good sector. In addition to supplying labor, households can act as shareholders (founders) and managers of intermediate goods firms. The final good sector combines labor and a variety N of non-durable intermediate goods to produce an homogeneous consumption good. Intermediate goods are produced from the final good. In what follows, we detail the technology of the final and intermediate goods sectors, and the decisions of shareholders, managers, and households about investments, entry, and consumption.

4.1 Final producers

A competitive representative firm produces a final good 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 final good is our numeraire. The final good production technology is

$$Y = \int_0^N X_i^\theta \left[Q_i \frac{L}{N^{1-\sigma}} \right]^{1-\theta} di, \quad 0 < \theta < 1,\ 0 \leq \sigma < 1, \tag{3}$$

where X_i is the amount of intermediate good i, N is the mass of non-durable intermediate goods, and L is the flow of labor services. The quality, Q_i, of intermediate good i is the good's ability to raise the productivity of the other production factors. The parameter θ is the elasticity of output to intermediates; σ governs the love for variety. This raises the marginal productivity of all intermediates. The congestion exponent $1 - \sigma$ makes such effect less pronounced than in Romer

(1990) types of models. Because in our set up spinoffs fuel the entry of new firms, they contribute to aggregate productivity gains through the variety effect.

Let P_i be the price of intermediate good i and w be the wage. The profit maximization problem yields that the final producer demands intermediate goods and labor according to:

$$X_i = \left(\frac{\theta}{P_i}\right)^{\frac{1}{1-\theta}} Q_i \frac{L}{N^{1-\sigma}}, \quad w = (1-\theta)\,\frac{Y}{L}. \tag{4}$$

Therefore, the final producer pays

$$\int_0^N P_i X_i di = \theta Y, \quad wL = (1-\theta)\,Y, \tag{5}$$

to, respectively, suppliers of intermediate goods and labor.

4.2 Intermediate good producers

Each intermediate firm i has to take decisions about production and investment. Investment can be of two types. One is the accumulation of knowledge, which enhances the quality of the firm's intermediate product, Q_i. Enhancing the product quality earns the firm a larger market (see (4)). A second type of investment is the expansion of product lines through the creation of spinoff firms. We refer to these two investments as R&D and spinoff investments, respectively. The founder of the firm could be in charge of executing investments. He may, however, delegate one or both investment activities to professional managers who are more efficient in executing investments. Delegation is nevertheless costly, because managers seek to earn a private benefit by diverting resources from the firm. A broad body of studies (e.g., Klepper and Sleeper, 2005; Thompson and Klepper, 2005; Hellmann and Thiele, 2011; Garvin, 1983; Brittain and Freeman, 1986) show that employees can devote effort, ideas and R&D findings ("investment resources") to plan and set up their own businesses (engage in conflictual spinoffs) rather than to increase the value of parent firms.[12]

We present the production and investment decisions of an intermediate firm whose founder

[12] Given our focus on the aggregate effects of spinoffs, we specify the managerial sector in a simplified way. We do not model a managerial market, or hiring and firing processes of managers. Thus, shareholders partially discipline managers through incentivizing contracts, rather than through firing threats. On the other hand, since managers are homogeneous and behave the same way, a firm would have no incentive to fire a manager and hire a new one.

delegates both R&D and spinoff activities. We then study the conditions for delegation to take place. For clarity of exposition, in an intermediate firm R&D and spinoff investments are executed by different agents to whom we refer as "R&D manager"and "spinoff manager", respectively. We begin with a description of the production and investment processes and then describe firms' entry.

Production and product quality. Intermediate firm i can transform one unit of final good into one unit of its intermediate good. Production also entails a fixed operating cost ϕQ_i in units of the final good, where Q_i is the quality of the intermediate good i. The firm's rise in the stock of knowledge Z_i improves the quality of its intermediate product. This is given by

$$Q_i = Z_i^{\alpha} Z^{1-\alpha}, \tag{6}$$

where $0 < \alpha < 1$. Thus, the contribution of good i to factor productivity downstream depends on the knowledge of firm i, Z_i, and on the average knowledge of the industry $Z = \int_0^N (Z_i/N)\, di$.

In-house innovation in product quality. Under R&D delegation, the firm's stock of knowledge, Z_i, increases according to

$$\dot{Z}_i = h(1 - S_{I_i}) \cdot I_i, \tag{7}$$

where $h > 1$ is the R&D manager's efficiency (this is equal to 1 for the founder) in running the R&D lab, I_i denotes the investment in units of the final good that the founder allocates to in-house knowledge accumulation (R&D) for the improvement of its product quality, and S_{I_i} is the fraction of R&D investment funds diverted by the R&D manager.

Entry. We distinguish between ex-novo and spinoff entry. Any intermediate firm, regardless of how it is created, starts operations with an industry-average stock of knowledge Z. However, thanks to the experience accumulated by managers in incumbent firms, the cost of entry of a spinoff created by a professional manager is lower that that of an ex-novo firm.

Ex-Novo entry. An ex-novo firm is financed through households' savings. A de-novo firm starts operations with an average-industry knowledge stock Z, as noted. Entry requires payment of a sunk entry cost βX in units of the final good, where X is the industry average of firms' output and is meant to capture the targeted volume of production of the entering firm. Under free entry, the value of a new firm, V_i, is equal to its entry cost:

$$V_i = \beta X.$$

Consensual spinoffs. A spinoff carried out by a manager can use one unit of final good of the firm to cover $e > 1$ units of entry cost. The assumption that e is larger than one captures the idea that, relative to households, managers are better positioned to start up a new firm thanks to their experience matured in incumbent firms. Thus, the parameter e measures how knowledge transfers can defray entry costs. When delegating the creation of spinoffs to a manager, an incumbent firm gives to the manager access to its resources for spinoff creation. Formally, denoting with F_i the firm's flow of cash, a spinoff manager who uses a fraction a_i of such available resources creates on behalf of the incumbent firm the flow of consensual spinoff firms

$$\dot{N}_{F_i} = \frac{e(1 - S_{J_i})a_i F_i}{\beta X}, \tag{8}$$

where the variable $0 < S_{J_i} < 1$ is the fraction of resources diverted by the spinoff manager for his own private benefits (i.e., to create conflictually his own spinoff firms).

Conflictual spinoffs. Either type of manager, while under the payroll of the firm, can use diverted resources as seeds to develop a parallel startup project. Specifically, with every unit of subtracted resources a manager can cover $e > 1$ units of setup cost of a new firm (a conflictual spinoff). Although managers have the option of immediately consuming the diverted resources, this is less desirable than investing the resources in firm creation because $e > 1$. Hence, with the resources diverted from firm i the R&D manager creates a flow of conflictual spinoffs of

$$\dot{N}_{I_i} = \frac{e S_{I_i} I_i}{\beta X}, \tag{9}$$

and the spinoff manager

$$\dot{N}_{J_i} = \frac{e S_{J_i} a_i F_i}{\beta X}. \tag{10}$$

All intermediate firms, regardless of their creation process, operate under Bertrand competition.

The presence of entry sunk costs then implies that an entrant introduces a new good rather than competing with an existing producer. Therefore, in our set up there is only one firm per product line. Each firm can shift its demand curve to the right by investing in the quality of the good it sells. This boosts the firm's profitability since the demand system in (4) yields that the firm charges a constant markup over the marginal cost of production.

4.2.1 The R&D manager

The founder earmarks a flow of investment I_i to knowledge accumulation, Z_i. To mitigate diversion, the founder offers the R&D manager an incentivizing contract $\omega_{I_i}\dot{Z}_i$, which is conditioned on the results of R&D investments (i.e., the increase in the firm's knowledge stock). In addition to this contractual compensation, the R&D manager uses diverted resources to create firms worth $V\dot{N}_{I_i}$, where V is the expected value of a newly created firm. The diversion effort cost is proportional to the flow of investments: $\delta_I c_I(S_{I_i})I_i$, with $c_I'(S_{I_i}) > 0$ and $c_I''(S_{I_i}) > 0$. The parameter δ_I and the curvature of $c_I(S_{I_i})$ capture institutional features of the economy, that is, the extent to which the legal system is able to mitigate managers' tendency to divert firms' R&D resources. Thus, the R&D manager, taking as given the founder's choices of I_i and ω_i, maximizes the flow of utility

$$u_{I_i} = \omega_{I_i} h(1 - S_{I_i})I_i + eS_{I_i}I_i - \delta_I c_I(S_{I_i})I_i, \tag{11}$$

where we used (7) and (9) to replace $\dot{Z}_i$ and $\dot{N}_{I_i}$, as well as the free-entry condition $V_i = \beta X$. The diversion rate chosen by the R&D manager satisfies the marginal condition

$$e = \delta_I c_I'(S_{I_i}) + h\omega_{I_i}. \tag{12}$$

The condition says that the diversion costs comprise not only the manager's diversion effort but also the forgone contractual compensations ω_{I_i}. We denote with $S_{I_i} = S_I(\omega_{I_i}; \delta_I, h, e)$ the solution of (12). The R&D manager participates to the contract if his discounted flow of utility is positive,

$$V_i^{R\&D} = \int_t^{\infty} e^{-\int_t^{\tau} r(s)ds} u_{I_i} d\tau > 0, \tag{13}$$

where u_{I_i} is evaluated on the reaction function (12).

4.2.2 The spinoff manager

The activity of the spinoff manager is one of innovation as much as that of the R&D manager, except that it fuels horizontal rather than vertical expansion. The spinoff manager receives a compensation proportional to the value of created consensual spinoffs: $\omega_{J_i}\dot{N}_{F_i}V$. He is also able to divert resources for $S_{J_i}\dot{N}_{J_i}$ from the funds available for spinoff activities. The manager sustains an effort cost, both to spinoff firms on behalf of the parent company and to divert resources for conflictual spinoffs. To keep the analysis simple the cost function is separable in the two types of effort. Specifically, the cost of creating spinoffs on behalf of the parent company is proportional to the funds earmarked to spinoffs, a_iF_i, that is $\hat{\delta}_J\hat{c}_J(a_i)F_i$, where $\hat{\delta}_J > 0$ and $\hat{c}'_J(a_i) > 0$, $\hat{c}''_J(a_i) > 0$. This assumption implies that the marginal cost of spinoffs increases as the manager employs a greater share of cash for such activities. Similarly, the cost of diverting resources for conflictual spinoffs is $\delta_J c_J(S_{J_i})a_iF_i$, with $\delta_J > 0$, $c'_J(S_{J_i}) > 0$, $c''_J(S_{J_i}) > 0$. Then, the spinoff manager maximizes

$$u_{J_i} = \omega_{J_i}e(1 - S_{J_i})a_iF_i + eS_{J_i}a_iF_i - (\delta_J c_J(S_{J_i})a_i + \hat{\delta}_J\hat{c}_J(a_i))F_i, \tag{14}$$

where we used (8) and (10) to replace $\dot{N}_{F_i}$ and $\dot{N}_{J_i}$, as well as the free entry condition $V_i = \beta X$. The diversion rate chosen by the spinoff manager satisfies the condition

$$e = \delta_J c'_J + e\omega_{J_i}. \tag{15}$$

This says that the gains of diversion equal the marginal cost of effort plus the loss of some compensation. The condition for the usage of funds for spinoff activities (i.e., the choice of a_i) is

$$\omega_{J_i}e(1 - S_{J_i}) + eS_{J_i} = \hat{\delta}_J\hat{c}'_J. \tag{16}$$

In this case, the marginal gains are the contractual shares of the value of consensual spinoffs plus the non-contractual capital gains associated with the diversion of spinoff resources. We denote the joint solution of (15) and (16) with $S_{J_i} = S_J(\omega_{J_i}; \delta_J, e)$ and $a_i = a(\omega_{J_i}; \hat{\delta}_J, e)$. The spinoff manager's participation constraint requires

$$V_i^{SO} = \int_t^{\infty} e^{-\int_t^{\tau} r(s)ds} u_{J_i} d\tau > 0, \tag{17}$$

where u_{J_i} is evaluated on the optimal conditions (15)-(16).

4.2.3 The founder (principal)

We now consider the dynamic problem of a firm from the founder's point of view. It is useful first to define the earnings of the founder in a basic scenario in which the founder retains full control of the firm. In such scenario there is no creation of spinoffs (the founder has no entry cost benefit and would have to sustain a spinoff creation cost). Moreover, the firm's stock of knowledge would grow according to $\dot{Z}_i = I_i$ and the founder would earn a flow of cash of $F_i = \Pi_i - I_i$, where

$$\Pi_i = (P_i - 1)X_i - \phi Q_i, \tag{18}$$

is the firm's profits, with P_i being the price the firm charges for one unit of product of quality Q_i. In such scenario F_i corresponds to the dividend income received by the founder.

When the founder delegates R&D to a manager, the stock of knowledge expands according to (7), that is, $\dot{Z}_i = h(1 - S_{I_i})I_i$ and the flow of cash becomes

$$F_i = \Pi_i - I_i - \omega_{I_i} h(1 - S_{I_i})I_i. \tag{19}$$

When the founder also hires a spinoff manager with the task of creating new product lines (consensual spinoffs), his flow of cash reduces to $(1 - a_i)F_i - \omega_{J_i} e(1 - S_{J_i})a_i F_i$ but he has capital gains for $e(1 - S_{J_i})a_i F_i$. Thus, the sum of the founder's flow of cash and wealth creation is

$$\Gamma_i = \Sigma_i[\Pi_i - I_i - \omega_{I_i} h(1 - S_{I_i})I_i], \tag{20}$$

where

$$\Sigma_i \equiv (1 - a_i) + (e - \omega_{J_i})a_i(1 - S_{J_i}) > 1 \tag{21}$$

measures the spinoff surplus that the founder can extract from delegating spinoff creation to a manager (without such delegation Σ_i would be replaced by one in (20)).

The founder chooses the price P_i, a set of contracts for the managers $(\omega_{I_i}, \omega_{J_i})$, and a plan of investment I_i, with the objective to maximize

$$V_i(t) = \int_t^{\infty} e^{-\int_t^{\tau} r(s)ds} \Gamma_i(\tau)\, d\tau, \tag{22}$$

subject to the demand schedule in (4), the R&D investment technology (7), the managers' best responses (12), (15) and (16), and the managers' participation constraints (13) and (17). The optimal solution (see the Appendix for details) yields a time-invariant monopolistic price $P_i = \frac{1}{\theta}$. The optimal contractual term ω_{J_i} for the spinoff manager satisfies

$$(e - \omega_{J_i}) a_i (-\frac{\partial S_J}{\partial \omega_{J_i}}) + [(e - \omega_{J_i})(1 - S_{J_i})] \frac{\partial a}{\partial \omega_{J_i}} = (1 - S_{J_i}) a_i, \tag{23}$$

which says that the marginal benefits of ω_{J_i}, given by the diminished diversion and the capital gains for the founder (left-hand side), must be equal to the marginal cost of incentivizing the spinoff manager. Through the compensation ω_{J_i} the founder can affect the spinoff manager's reaction functions (15) and (16), influencing both the manager's use of resources for consensual spinoffs and his diversion effort for conflictual spinoffs. The joint solution of (15), (16), and (23) delivers the firm-invariant and time-invariant values $S_{J_i} = S_J(\delta_J, e)$, $\omega_{J_i} = \omega_J(\delta_J, e)$ and $a_i = a(\delta_J, e)$.

The optimal condition for the compensation of the R&D manager, ω_{I_i}, in turn satisfies

$$(1 - S_{I_i})^2 h = \Sigma_i(-\frac{\partial S_I(\omega_{I_i}; \delta_I, h, e)}{\partial \omega_{I_i}}). \tag{24}$$

This condition states that the founder's marginal cost of incentivizing the R&D manager, $1 - S_{I_i}$, is equal to the marginal gain generated by the reduction of diversion, $\frac{\partial S_I(\omega_{I_i}; \delta_I, h, e)}{\partial \omega_{I_i}}$.

In brief, the joint solution of (12), (15), (16), (23), and (24) yields the optimal compensations, and the optimal diversion and spinoff efforts: $S_{J_i} = S_J(\delta_J, e)$, $\omega_{J_i} = \omega_J(\delta_J, e), a_i = a(\delta_J, e), S_{I_i} = S_I(\delta_I, \delta_J, h, e)$ and $\omega_{I_i} = \omega_I(\delta_I, \delta_J, h, e)$. These variables are firm and time invariant. To ease the exposition, from now on we will drop the index i from the governance variables and omit to indicate their dependence on the parameters δ_I, δ_J, h, and e unless necessary to recall such relationships.

Return to in-house investment in product quality. The rate of return to in-house innovation is

$$r = r_{Z_i} \equiv \frac{\alpha}{q}\frac{\Pi_i}{Z_i} \tag{25}$$

where q is the shadow value of knowledge. The optimal condition on the investment flow, I_i, requires q to be equal to the (founder's) cost of knowledge accumulation:

$$q = \frac{\Sigma}{h(1-S_I)} + \omega_I. \tag{26}$$

In a set up with no spinoffs and no managers $q = 1$, as one unit of final good would be converted into one unit of firm knowledge. A higher spinoffs surplus Σ increases the opportunity cost of in-house investment. Such cost rises also when the R&D agency issues, captured by ω_I and S_I, increase. Conversely, the R&D manager's ability, h, lowers q and thus increases the return r_Z.

The arbitrage condition (25) also says that when the spinoff agency cost increases (S_J or ω_J are higher), the founder needs to accumulate more knowledge Z_i to match the outside return r. This follows from the property that $\frac{\Pi_i}{Z_i}$ is decreasing in Z_i. Intuitively, when agency issues are more severe on the spinoff side than on R&D, shareholders tend to invest relatively more in firm growth.

Return to equity. Time derivation of (22) yields the households' return on de-novo entry, $r = \frac{\Gamma_i}{V_i} + \frac{\dot{V}}{V_i}$. Combining this with the free-entry condition, $V_i = \beta X$, and using the definition of Γ_i in (20), we obtain (taking logs and time derivatives)

$$r = r_{E_i} \equiv \frac{\Sigma[\Pi_i - I_i - \omega_I h(1-S_I)I_i]}{\beta X} + \frac{\dot{X}}{X}. \tag{27}$$

Both spinoff and R&D agency issues lower households' return to equity. In particular, (27) shows that a higher surplus from spinoff activities Σ boosts firms' return to equity, incentivizing entry.

4.2.4 Delegation

The analysis focuses on a solution whereby the founder delegates to managers both R&D activities and the creation of new product lines. Since both activities give rise to agency issues, it is important to consider whether delegation of either one or both activities is profitable. This ultimately depends on how the productivity of managers compares with their ability to divert resources.

Spinoffs. For a given pattern of I_i, the founder delegates spinoff creation to a manager if

$$\Sigma \equiv (1-a) + (e-\omega_J)a(1-S_J) > 1, \tag{28}$$

that is if the founder expects that by investing in spinoffs he can multiply the undistributed cash flow by a factor $\Sigma > 1$.

R&D. If $\Sigma > 1$, the founder delegates R&D to a manager if, for a given $\frac{\Pi_i}{Z_i}$ ratio, the in-house innovation return is higher under R&D delegation than under no delegation (see 25):

$$\frac{h(1-S_I)}{\Sigma + \omega_I h(1-S_I)} > \frac{1}{\Sigma}. \tag{29}$$

If $\Sigma \leq 1$, the firm does not invest in product expansion, and the condition under which R&D delegation is optimal for the founder is (see 25)

$$\frac{h(1-S_I)}{1 + \omega_I h(1-S_I)} > 1. \tag{30}$$

Condition (29) reveals that there is some interaction between the two delegation decisions. If the founder has opted for investing in spinoffs, the R&D delegation threshold can be satisfied more easily. In the quantitative Section 7 we focus on an economy with a set of parameters that satisfies the two surplus conditions (28) and (29), the two managers' participation constraints (13) and (17), and that guarantees an interior solution for the governance variables $(S_I, S_J, a, \omega_I, \omega_J)$.

4.3 Households

The representative household has L members. Each household member is endowed with one unit of labor supplied inelastically to the final good sector. Consequently, the labor supply is L. Some households are also randomly chosen to perform managerial tasks in addition to labor activities in the final good sector. In view of the welfare analysis, we keep separate the income and consumption patterns of managers from the rest of the households. To simplify the analysis, managers consume immediately all their contractual and non-contractual earnings. In particular, managers sell newly created firms to households who seek to invest their savings. Anticipating the general equilibrium property of symmetry across intermediate firms, the total managers' consumption is

$$C^m = N\{[\omega_J e(1-S_J)a + eS_J a][\Pi - I - \omega_I h(1-S_I)I] + \omega_I h(1-S_I)I + eS_I I\}. \tag{31}$$

Households make their intertemporal consumption-saving choice according to preferences

$$U(0) = \int_0^\infty e^{-\rho t}\left[L(t)\log\left(\frac{C(t)}{L(t)}\right)\right]dt, \quad L(t) = e^{\lambda t}, \quad \rho > \lambda, \tag{32}$$

where 0 is the point in time when they make decisions, ρ is the intertemporal discount rate, and $C(t)$ is consumption, net of that of managers. The initial mass of households is $L(0) = 1$. They are subject to the budget constraint

$$\dot{A} = rA + wL - C, \tag{33}$$

where w is the wage and r is the return on assets.[13] These are the overall value of the firms, including those created by managers with diverted resources.

The consumption plan that maximizes (32) subject to (33) consists of the Euler equation

$$r = \rho - \lambda + \frac{\dot{C}}{C}, \tag{34}$$

the budget constraint (33), and the usual boundary conditions.

5 General Equilibrium

In this section we build the general equilibrium of the model. Because in equilibrium the intermediate sector is symmetric, i.e., intermediate firms charge the same price, produce the same quantity, and grow at the same rate, we drop the subscript i from all expressions.

We start by expressing the production function of the final good in a reduced form. Using the

[13]This budget constraint is equivalent to one that shows dividend income and capital gains (see the Appendix).

property that firms receive $NPX = \theta Y$ from the final producer, we have $X = \theta^2 Y/N$. Therefore, under symmetry (3) reduces to

$$Y = \theta^{\frac{2\theta}{1-\theta}} \cdot N^{\sigma} \cdot Z \cdot L. \tag{35}$$

This expression makes clear that labor productivity, Y/L, is higher in an environment where on average firms accumulate a larger stock of knowledge, Z, and have a larger number of products, which in our set up can be driven by spinoffs. Because the rates of return are increasing in the ratio between the volume of production, X , and the firm's stock of knowledge, it is convenient to define the state variable

$$x \equiv \frac{X}{Z} = \frac{L}{N^{1-\sigma}} \theta^{\frac{2}{1-\theta}} \tag{36}$$

which measures the quality-adjusted size of an intermediate firm. In the rest of the paper we refer to x simply as "firm size".

The number of firms (fueled also by consensual and conflictual spinoffs) increases the productivity of the final good sector through the *variety* effect and at the same time tends to shrink the average firm size as more intermediate firms share the same final market. This *competition effect* reduces the returns to in-house innovation. Specifically, using the cash flow definition, the returns to in-house knowledge investment and to equity (entry), (25) and (27), reduce to

$$r = r_Z \equiv \frac{h(1-S_I)}{\Sigma + \omega_I h(1-S_I)} \times \alpha[\left(\frac{1}{\theta} - 1\right) x - \phi], \tag{37}$$

and

$$r = r_N \equiv \frac{\Sigma}{\beta x}[(\frac{1}{\theta} - 1)x \ - \phi - (\frac{1}{h(1-S_I)} + \omega_I)z] + \frac{\dot{x}}{x} + z\,, \tag{38}$$

respectively, where $z \equiv \dot{Z}/Z = hI(1-S_I)/Z$ is the investment rate and $\Sigma \equiv (1-a)+(1-\omega_J)ea(1-S_J)$ is the spinoff surplus factor defined in (28). As equation (37) shows, the return to in-house investment in product quality, r_Z, is greater in an environment where R&D managers are relatively skilled (high h) and have limited latitude in diverting resources from in-house R&D activities (low S_I and small ω_I). A larger spinoff surplus factor Σ tends to induce firms to reallocate resources from in-house investment in product quality to the creation of consensual spinoffs. On the other hand, as equation (38) shows, a larger Σ results in a higher return to equity, r_N, which makes entry more attractive. This competition effect reduces the return r_Z to in-house investment in product quality in (37) through a reduction in the firm size x, compounding the direct negative effect of Σ.

Gross Domestic Product (GDP). In our set up, the GDP (G) can be obtained by subtracting the cost of intermediate inputs NX and the fixed cost ϕZN from the final output Y. Using (36),

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

and, replacing Y with the expression in (35), we have that per capita GDP is

$$\frac{G}{L} = [1 - \theta^2\left(1 + \frac{\phi}{x}\right)](\theta^{\frac{2\theta}{1-\theta}} \cdot N^{\sigma} Z). \tag{39}$$

There are three channels through which spinoff activities affect the level of the GDP. Spinoffs tend to increase the number of firms, N. This effect is driven directly by the creation of spinoff businesses and also by the boost that spinoff activities give to firms' return on equity (entry), as captured by the spinoff surplus factor Σ. The increase in the number of firms raises productivity through the *variety* channel, represented by the term N^{σ}, thereby promoting an expansion of per capita income. On the other hand, the rise in the number of firms relative to the size of the population (N/L ratio) implies a reduction in firm size, x. Having more firms per capita can be detrimental to the economy because they consume operating resources. Finally, the third channel whereby spinoffs alter the level of the GDP is through the pattern of Z. As noted above, knowledge accumulation can be adversely affected by spinoffs because they can limit in-house firm growth.

Assets. Since the only assets in the economy are the firms' value, we have that

$$A = NV, \tag{40}$$

where N measures all firms, including consensual and conflictual spinoffs. As already discussed, managers do not save; they sell their assets to households, and consume the proceeds immediately.

6 Steady State and Dynamics

We have now the elements to study the steady state and the dynamics of the economy.

6.1 The steady state

We characterize the steady state, a situation in which the firm's size, x, the interest rate, r, and the consumption-output ratio, C/Y, are constant. A constant x implies that $\frac{\dot{N}}{N} = n = \frac{\lambda}{1-\sigma}$ (see (36)). This suggests that in the long run the rate of entry is eventually tied to population growth. However, as discussed in the previous section, the level of N depends on the intensity of spinoffs. We may have two economies that in the long run have the same entry rate and yet at each point in time have a very different mass of firms, and differ in the value of wealth.

Exploiting the property that $\frac{\dot{C}}{C} = \frac{\dot{Y}}{Y}$, using the production function (35) we have that $\frac{\dot{C}}{C} = \sigma n + z + \lambda$. Combining this result with (34) and using the result $n = \frac{\lambda}{1-\sigma}$,

$$r = \frac{\sigma}{1-\sigma}\lambda + z + \rho. \tag{41}$$

Substituting this expression in the returns to in-house investment (37) and to equity (entry) (38) and setting $\dot{x} = 0$, we obtain

$$z = \frac{\alpha}{q}[\left(\frac{1}{\theta} - 1\right) x - \phi] - \frac{\sigma}{1-\sigma}\lambda - \rho, \tag{42}$$

and

$$z = \frac{h(1-S_I)}{1+\omega_I h(1-S_I)} \left\{ \left[\frac{1}{\theta} - 1 - \frac{(\frac{\sigma}{1-\sigma}\lambda + \rho)\beta}{\Sigma} \right] x - \phi \right\}. \tag{43}$$

According to the in-house investment locus (42), for a given firm size, x, the effort of R&D managers to divert resources for conflictual spinoffs, represented by S_I, and the contractual remedies used by founders to address this issue, captured by ω_I, reduce the attractiveness of investments in firm growth. Note, in fact, that S_I and ω_I cause an increase in the internal cost of capital, q, as shown in equation (26). The entry locus (43) states that, for a given rate of in-house investment, the surplus generated by spinoff activities, Σ, reduces the size of firms in the industry, x. Additionally, this locus indicates that, for a given firm size x, in an environment with high R&D agency costs, S_I and ω_I, firms enter with a plan to invest at a relatively low rate z.

The crossing of the loci (42)-(43) yields the steady-state firm size and in-house investment rate. This intersection captures the general equilibrium feedback between the two arbitrage conditions just described. The steady-state, general equilibrium effects of any change in agency conditions can be understood through differentiation of the solutions for x and z.

Proposition 1 *(Steady State). Letting* $\hat{q} = \frac{1}{h(1-S_I)} + \omega_I$ *and* $q = \frac{\Sigma}{h(1-S_I)} + \omega_I$*, the steady state can be characterized as follows:*

$$x^* = \frac{[\hat{q}(\rho + \frac{\sigma}{1-\sigma}\lambda) - \phi(1 - \frac{\alpha\hat{q}}{q})]}{(\rho + \frac{\sigma}{1-\sigma}\lambda)\frac{\beta(1-\gamma)}{\Sigma} - (1 - \frac{\alpha\hat{q}}{q})\left(\frac{1}{\theta} - 1\right)},$$

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

$$n^* = \frac{\lambda}{1-\sigma},$$

$$r^* = \frac{\alpha}{q}\left[\left(\frac{1}{\theta} - 1\right)x^* - \phi\right],$$

and

$$c^* = (1-\theta) - (\lambda - \rho)\beta\theta^2. \tag{44}$$

Proof. See Appendix. ■

6.2 Dynamic system

The dynamic equilibrium can be represented by a phase diagram in two variables: the firm size, x, which is the state variable of the system, and the consumption output ratio, $c \equiv \frac{C}{Y}$, which is a jump variable. While the dynamics may exhibit phases in which either n or z or both are zero, here we focus on a scenario in which both are positive. Proposition 2 summarizes the result. The Appendix provides details on the derivation and discusses the conditions for having $n > 0$ and $z > 0$.

Proposition 2 *(Dynamic System). Let* $x(0) > x_Z$ *and* $x(0) > x_N$*, where the expressions of* x_Z *and* x_N *are reported in the Appendix. Assume an interior governance equilibrium, that is one in which (12), (15), (16), (23), and (24) hold, with* $\Sigma > 1$*,* $\frac{h(1-S_I)}{\Sigma + \omega_I h(1-S_I)} > 1$*, and the managers' participation constraints (13) and (17) are satisfied. The dynamic system of the economy can be characterized as follows*

$$c = (1-\theta) - (\lambda - \rho)\beta\theta^2, \tag{45}$$

$$\frac{\dot{x}}{x} = \lambda - (1-\sigma)n, \tag{46}$$

where

$$n = \frac{\Sigma}{\beta}[(\frac{1}{\theta} - 1 - \frac{\phi}{x}) - (\frac{1}{h(1-S_I)} + \omega_I)\frac{z}{x}] + (\lambda - \rho), \tag{47}$$

and

$$z(x) = \frac{1}{\psi}\{(\frac{h(1-S_I)\alpha}{\Sigma + \omega_I h(1-S_I)} - \frac{\sigma\Sigma}{\beta x})[\left(\frac{1}{\theta} - 1\right) x - \phi] - \rho(1-\sigma) - \sigma\lambda\}, \tag{48}$$

where $\psi \equiv 1 - \frac{\sigma\Sigma}{\beta x}(\frac{1}{h(1-S_I)} + \omega_{I_i})$.

Proof. See the Appendix. ■

7 Quantitative Analysis

The objective of this section is to quantify the short- and long-run aggregate effects of spinoff activities. We are interested in the effects on firm entry and on incumbents' investments, and the implications for growth and welfare. We are also interested in the feedback from the macroeconomy to the intensity of spinoffs. In carrying out the quantitative analysis, in line also with the empirical analysis of Section 3, we alter the degree of protection of incumbents' investments, as captured by managers' effort cost in diverting R&D and spinoff resources (δ_I and δ_J, respectively).

7.1 Calibration

The baseline parameterization of the economy is displayed in Table 2. While we especially refer to the Italian data in Section 3 to match spinoff activities, we choose other macroeconomic values in line with those typically adopted by the literature for modern growing economies, especially the United States. We set the population growth $\lambda = 1.2\%$. This is close to the population growth rate of the United States and is also close to the population growth of the Italian provinces during the 1995-2010 period (the sample period for the data used in Section 3). The social return to variety is determined through (46) with $\dot{x} = 0$: $\sigma = 1 - \lambda/n$. The Italian Chambers of Commerce report a firm entry rate of about 0.8% for 1995-2006, close to population growth. This would imply $\sigma = 0$. The World Bank Entrepreneurship database, however, indicates that from 1982 to the 2008 crisis firms' net entry rate in other advanced countries was higher – for instance it was

2.5% in the United States, implying $\sigma = 0.6$.[14] We choose a baseline $\sigma = 0.25$, with associated $n = 1.61\%$. The private return to quality, α, is set to 0.30. In Jones and Williams (1998) the social rate of return on R&D – a proxy for product quality investment – is in the 30-100 percent range, with R&D spillovers, $1-\alpha$, of 70%. While the implied spillovers could appear large, others have calculated similar spillovers through alternative methods for estimating uncompensated external benefits (Baumol, 2002, pp.133-134). In the United States, markups have been on the rise for decades, but they appear to have stabilized in recent years. According to Jaumandreu (2022), who combined data of the Survey of Manufacturers and Census of Manufacturers, the markup in the U.S. manufacturing sector from 2010 to 2020 was between 0.24 and 0.30, depending on the year of reference and the adjustment for the cost of capital. Because in our framework the monopolistic price is set by intermediate firms, we use this kind of empirical evidence rather than that on final products. Thus, we pick θ=0.79 which implies a monopolistic price P of 1.27. We set $\rho = 3\%$ and target a growth rate of per capita income, $g_{G/L}$, of 2%, and an interest rate of 5%. We choose the growth rate to reflect the performance of an economy that has a relatively stable growth. The parameters ϕ and β are set to match $g_{G/L} = 2\%$ and a long-run saving rate ($s = 1 - C/G$) of about 10.8%. According to data from the Bureau of Economic Analysis, the U.S. gross national saving rate in the post-war period fluctuated between 15% and 20%. Allowing for a depreciation rate of 8%, this would imply a net saving rate, as a ratio of GDP, in the interval of 7-12%. Our calibration matches a saving rate in the middle of this interval. The resulting investment rate $z = y - \sigma n = 1.60\%$.

Agency costs: spinoffs. We use simple logarithmic functions to represent the utility costs of diversion for conflictual spinoffs and of creation of consensual spinoffs: $c_J(S_J) = -\log(1 - S_J/b_J)$ and $c_J(\hat{S}_J) = -\log(1 - \hat{S}_J/\hat{b}_J)$. The spinoff manager's reaction functions (15) and (16), together with the founder's optimal contract for the spinoff manager (23), yield the following three equations:

$$S_J = b_J - \frac{\delta_J}{e(1-\omega_J)}, \tag{49}$$

$$a = \hat{b}_J - \frac{\hat{\delta}_J}{\omega_J e(1-S_J) + eS_J}, \tag{50}$$

[14] See also Lee and Mukoyama (2015) for the entry rates in the U.S. manufacturing sector.

and

$$(e-\omega_J)a\frac{1}{e}\frac{\delta_J}{(1-\omega_J)^2}+(e-\omega_J)(1-S_J)\frac{\hat{\delta}_J e(1-S_J)}{(\omega_J e(1-S_J)+eS_J)^2}=(1-S_J)a. \tag{51}$$

Further, for the delegation of spinoff activities to be profitable for founders it must be that $\Sigma > 1$.

Agency costs: R&D. We also rely on a logarithmic function for the cost of diverting R&D resources: $c_I(S_I) = -\log(1 - S_I/b_I)$. The parameters (δ_I, b_I) scale up the cost of diversion effort and regulate R&D managers' diversion ability. We choose these two parameters by solving for them the two equations:

$$S_I = b_I - \frac{\delta_I}{e(1-h\omega_I)},$$

and

$$(1-S_I)h = \Sigma\frac{\delta_I h}{(e-h\omega_I)^2},$$

that follow from the R&D manager's reaction function (12) and contract (24), taking ω_I, S_I, and h as given.

In total, we have eight governance parameters to fix: $\delta_I, b_I, \delta_J, b_J, \hat{\delta}_J, \hat{b}_J, h, e$. By targeting the values $(S_I, S_J, a, \omega_I, \omega_J)$ the above five equations give us five constraints. Two additional constraints come from the spinoff surplus factor Σ and the internal cost of capital q. Thus, we are left with a free parameter that we use to insure an interior governance equilibrium. The parameters δ_I and δ_J scale up managers' diversion effort cost, whereas b_I and b_J regulate the curvature of the cost functions. A stronger investment protection, as determined by higher quality of the judiciary and more stringent laws, is captured by an increase in the diversion cost parameters δ_I and δ_J. The parameter $\hat{\delta}_J$ indicates how hostile is the business environment towards the creation of spinoffs on the part of incumbent firms, whereas $\hat{b}_J$ captures managers' spinoff efficiency.

We proceed to the targeting of the seven governance variables $(S_I, S_J, a, \omega_I, \omega_J, \Sigma, q)$ using a mix of corporate finance, industry, and macroeconomic evidence. Lacking compelling evidence that allows us to distinguish between the intensities of the two types of diversion (in R&D and spinoff activities), we simply set $S_J = S_I$ and $\omega_I = \omega_J$. This simplifying assumption, which has the advantage of bringing clarity to the calibration exercise, turns out to generate results that are in line with available evidence.

The Capitalia Survey on Italian Manufacturing Firms indicates that the R&D over sales ratio is about 4.1% and that around 40% of R&D expenses is absorbed by radical product innovations which lead to new products. Only a fraction of the radical product innovations, however, is later developed through spinoffs. In particular, the survey suggests that about a third of them are carried out through spinoffs while the rest remain within incumbent firms. This evidence thus implies that $\frac{aF}{pX} = 0.00547$. Anticipating a steady state value of $\frac{F}{pX}$ around 0.1, we therefore target $a = 0.05$.

Next, we use evidence about the relative share of conflictual and non-conflictual spinoffs, R^C. Our computations with the Italian data in Section 3 indicate that such ratio is between 20 and 25 percent. Using equations (8)-(10), we then have

$$R^C = \frac{\dot{N}_{J_i} + \dot{N}_{I_i}}{\dot{N}_{F_i}} = \frac{S_J}{1 - S_J} + \frac{S_I}{1 - S_J}\frac{I}{aF} = 0.223. \tag{52}$$

In steady state I/F is about 0.072. With $a = 0.05$, and recalling the condition $S_J{=}S_I$, the above equation yields $S_J = 0.08$. For the managers' compensation we combine information regarding managers' total pay relative to the asset evaluation of firms (Glovert and Levine, 2017), together with data on the share of managers' pay accounted for by variable compensation, including bonuses (Chenevert and Hoffman, 2017). These studies imply that managerial compensation is around 0.2% of the assets. In our model the managers' compensation over asset ratio is $R^m = (\omega_I\ \dot{Z} + \omega_J \dot{N}_F)/V$. Using the free entry condition $V = \beta X$, and the condition $\omega_I = \omega_J$, after some algebra we obtain

$$R^m = \frac{\omega_I}{\beta}[\frac{z}{x} + ea\frac{F}{X}(1 - S_J)].$$

Evaluating z, x, and $\frac{F}{X}$ on their steady state value using the targeted governance variables, we obtain $R^m = 0.2\%$ with an $\omega_I = 0.25$.

We set the two remaining governance parameters e and h so as to imply values for Σ and q marginally above and below 1, respectively. By doing so, we have $e = 1.4$ and $h = 1.48$. We also verified that under our governance targets the model generates a spinoff rate similar to the empirical evidence. Section 3 reported a spinoff rate (spinoffs over total entries) for Italian firms of approximately 25%. Klepper and Sleeper (2005) calculated spinoff rates of 17%, 20%, and 24% for the U.S. laser, automaker, and disk drive industries, respectively. Using equations (8-10), the model's spinoff rate, $R^S = \frac{N(\dot{N}_{F_i}+\dot{N}_{J_i}+\dot{N}_{I_i})}{\dot{N}}$, can be written as

$$R^S = \frac{e}{n\beta}(a\frac{F}{X} + S_I\frac{z}{xh(1-S_I)}). \tag{53}$$

Employing the steady state values for F/X, z, n, and x, and the governance parameters detailed above, we obtain $R^S = 25.5\%$. Table 2, Panel D, summarizes the economy steady state values.

7.2 Spinoff activities in the long run

This section compares the long-run equilibrium (steady state) of economies that differ only with respect to investment protection. In our model a stronger investment protection can be represented by a higher δ_I or a higher δ_J, which measure managers' cost of diversion in R&D and spinoff activities, respectively. An increase of δ_I and of δ_J captures reforms of the legal system that make it more difficult for employees to divert resources from funds allocated to the improvement of existing products or to the creation of new ones. Such reforms could, for instance, allow greater latitude to firms to offer labour contracts and covenants with restrictive non-competition clauses, or more in general that restrict the employees' freedom in enterprising activities that could hurt the commercial interests of the current employer. They could also introduce more stringent norms on the relationship between newly created spinoffs and parent companies or on the competition among divisions of multi-product firms.[15] Although in practice and in the law the protection of investments in product creation and in quality enhancement tend to be interwined, in the quantitative analysis we mantain such distinction to disentangle the key mechanisms.

Specifically, we consider three scenarios. In one only the parameter δ_I varies across economies. Hence, we compare economies that differ in legislation or enforcement with respect to the sanctions applied to agents who use incumbents' R&D resources to set up new firms. In a second scenario we vary the parameter δ_J, that is, we compare economies that differ in the severity of sanctions for agents that divert resources during spinoff activities. In a third scenario the two parameters δ_I and δ_J move in lock-step so that their ratio is held constant. This is intended to capture variation in legislation that is neutral with respect to the two types of diversion. Finally, we interpret the

[15] Section 2125 of the Italian Civil Code regulates employees' non-competition clauses; article 2557 of the Code regulates firm competition.

evidence of Section 3 with the lens of the calibration exercise and conclude that it matches well with the scenario of neutral investment protection variation (constant δ_J/δ_I) or with one in which investment protection has a relatively more pronounced effect on the diversion cost δ_I than on δ_J.

The main takeaway message of the quantitative experiments is that a priori investment protection can have ambiguous effects on the incidence of spinoffs in firm entry and on incumbents' R&D investment in product quality, depending on whether the variation of investment protection affects relatively more δ_I or δ_J. Specifically, the experiments show that firm growth, z, is increasing in δ_I while the spinoff rate, R^S, declines in δ_I: that is, economies that especially protect the results of R&D and, for instance, impose strong sanctions in labor contracts between owners and R&D managers are predicted to reduce the incidence of spinoffs and boost incumbents' R&D investments and growth. Conversely, firm growth, z, is decreasing in δ_J and the spinoff rate, R^S, increases in δ_J: economies that focus on disciplining corporate spinoff activities or the relationship between newly created spinoffs and parent companies can raise the incidence of spinoffs, while reducing incumbents' R&D investment in product quality. The quantitative results further suggest that a broad legal reform enhancing overall investment protection (thus raising both δ_I and δ_J) should have effects more in line with those of a reform that increases δ_I, reducing the incidence of spinoffs, boosting incumbents' R&D investments, and lowering the relative importance of conflictual spinoffs among spinoff entrants.

It is useful to recall here that in our framework the expression for the internal cost of capital $q = \frac{\Sigma}{h(1-S_I)} + \omega_I$ contains all the governance wedges. Any reduction of the internal cost of capital, for instance due to a reduction in the R&D agency costs, incentivizes in-house innovation, z, for a given firm size. In addition, in general equilibrium incumbents' investment in in-house innovation is also driven by changes in firms' size. Following firm growth z in steady state is of great interest because any governance variation that affects the steady state per capita income growth rate, $\sigma n + z$, goes through z; the rate of entry n is pinned down by population growth, which is exogenous.

Scenario 1: Investment protection and R&D activities (δ_I). Section 4.2.3 showed that when the diversion of R&D resources is very costly, i.e. with high δ_I, an R&D manager exerts a lower diversion effort S_I, for a given ω_I, and the founder finds it optimal to raise the compensation

ω_I. This further reduces diversion, S_I. Hence, for a given R&D investment I, the number of conflictual spinoffs created by R&D managers declines with δ_I, which tends to drive down the spinoff rate. The decline of R&D diversion S_I also leads to a reduction of q, and therefore creates stronger incentives for incumbent firms' R&D investment and growth z.

In general equilibrium, there are additional mechanisms to consider. Figure (1) helps understand these mechanisms. It confirms that at a higher δ_I, R&D managers receive a more generous compensation and divert less R&D resources. The reduction of the cost of capital, q, leads to higher firm growth, z. This means that the base from which R&D managers can divert resources expands. Hence, in general equilibrium there are contrasting effects associated with a stronger investment protection that goes through an increase of δ_I. On the one hand, this diminishes the fraction of R&D investments diverted to conflictual spinoffs. On the other hand, it expands the diversion base, I. In our calibrated economies the former effect dominates the latter. This explains the decline of the spinoff rate, R^S, together with the decline in the ratio of conflictual over consensual spinoffs, R^C. Observe that all the results are explained through the agency relationships between founders and R&D managers. Spinoff managers' diversion does not react to changes in δ_I, and the decision about the rate of investment in spinoffs, a, is neutral with respect to δ_I.

Scenario 2: Investment protection and spinoff activities (δ_J). Figure (2) compares the governance values S_J , ω_J, and a for economies that differ only in the parameter δ_J, which captures the strength of investment protection in preventing the diversion of spinoff resources. Similar to Figure (1), Figure (2) also shows the aggregate consequences of variations of δ_J .

While an improvement in investment protection that takes the form of rises in the value of δ_I is associated with stronger incumbents' growth and fewer spinoffs, one that increases δ_J may have the opposite effects on these two quantities. Figure (2) shows that the spinoff rate, R^S, rises in δ_J despite the negative effect that this has on S_J, i.e., on the creation of conflictual spinoffs by spinoff managers. Indeed, the improvement in the agency relationship between founders and spinoff managers induces founders to reduce ω_I and increase ω_J (a founder knows that spinoff resources will be diverted to a lower extent, and hence tends to compensate the spinoff manager more). The increase in ω_J stimulates the creation of consensual spinoffs. Moreover, the reduction of R&D

managers' compensation ω_I induced by a higher δ_J triggers an increase in conflictual spinoffs by R&D managers. Together these effects outweigh the reduction in conflictual spinoffs of spinoff managers, overall raising the spinoff rate R^S. On the other hand, improving the protection of spinoff activities reduces incentives for firm growth, z, for two reasons. First, it tilts the arbitrage between product quality improvement and product development towards the latter, as shown by Σ entering at the denominator of the in-house investment condition (38) and at the numerator of the equity return condition (39). Indeed, Figure (2) shows that at a higher δ_J firms allocate a larger share of cash to product expansion through spinoffs, a, and confirms that founders' surplus from delegating the creation of startups, Σ, improves. Second, more favorable entry conditions (i.e., a higher return to equity) in economies with higher δ_j lead to a smaller average firm size, x, further reducing the incentives to invest in product quality.

Scenario 3: A broad legal reform (constant ratio δ_J/δ_I). The analysis so far indicated that in the parameter region of our calibrated economy, δ_I and δ_J can generate contrasting effects on incumbents' long-run growth and on the incidence of spinoffs. A comparison of Figures (1) and (2) suggests that firm growth is relatively more sensitive to variations in δ_I than to variations in δ_J. To gain additional insights, we compare economies that differ in investment protection but have the same ratio δ_I/δ_J. Put differently, we compare economies with different strengths of investment protection, but this is not biased towards preventing one or the other type of diversion. As noted, this type of exercise is likely to mimic the effect of a broad legal reform or of an overall improvement in the efficiency of courts, such as that considered in our empirical analysis of Section 3.

Figure (3) shows the results, plotting the aggregate and governance variables against δ_I. The effects on z and on the spinoff rate, R^S, echo those shown in Figure (1) for scenario 1, where δ_J was kept constant. The changes in R&D agency relationships also mimic those of Figure (1). Differently than in scenario 1, there is a milder decline of the spinoff rate, R^S, as the reduction of S_I is partly counterbalanced by the effects of a reduction of S_J. Under such unbiased improvement in the quality of investment protection, firm growth and long-run per capita income growth increase. The predictions of the model under this exercise are consistent with the evidence of Section 3. Recall, in fact, that in the empirical tests we obtained that a higher court efficiency is associated with a lower spinoff rate (columns 1-4 of Table 1) and with a lower ratio of conflictual over consensual spinoffs (columns 5-6 of Table 1). We also found that it is associated with larger innovation of incumbents aimed at product improvement (Panel B of Table 1), again in line with the model predictions.

7.3 Shocks and spinoff activities in the short and medium runs

In this section, we use the dynamics of the model to investigate the short- and medium-run effects of a reform that makes it harder for managers to divert resources from incumbent firms. While a broad reform is likely to increase both types of diversion costs δ_I and δ_J, because these affect the adjustment process differently, we first consider a variation of one type of diversion cost at a time. In particular, we first consider an unanticipated shock that causes an immediate and permanent increase of δ_I, keeping δ_J fixed, and then one which causes a permanent increase of δ_J, but that does not affect δ_I. Figures (4) and (5) plot the adjustment of the policy functions $z(x)$ and $n(x)$ and of the two spinoff ratios $R^S(x)$ and $R^C(x)$ with respect to the firm size, the system's state variable. Figure (6) shows the economy's response through the time series of these four variables. Before a shock hits, the economy is on a steady state. We denote values for the pre-shock steady state with subscripts 0 and values for the new steady state with an asterisk. As the figures show, a variable, such as z or n, typically exhibits an initial jump in the immediate aftermath of the shock, followed by a slow movement toward the new steady state. The initial jump captures the short-run response, for a given level of industry competition. The subsequent movement is driven by industry dynamics, represented through a rise or fall of the average firm size, x.

A key insight of the dynamic responses is that the dynamic general equilibrium effects associated with the adjustment of the market structure reinforce the effects discussed in Section 7.2. Following a shock to δ_I (i.e., a reform that better protects R&D results), the reduction in spinoff creation and the overall decrease in firm entry tend to make incumbent firms larger, further boosting in-house R&D investments. By contrast, following a shock to δ_J (i.e., a reform that better protects incumbent firms' spinoff activities) the increase in spinoff creation and the overall increase in firm entry tend to make incumbent firms smaller, further depressing in-house R&D investments.

Shock to δ_I. Suppose that a legislative reform causes the R&D diversion parameter δ_I to go up so as to reduce the level of diversion S_I by half ($\Delta\delta_I = 0.0044$). Figure (4.A) shows that in the aftermath of the shock the in-house investment rate and the entry rate move in opposite directions. The decline in the internal cost of capital, q, induces firms to boost up their in-house investment in product quality z. Because households allocate a relatively larger share of income to in-house innovation, they reduce the funding for the creation of de-novo firms. The spinoff rate, R^S, drops. This indicates that the direct effect of the rising diversion cost, δ_I, is sufficiently strong to outweigh any advantage R&D managers may derive from an enlarged diversion base, I. As the economy moves towards the new steady state, i.e. as x rises from x_0 to x^*, firms further step up their in-house investment z. De novo entry also rises progressively as firms' expected profitability improves. This implies that the saving rate goes up during the transition (Figure (6)). The transition has relatively small effects on the spinoff rate, R^S, and on the share of conflictual spinoffs, that is, a substantial portion of the effects on spinoffs show up immediately after the shock. Table 3.A summarizes the short- and long-run changes of the macroeconomic variables.

Shock to δ_J. A reform that tightens up managers' control on the use of firms' spinoff investments, aF, triggers effects that may be strikingly different than those illustrated above. Figure (4.B) shows the effects of a permanent increase of δ_J that causes S_J to drop by half ($\delta_J = 0.0339$). As a result of the increase of δ_J, firm size declines from x_0 to x^*, the rate of investment, z, drops from z_0 and then descends toward z^*, and n first jumps up from n_0 and then moves smoothly to a lower level n^*. The immediate drop in z reflects the fact that the shock induces firms to rebalance their investment outlays towards consensual spinoffs and away from product quality improvement. The changing investment incentives can be understood from the in-house arbitrage condition (37), which contains the spinoff surplus factor Σ in the denominator. The subsequent decline in z, however, is due to an industry adjustment effect. In particular, the greater flow of consensual spinoffs reinforces entry and, hence, reduces the average firm size,[16] which explains the decline in x from x_0 to x^*. The entry of ex-novo firms also accelerates as households expect higher capital gains from new firms, as these can appropriate a larger share of the value of their spinoffs.

The time series of the saving rate and of the per capita GDP growth rate, shown in Figure (6),

[16] The share of conflictual spinoffs R^C declines.

imply that in the short run the decline in firm growth is compensated by firm entry. Nevertheless, along the transition both the saving rate and the rate of per capita GDP growth slightly decline. This is also due to the stronger competition effect that reduces the average firm size, and thus the return on in-house investment, as noted. The short- and long-run variations of key macroeconomic variables are summarized in Table 3.B.

Taking stock. The two experiments demonstrated that a policy reform that affects δ_I generates short- and medium-run macroeconomic effects that go in the opposite direction of those that stem from a rise of δ_J. Further, the magnitude of the quantitative responses of firm growth, entry, and per capita GDP are quite different in the two cases (recall that for comparative purposes we built the shocks so that each induces the relevant margin of diversion S_I or S_J to go down by half). For instance, the average rate of in-house investment goes up by 0.0256 percentage points in the long run in response to a shock to δ_I but declines only by a fifth of that when the shock alters δ_J; and the drop in the entry rate, n, in the immediate aftermath of the shock to δ_I is about twice as large as the rise of n after the shock to δ_J (see Panels A and B of Table 3). When the shock alters both δ_I and δ_J by the same size described above for the stand-alone shocks, the macroeconomic responses are in between of those for the stand-alone experiments, but closer to the δ_I-experiment. For instance, in the stand-alone δ_I and δ_J experiments the short-run variations of z are 0.0173 and -0.0011 percentage points, respectively, whereas in the joint experiment the variation of z is 0.0163 percentage points; the long-run variations of z are 0.0256 and -0.0047 percentage points in the stand-alone experiments, and 0.021 percentage points in the joint experiment.

7.4 Welfare

We now study the welfare consequences of investment protection shocks.[17] To keep the analysis simple, we focus on the welfare of households excluding the consumption of managers, that is of the households that solve the intertemporal consumption-saving problem and whose preferences

[17] In the Appendix we discuss how the equilibrium of our economy compares with the first best allocation.

are described in (32). Using the reduced-form production function (35), this can be written as

$$u = \log\left(\frac{C}{L}\right) = \hat{\theta} + \log c + \sigma \log N + \log Z, \tag{54}$$

where $\hat{\theta} \equiv \frac{2\theta}{1-\theta}\log\theta$. Breaking down per capita consumption into the three variables c, N, and Z, presents the advantage of weighing the relative importance of the forces that affect households' welfare. In our economy, the equilibrium consumption-output ratio $c = (1-\theta) - (\lambda - \rho)\beta\theta^2$ is constant and is not affected by investment protection shocks. Such shocks affect productivity directly through the product variety, N. For example, an expansion of product lines, which are fueled by consensual and non-consensual spinoffs and by ex-novo entries, makes the final good sector more productive. This productivity improvement is governed by the social externality parameter, σ. Therefore, a reform that restricts spinoffs tends to slow down variety-driven productivity gains. As noted, however, such a reform can stimulate the growth of incumbents, as it curbs non-consensual spinoffs and raises the return on in-house investment in product quality. The faster improvement of the quality of intermediate products, Q, means a faster labor productivity growth in the final good sector, yielding wage gains. The contrasting productivity effects of a policy reform translate a priori into an ambiguous impact on welfare.

Following the layout of Section 7.3, we examine the welfare implications of a change in δ_I and δ_J, separately, and then of a contemporaneous change in both parameters. The consumption equivalent welfare effects of the shocks are illustrated in Figure (7). The fraction of consumption, χ, that needs to be given to (or taken from) the representative household of the untreated economy, in order to equate its utility flow with that of the household of the treated economy, can be obtained by solving $u(\frac{C}{L})(1+\chi) = u(\frac{\tilde{C}}{L})$, where $(\sim)$ refers to the treated economy. Using (54), this implies

$$\log(1+\chi) = \log\frac{\tilde{c}}{c} + \sigma\log\frac{\tilde{N}}{N} + \log\frac{\tilde{Z}}{Z}. \tag{55}$$

Figure (7) decomposes the welfare change into its the three main components: the number of firms, the stock of knowledge, and the consumption output ratio. To account for the role of spinoffs in entry, the figure also plots $\log\frac{\tilde{N}^S}{N^S}$. Both economies share the same initial condition, corresponding to the steady state of the untreated economy.

An improvement of the R&D governance (higher δ_I) has an overall positive welfare effect, χ, at every time horizon. This is mostly driven by the significant productivity gains that stem from firm growth, Z. However, the slowdown in business dynamics, N, caused by the more modest firm entry, reduces the welfare gains fueled by firm growth. The entry effect, however, is one order of magnitude smaller relative to the firm growth channel. For instance, five years after the shock, there is a consumption equivalent welfare gain, χ, of 0.104%. After five years, the treated economy's firm knowledge, Z, is 0.1082% higher while the number of firms, and hence the number of products, is 0.0158% lower. Using (55) with a product variety social parameter $\sigma = 0.25$, we calculate the welfare gains to be 0.1082%+0.25(-0.0158%)=0.104% after five years. Additionally, the spinoff rate is 3.77% lower in the treated economy than in the untreated economy, which corresponds to a decline of the initial spinoff rate, R^S, by about 1 percentage point, from 25.5% to 24.5%. In other words, while the overall response of entry is relatively small compared to firm growth, there is a considerable entry composition effect: after 5 years, the treated economy has one fewer spinoff out of 100 firms than the untreated economy. Therefore, while spinoffs reduce the consumption equivalent welfare by $\sigma \times 1\% = 0.25\%$ (which is about two and a half times the welfare change driven by firm growth Z), ex-novo firms almost entirely compensate for this welfare decline. This is because a higher δ_I makes firms more profitable and therefore attracts more ex-novo firms. Figure (7.A) shows that the log difference of the spinoff rate declines slightly over time, suggesting that there is some additional long-run welfare effect attributable to the reshuffling between ex-novo and spinoffs firms. Although the negative welfare effect increases in magnitude over time, it remains small relative to the welfare gains from firm growth, Z, which also continue to increase.

The welfare consequences of an improvement of the spinoff governance (higher δ_J), depicted in Figure (7.B), are opposite in direction to those resulting form the shock to δ_I. The spinoff rate differential increases by about 1%, as opposed to the -3.77% observed in the previous experiment, and the log differential in the overall number of firms is of the same order of magnitude (but with the opposite sign) of that observed in the δ_I-experiment. The slowdown in firm growth is about one fifth of the acceleration recorded in the δ_I-experiment. Overall, in terms of consumption equivalence, the welfare decline in the δ_J-experiment is one order of magnitude smaller than the welfare expansion in the δ_I-experiment. Figure (7.C) shows the welfare gains when both δ_I and

δ_J are increased simultaneously, resulting in halving the rates of diversion S_I and S_J. The figure suggests that the welfare implications depend relatively more on the agency relationship between incumbents and R&D managers than on that between incumbents and spinoff managers.

Sensitivity of welfare effects. How do the welfare results depend on the efficiency with which managers use resources to generate spinoffs? We replicated the δ_I and the δ_J experiments for an economy that has a value of e 20% larger than the baseline economy. In an economy where consensual spinoff creation is more profitable, Σ is larger. Nevertheless, conflictual spinoffs become more profitable too. This induces managers to divert relatively more resources and owners to propose more generous contracts to managers. For instance, in the baseline economy $S_I = S_J = 0.08$, whereas in the high-e economy $S_I = 0.175$ and $S_J = 0.0975$. In our experiments, however, the increase in agency costs is more than compensated by the larger capital gains due to the consensual spinoffs. Specifically, the producer surplus Σ is about 1.30% larger in the high$-e$ economy. Panel A of Figure (8) shows that an improvement in the R&D governance has a more modest but still positive welfare effect in the high-e economy. Indeed, in this economy the in-house investment arbitrage condition is less sensitive to δ_I, which explains why firm growth, Z, reacts relatively less to the shock. Conversely, the welfare change of the high$-e$ economy is more pronounced in the case of an improvement of the spinoff governance (higher δ_J). Relative to the baseline economy, the shock induces a more robust ex-novo entry, which adversely affects incumbents' growth, Z.

7.5 Robustness and further sensitivity analysis

The data in Section 3 suggest that there is some variation in the incidence of consensual spinoffs (e.g., due to cross-industry technological differences). In our set up, this can be captured by the parameter $\hat{\delta}_J$ which governs the cost of creating consensual spinoffs. Motivated by the evidence, we study the sensitivity of the responses to a reform with respect to the consensual spinoff costs of the industry. Appendix Table A2, Panels A-C, and Appendix Figure (A2) summarize the outcomes of the above experiments, but for an economy where $\hat{\delta}_J$ is 50% higher. The outcomes are quite close to those obtained for the baseline economy. For example, in the δ_I-experiment, R&D diversion is about one-tenth higher in the high-$\hat{\delta}_J$ scenario than in the baseline economy. The immediate responses of entry and of in-house investment also show little difference relative to the baseline economy. The changes of z and n are 0.0171 and -0.0028 percentage points in the high-$\hat{\delta}_J$ scenario, whereas the corresponding values for the baseline economy are 0.0173 and -0.0029 (see Panel A of Table 3 and of Appendix Table A2). Robustness to altering $\hat{\delta}_J$ also emerges when considering the shock to δ_J and the joint shock (refer to Panels B and C of Table 3 and of Appendix Table A2).

A further useful sensitivity analysis regards the influence of knowledge externalities. In our framework, an intermediate firm benefits from the average knowledge developed by other firms, according to the parameter $1-\alpha$. Indeed, a firm's in-house return elasticity to its own knowledge is α. As noted, a reader could wonder whether the knowledge externalities implied by our choice of α are somewhat large (in the baseline economy $\alpha = 0.3$). We then replicated the δ_I and δ_J experiments in an environment with weaker knowledge externalities, or, equivalently, with a stronger private knowledge appropriation ($\alpha = 0.35$). The findings are in Panels A-B of Appendix Table A3. The effects of the δ_J experiment (a reform that raises the protection of spinoff investments) are very close to the baseline, while, if anything, those of the δ_I experiment (an increase in the protection of R&D investments) are somewhat stronger when α is higher. Our calculations reveal that the short- and long-term changes of the investment rate, z, are approximately one-third stronger in the economy with $\alpha = 0.35$. In neither experiment the overall entry rate is sensitive to α. Nevertheless, the decline of the spinoff rate in the δ_I experiment is more significant in the high-α economy, where the drop (1.8 percentage points) is about twice as large as that of the baseline economy.[18] Further, the welfare response in the δ_I experiment is about one-third stronger in the economy with $\alpha = 0.35$.

8 Investment Protection and Subsidies

To gain additional insights, we study alternative policies aimed at promoting business dynamics and R&D efforts. In one set of experiments, we contrast a legal reform that attempts to incite entry by weakening investor protection with a more traditional policy that subsidizes the creation of new firms. In a second set of experiments, the government tries to stimulate growth by promoting in-house investments in two alternative ways: by strengthening R&D investment protection or by providing an R&D subsidy. In any experiment involving a subsidy, this is fully financed through a

[18] The drop of the ratio of conflictual over consensual spinoffs is about two times larger in the high-α economy.

flat tax on labor income – that is, the government keeps a balanced budget in every period. In what follows, we first explain how the baseline model can be amended to allow for the two subsidies.[19] Then, we discuss the two sets of experiments in which only one subsidy at a time is considered.

Since the labor supply is inelastic, the tax is non-distortionary. With a tax rate τ, the per period tax revenue is τwL. If the government provides an entry subsidy proportional to the entry cost, a new firm entry cost is $\beta(1-\gamma)X$. Similarly, an R&D subsidy allows an incumbent firm to have a lower cost of knowledge creation. Therefore, (7) becomes (dropping the index i)

$$\dot{Z} = h(1 - S_I) \cdot I(1 + \xi). \tag{56}$$

The parameters γ and ξ govern the size of the entry and R&D subsidies, respectively.

The introduction of the labor tax transforms the household budget constraint (33) as follows

$$\dot{A} = rA + (1 - \tau)wL - C. \tag{57}$$

As noted, the tax revenue τwL covers the entry subsidy $\gamma\beta X\dot{N}$ and the R&D subsidy ξIN:

$$\tau wL = \gamma\beta X\dot{N} + \xi IN.$$

Using (5), the government budget constraint can be written as

$$\tau = \gamma n\beta\theta^2 + \xi\frac{IN}{Y}.$$

This can also be rearranged as

$$\tau = \gamma n\beta\theta^2 + \xi\frac{z}{x}\frac{\theta^2}{h(1 - S_I)(1 + \xi)} \tag{58}$$

where we made again use of (5) and of (56). The dynamics of this extended version of the model with subsidies are more articulated than those of the baseline model, because the consumption output ratio is no longer constant over the transition (observe that, for a constant τ, the subsidy

[19]See also the Appendix for details on this extension with subsidies.

rate depends on the firm size, x). Here, we focus on salient steady state properties.

Steady State. The steady state entry rate is still $n^* = \frac{\lambda}{1-\sigma}$. The firm size is similar to that in Proposition (1) except that β is replaced by $\beta(1-\gamma)$ and that $\hat{q}$ and q now represent the expressions $\hat{q} = \frac{1}{h(1-S_I)(1+\xi)} + \omega_I$ and $q = \frac{\Sigma}{h(1-S_I)(1+\xi)} + \omega_I$, respectively:

$$x^* = \frac{[\phi(1 - \frac{\alpha\hat{q}}{q}) - \hat{q}(\rho + \frac{\sigma}{1-\sigma}\lambda)]}{(1 - \frac{\alpha\hat{q}}{q})\left(\frac{1}{\theta} - 1\right) - (\rho + \frac{\sigma}{1-\sigma}\lambda)\frac{\beta(1-\gamma)}{\Sigma}}. \tag{59}$$

Observe that the firm size declines with the intensity of the entry subsidy γ, while it increases with the intensity of the R&D subsidy ξ. Consequently, in an economy with a larger entry subsidy γ the investment rate is smaller as this depends on firms' scale: in an economy with smaller firms, the rate of investment is lower (see the expression for z^* in Proposition 1). This result is reversed when there is a larger R&D subsidy ξ. The steady state expressions for the firm size, innovation rate, and entry rate, x^*, z^* and n^*, respectively, displayed in Proposition (1) will also hold provided that β is replaced with $\beta(1-\gamma^*)$. The spinoff rate becomes

$$(R^S)^* = \frac{e}{n^*\beta(1-\gamma)}[a(\frac{F}{X})^* + S_I\frac{z^*}{xh(1-S_I)(1+\xi)}]$$

or being more explicit on the ratio $(\frac{F}{X})^*$

$$(R^S)^* = \frac{e}{n^*\beta(1-\gamma)}\{a[\frac{1}{\theta} - 1 - \frac{\phi}{x^*} - (\frac{1}{h(1-S_I)(1+\xi)} + \omega_I)\frac{z^*}{x^*}] + S_I\frac{z^*}{x^*h(1-S_I)(1+\xi)}\}. \tag{60}$$

This expression says that the entry subsidy γ has a positive effect on the spinoff rate, both directly and through x^*. The positive feedback through x^*, however, is diluted by the decline of the investment rate z^*, that is, by a decline of the resources that can be employed in conflictual spinoffs. The effect of the R&D subsidy ξ on the spinoff rate is instead ambiguous. Nevertheless, if R&D investments are sufficiently responsive to the subsidy, the spinoff rate goes up with ξ .

Comparing policies: entry subsidies and investment protection. Consider two policy reforms. With one, the government loosens up the legislation that inhibits R&D managers to make off with incumbents' R&D investments. This is captured by an unexpected and permanent decline of δ_I in the baseline economy. In this experiment $\gamma = \xi = \tau = 0$. With the other policy, the government subsidizes entry and finances it through a labor tax in the manner described above (there are no R&D subsidies, i.e. $\xi = 0$). To easy the comparison, both experiments cause long-run firm growth to slow down by 0.1%. In both experiments, the intensification of entry increases the degree of competition, i.e., the firm size, x, declines, weakening firms' incentive to invest in product improvement. While the direction of the change is similar in the two experiments, the magnitude of the responses is quite different (see Appendix Figure (A3)). In the short run, the introduction of an entry subsidy causes a more modest slowdown of knowledge accumulation and a milder change of the spinoff ratios than a reduction of δ_I. Table A4 shows that z, for instance, drops by 0.0045 percentage points in the case of the entry subsidy and by 0.0671 percentage points in the case of a reduction of δ_I. Conversely, the subsidy shock has a short-term impact on firm entry about twice as large of that triggered by the legal reform (0.034 vs 0.011 percentage points; see Table A4).

Turning to welfare, following the introduction of an entry subsidy in the short term there is a visible drop of the welfare χ mostly driven by the introduction of a labor tax, τ. The welfare change then remains negative at all time horizons because the more intense competition deflates incumbents' incentives to invest. Welfare also reacts negatively at all time horizons to a reduction of δ_I – as noted, the deterioration of the R&D agency issues also makes incumbents more reluctant to invest in product improvement. The welfare losses, however, are more pronounced in the case of an entry subsidy, mostly because of the negative wealth effect of the labor tax (Figure 7.D).

Comparing policies: R&D subsidies and investment protection. As an R&D subsidy reduces the internal cost of capital q, incumbents are incentivized to increase their in-house R&D investment. It is then natural to compare this policy with a legal reform that increases the cost of R&D diversion (higher δ_I). To facilitate this comparison, we introduce an R&D subsidy χ that raises the economy's long-term growth by the same amount as the δ_I experiment above, as reported in Table 3. The responses of overall business dynamics and firm growth are nearly identical in the two experiments (compare Table A5 with Table 3). However, the response of spinoffs differs considerably: the R&D subsidy increases the spinoff rate modestly (by around 0.1%), whereas this decreases by about 7% as a result of the legal reform. Since the subsidy encourages knowledge accumulation, it also expands the diversion basis. Conversely, the legal reform makes it more expensive for managers to funnel resources, and therefore to generate spinoff firms.

The welfare consequences of the introduction of an R&D subsidy are almost indistinguishable from those of the legal reform that raises δ_I. In fact, the response of n and z is nearly identical in the two experiments (compare Table A5 with Table 3). While the R&D subsidy results in a drop of the consumption output ratio, such a drop is very small (-0.0003%, as shown in Table A5) and does not make a significant difference between the two policies.

9 Conclusion

This paper has investigated the short- and long-run aggregate consequences of spinoffs. The analysis was motivated by two contrasting views. On the one hand, the law view voices the concern that incumbent firms may react to the potential diversion of trade secrets associated with conflictual spinoffs by reducing their investment in knowledge creation and product improvement. On the other hand, spinoffs can be a useful vehicle to spur the rapid dissemination of new technologies: new businesses bring new ideas. Our empirical evidence supported the notion that the intensity of spinoffs is influence by the quality of the judiciary and of investment protection.

In the model we assumed that employees with special skills in using investment resources can channel a fraction of these resources to the creation of spinoffs in conflict with incumbent firms. We found that a priori investment protection has ambiguous effects on the intensity of spinoff activities and on the pace of incumbents' investments in product quality. When the legal system is strong in protecting incumbents' expansion of product lines, the economy will experience more intense spinoff creation, a wider set of intermediate products, but also smaller investments in product quality improvement. However, if the legal system also highlights the protection of in-house R&D results, the economy will have lower spinoff creation and more intense R&D investments in product quality. Our quantitative analysis revealed that, following a broad legal reform that strengthens investment protection, the positive impact of the increased amelioration of product quality on GDP growth and welfare will outweigh the negative effect through the reduced spinoff creation and the resulting slower introduction of new inputs. Thus, the analysis supports the rule of law view.

The paper leaves relevant questions open for future research. An aspect worth investigating is how the relationship between the average rate of innovation and investment protection is affected by the degree of competition between incumbents and spinoff firms. In a situation in which spinoffs represent a strong competitive threat, on the one hand, such a threat can further reduce the incentive to invest – thus the Schumpeterian competitive effect would reinforce the "law view" – but on the other hand it could give a further kick to incumbents' innovation effort to fend off spinoffs' attempt to take over a market share (see, for instance, Aghion et al., 2001; Aghion et al., 2005; and, more recently, Cavenaile et al., 2020). We leave this and other issues to future research.

References

Aghion, P., U. Akcigit, and P. Howitt (2014). What do we learn from Schumpeterian growth theory?. Handbook of economic growth. Vol. 2. Elsevier, 515-563.

Aghion, P., N. Bloom, R. Blundell, R. Griffith, and P. Howitt (2005). Competition and innovation: an inverted-U relationship. The Quarterly Journal of Economics, 120(2), 701-728.

Aghion, P., C. Harris, P. Howitt, and J. Vickers (2001). Competition, Imitation and Growth with Step-by-Step Innovation. The Review of Economic Studies, 68, 467-492.

Aghion, P. and P. Howitt (1998). Endogenous Growth Theory. Cambridge, MA: MIT Press.

Aghion, P., P. Howitt and D. Mayer-Foulkes (2005). The effect of financial development on convergence: Theory and evidence. Quarterly Journal of Economics 120, 173-222.

Akcigit, U., H. Alp and M. Peters (2021). Lack of selection and limits to delegation: Firm dynamics in developing countries. American Economic Review, 111(1), 231-75.

Andersson, M. and S. Klepper (2013). Characteristics and performance of new firms and spinoffs in Sweden. Industrial and Corporate Change 22(1), 245−280.

Baslandze, S. (2022). Entrepreneurship through employee mobility, innovation, and growth. Working Paper 2022-10, Federal Reserve Bank of Atlanta.

Baumol, W. J. (2002). The free-market innovation machine: Analyzing the growth miracle of capitalism. Princeton University Press.

Bernardt, Y., Kerste, R. A. J., and J. Meijaard (2002). Spin-off start-ups in the Netherlands: at first glance. EIM, Business and Policy Research.

Boldrin, M. and D. K. Levine (2013). The case against patents. Journal of Economic Perspectives 27(1), 3−22.

Brittain, J. W. and J. Freeman (1986). Entrepreneurship in the semiconductor industry. Mimeo, University of Utah.

Cabral, L., Z. Wang and D. Y. Xu (2018). Competitors, complementors, parents and places: Explaining regional agglomeration in the U.S. Auto Industry. Review of Economic Dynamics 30, 1−29.

Carmignani, A. and S. Giacomelli (2009). Italian civil justice: regional disparities. Bank of Italy Occasional Paper 40, Bank of Italy, Rome.

Caselli, F. and N. Gennaioli (2013) Dynastic management. Economic Inquiry 51, 971−996.

Cavenaile, L., M. A. Celik and X. Tian (2020). Are Markups Too High? Competition, Strategic Innovation, and Industry Dynamics, SSRN Working Paper.

Celik, M. A. and X. Tian (2018). Agency frictions, managerial compensation, and disruptive innovations. Working paper, University of Toronto.

Chatterjee, S. and E. Rossi-Hansberg (2012). Spinoffs and the market for ideas. International Economic Review 53(1), 53−93.

Chenevert, R., and M. G. Hoffman (2017). Common Pay Patterns and Extra Earnings: 2013, Current Population Reports, P70BR150, U.S. Census Bureau, Washington, DC.

Christensen, C. M. (1993). The rigid disk drive industry: A history of commercial and technological turbulence. Business History Review 67(4), 531−588.

Cooley, T. F., R. Marimon and V. Quadrini (2014). Risky investments with limited commitment. Working paper, University of Southern California.

Cooley, T. F. and V. Quadrini (2001). Financial markets and firm dynamics. American Economic Review 5, 1286−1310.

Edmans, A., and X. Gabaix (2016). Executive compensation: A modern primer. Journal of Economic Literature, 54(4), 1232-1287.

Eriksson, T. and J. M. Kuhn (2006). Firm spin-offs in Denmark 1981–2000—patterns of entry and exit. International Journal of Industrial Organization 24(5), 1021−1040.

Etro, F. (2009). Endogenous Market Structures and the Macroeconomy, Berlin and New York: Springer.

Franco, A. M. and D. Filson (2006). Spin-outs: knowledge diffusion through employee mobility. Rand Journal of Economics 37(4), 841−860.

Garcia-Macia, D., Hsieh C.-T., and P. J. Klenow (2019). How destructive is innovation? Econometrica 87(5), 1507-1541.

Garvin, D. A. (1983). Spin-offs and the new firm formation process. California Management Review 25(2), 3−20.

Glover, B., and O. Levine (2017). Idiosyncratic risk and the manager. Journal of Financial Economics, 126(2), 320-341.

Hellmann, T. and V. Thiele (2011). Incentives and innovation: A multitasking approach. American Economic Journal: Microeconomics 3(1), 78−128.

Howitt, P. (1999). Steady endogenous growth with population and R&D inputs growing. Journal of Political Economy 107, 715−730.

Hvide, H. K. (2009). The quality of entrepreneurs. Economic Journal 119(539), 1010−1035.

Iacopetta, M., Minetti, R. and P. F. Peretto (2019). Financial markets, industry dynamics and growth. Economic Journal 129(621), 2192−2215.

Iacopetta, M., and P. F. Peretto (2021). Corporate governance and industrialization. European Economic Review, 135, 103718.

Jaumandreu, J. (2022). The Remarkable Stability of the US Manufacturing Markups. Working Paper, Boston University.

Jones, C. I. and J. C. Williams (1998). Measuring the social return to R&D. Quarterly Journal of Economics 113(4), 1119−1135.

Klepper, S. (2002). The capabilities of new firms and the evolution of the US automobile industry. Industrial and Corporate Change 11(4), 645−666.

Klepper, S., & Sleeper, S. (2005). Entry by spinoffs. Management Science 51(8), 1291−1306.

Lee, Y. and T. Mukoyama (2015). Entry and exit of manufacturing plants over the business cycle. European Economic Review 77, 20−27.

Moore, G. and K. Davis (2004). Learning the silicon valley way. Building high-tech clusters: Silicon Valley and beyond, 7−39.

Muendler, M.-A. and J. E. Rauch (2018). Do employee spinoffs learn markets from their parents? Evidence from international trade. European Economic Review 105(C), 159−173.

Muendler, M. A., Rauch, J. E. and O. Tocoian (2012). Employee spinoffs and other entrants: Stylized facts from Brazil. International Journal of Industrial Organization 30(5), 447−458.

Nikolov, B. and T. M. Whited (2014). Agency conflicts and cash: Estimates from a dynamic model. Journal of Finance 69(5), 1883-1921.

Peretto, P. F. (1999). Cost reduction, entry, and the interdependence of market structure and economic growth. Journal of Monetary Economics, 43(1), 173-195.

Pezone, V. (2021). The Real Effects of Judicial Enforcement. SAFE Working Paper No. 192.

Rocha, V., Carneiro, A. and C. A. Varum (2015). Entry and exit dynamics of nascent business owners. Small Business Economics 45(1), 63−84.

Samaniego, R. M. and J. Y. Sun (2019). Rule of law, economic structure and development. Working paper, George Washington University.

Sohail, F. (2021). From employee to entrepreneur: Learning, employer size, and spinout dynamics. Journal of Economic Dynamics and Control 133, 104270.

Stiglitz, J. E. (2014). Intellectual property rights, the pool of knowledge, and innovation. NBER Working Paper 20014.

Terry, S. J. (2017). The macro impact of short-termism. Working paper, Boston University.

Thompson, P. and S. Klepper (2005). Spinoff entry in high-tech industries: Motives and consequences. In Perspectives on Innovation, F. Malerba and S. Brusoni, eds., pp. 187−218, Cambridge University Press.

Young, A. (1998). Growth without scale effects. Journal of Political Economy 106, 41−63.

World Bank (2013). Doing Business 2012. Doing Business in a More Transparent World. World Bank. International Finance, Washington, DC.

Table 1: Quality of Judiciary, Spinoff Intensity, and Firm Innovation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Panel A: Judiciary and Spinoffs				Panel B: Judiciary and In-house Innovation				Panel C: Consensual and Conflictual Spinoffs			
VARIABLES	Spinoff intensity	Spinoff intensity	Spinoff intensity	Spinoff intensity	Innovation probability	R&D/ Sales	Innovation probability	R&D/ Sales	Consensual spinoff	Consensual spinoff	Consensual spinoff/ Total spinoff	Consensual spinoff/ Total spinoff
Trial length	0.058*				-0.091***	-0.002**			-0.002		-0.309*	
	(0.034)				(0.022)	(0.001)			(0.007)		(0.179)	
Clearance rate		-0.071***					0.112***	-0.001		-0.000		0.476*
		(0.025)					(0.033)	(0.002)		(0.007)		(0.243)
Delta trial length (2012-2014)			0.050**									
			(0.020)									
Delta clearance rate (2012-2014)				-0.013								
				(0.275)								
+ Provincial controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
+ Firm-level controls	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sectoral dummies	N	N	N	N	Y	Y	Y	Y	Y	Y	N	N
Time dummies	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N
Observations	412	515	78	78	17,000	8,222	17,000	8,222	16,904	16,904	196	196
R-squared	0.076	0.102	0.169	0.094	0.045	0.066	0.045	0.065	0.023	0.023	0.191	0.185

Note: Panel A of this table reports OLS estimates for the effects of court (in)efficiency on the share of startups accounted for by spinoffs in a province; Panel B reports OLS estimates for the effects of court (in)efficiency on the likelihood of innovation aimed at product improvement and on the amount of R&D expenditure over sales; Panel C reports OLS estimates for the effects of court (in)efficiency on the likelihood of consensual spinoffs and on the ratio of consensual over non-consensual spinoffs in a province. All the regressions control for: (log) unemployment rate; population growth rate; bank branches density; bank concentration (HHI); (log) trade openness; (log) material infrastructures; geographical area dummies; and time dummies. The regressions in columns (5)-(10) control also for firm specific variables: total assets; firms' age; ROE; and for 2-digit NACE industry dummies. Detailed definitions of the variables are in Table A1. The table reports the regression coefficients and, in parentheses, the associated standard errors (clustered by province). *, **, *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Table 2: Parameters and Steady State

Panel A: External Parameters, Macroeconomy					
α	Return Elasticity to Knowledge	0.300			
θ	Inverse Price Markup	0.790			
λ	Population Growth	0.012			
Panel B: Targeted Parameters, Macroeconomy					
Parameters			Targets		
σ	Variety Externality	0.25	n	Rate of Entry	0.016
ϕ	Operating Cost	0.33	$g_{G/L}$	Output Growth Rate	0.020
ρ	Discount Rate	0.03	r	Real Interest Rate	0.050
β	Entry Cost	2.34	s	Saving Rate	0.108
Panel C: Agency Relationships					
Spinoffs					
Parameters			Targets		
b_J	Curvature	0.18	Σ	Spinoff Surplus	1.001
δ_J	Scale up Factor	0.10	S_J	Diversion	0.080
$\hat{b_J}$	Curvature	0.06	a	Investment Rate	0.050
$\hat{\delta_J}$	Scale up Factor	0.01	ω_J	Compensation	0.250
e	Manager's Efficiency	1.40	R^C	Conflictual/Non Confl.	0.223
R&D					
Parameters			Targets		
b_I	Curvature	0.95	q	Cost of Capital	0.987
δ_I	Scale up Factor	0.90	S_I	Diversion	0.080
h	Manager's Efficiency	1.48	ω_I	Compensation	0.250
Panel D: Steady State					
Macroeconomy			Governance		
z	Firm Growth Rate	0.016	R^S	Spinoff Ratio	0.255
x	Firm Size	1.873	R^m	Managers Compensation over Assets	0.002
$c = C/Y$	Consumption/Output	0.236			

Table 3: Strengthening of Investment Protection (S_I and/or S_J drop by half)

Panel A: $\Delta\delta_I$=0.0044									
Governance									
a	S_J	ω_J	S_I	ω_I					
0	0	0	-4	2.7366					
Macroeconomy									
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	0.0173	-0.0029	0	0	0	0.0169	-7.0133	-0.9331	0.0206
Long Run	0.0256	0	0.1069	0	0.0213	0.0256	-6.9888	7	0.0211
Panel B: $\Delta\delta_J$=0.0339									
Governance									
a	S_J	ω_J	S_I	ω_I					
0.0432	-4.0042	4.3	0.2	-0.1609					
Macroeconomy									
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	-0.0011	0.0012	0	0	0	-0.0009	-4.8699	0.251	0.0032
Long Run	-0.0047	0	-0.0459	0	-0.0092	-0.0047	-4.8915	0.2429	0.0032
Panel C: $\Delta\delta_I$=0.0044 and $\Delta\delta_J$=0.0339 (joint)									
Governance									
a	S_J	ω_J	S_I	ω_I					
0.0432	-4.0042	4.3	-3.8	2.5881					
Macroeconomy									
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	0.0163	-0.0016	0	0	0	0.016	-11.552	-0.7	0.0248
Long Run	0.021	0	0.0615	0	0.0123	0.021	-11.539	-0.7118	0.0248

Note: Percentage points variations; changes of x multiplied by 100.

Figure 1: Comparative Steady State and Variations in R&D Investment Protection

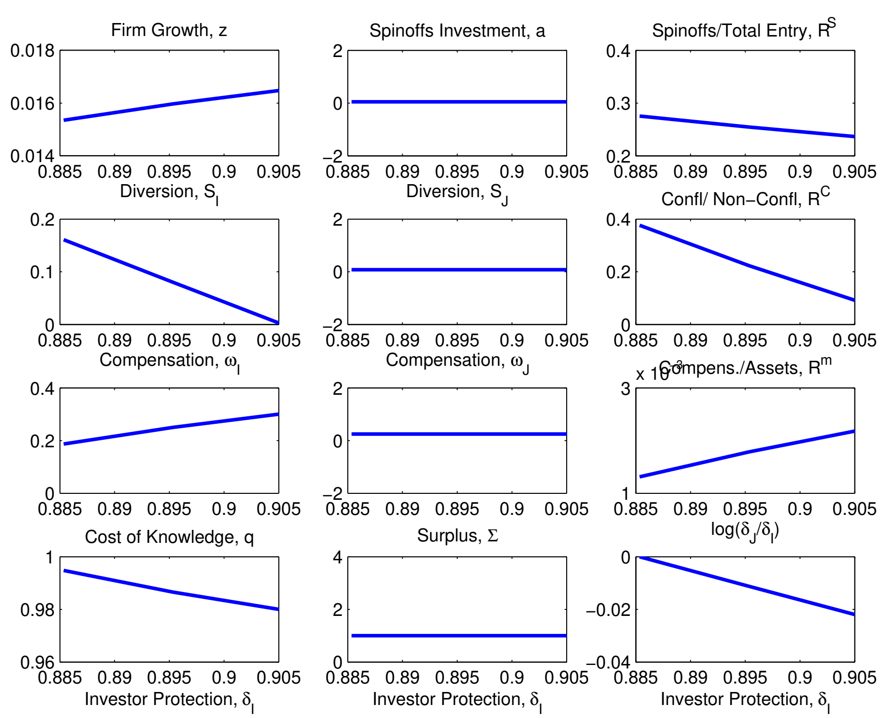


Figure 2: Comparative Steady State and Variations in Spinoff Investment Protection

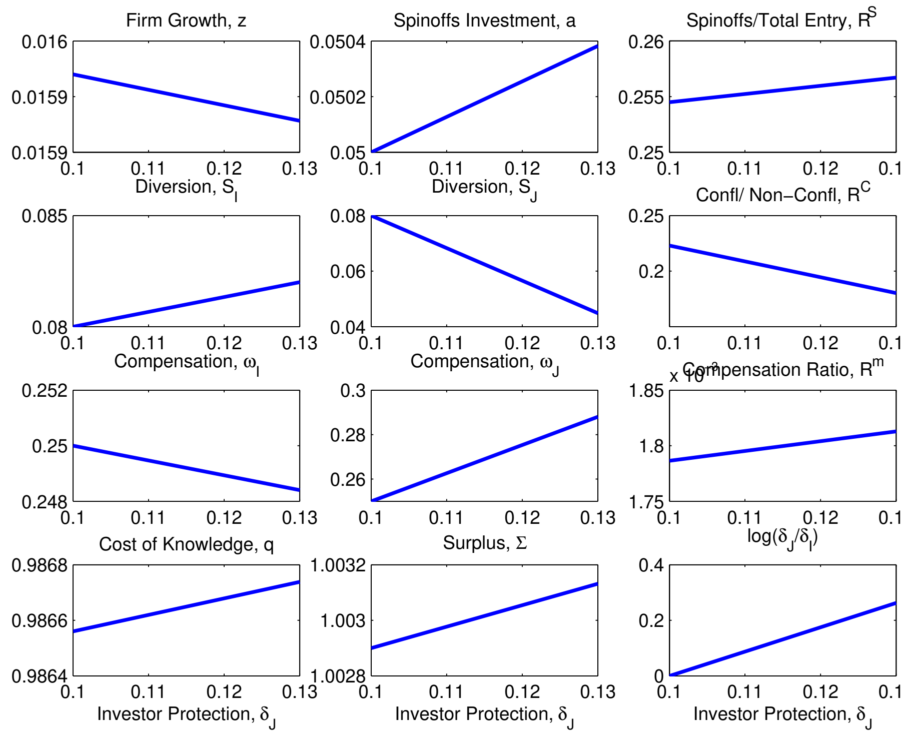


Figure 3: Comparative Steady State, Variations in Investment Protection for R&D and Spinoffs

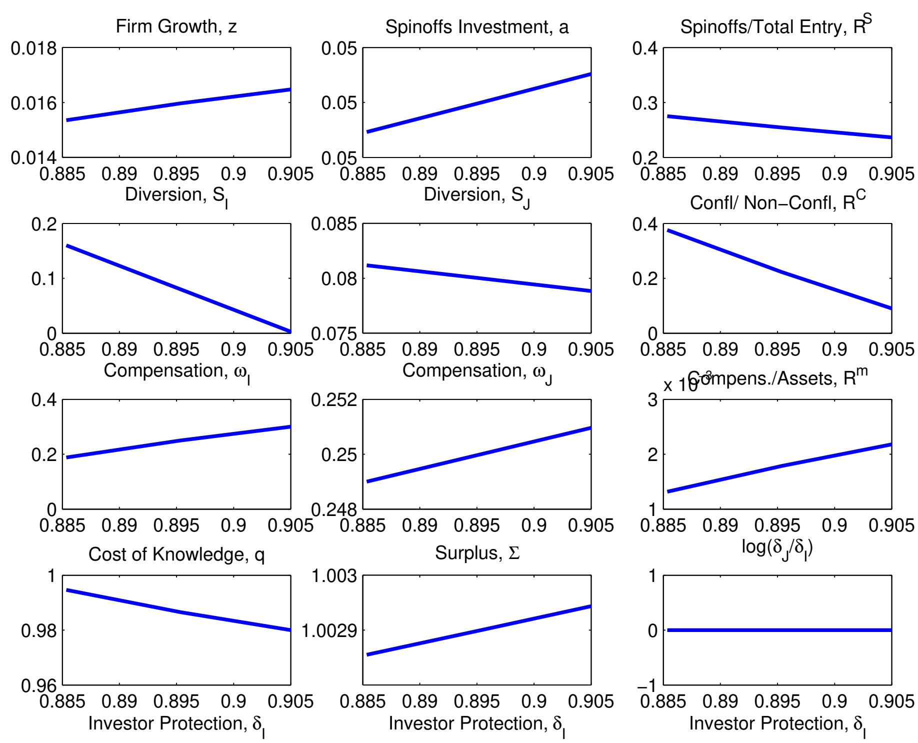
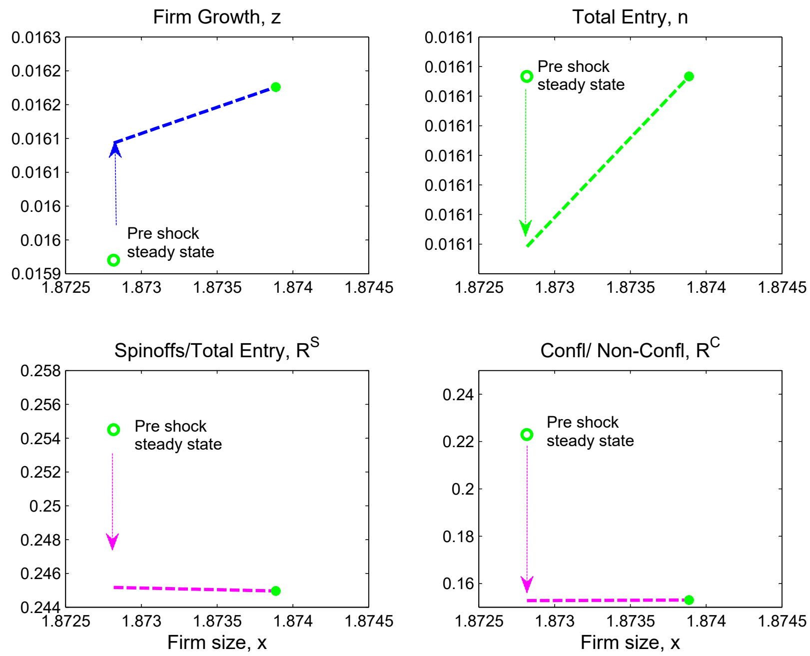
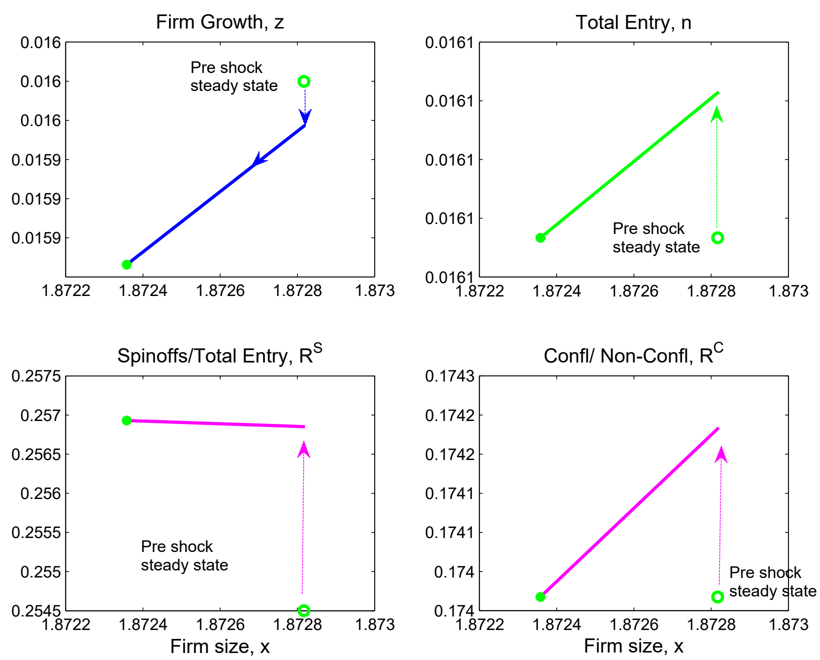


Figure 4: Policy Functions

Panel A: Shock to δ_I

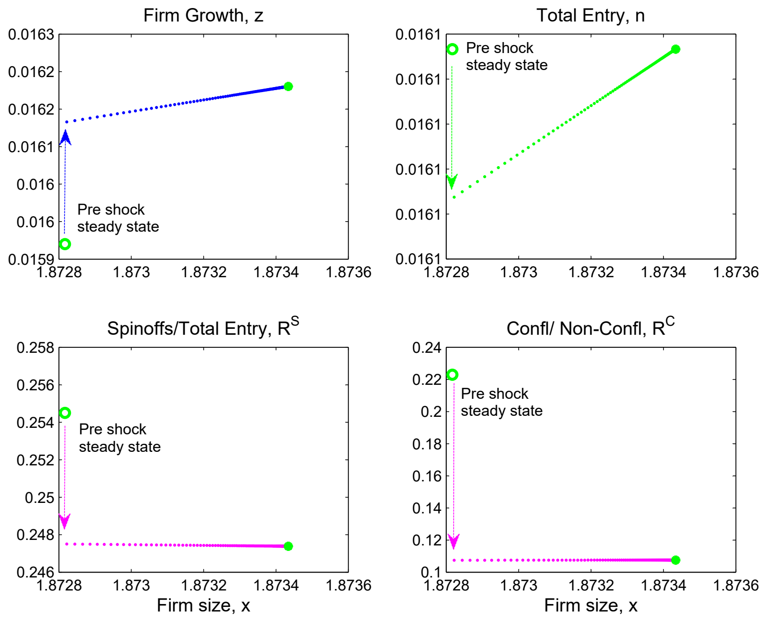


Panel B: Shock to δ_J



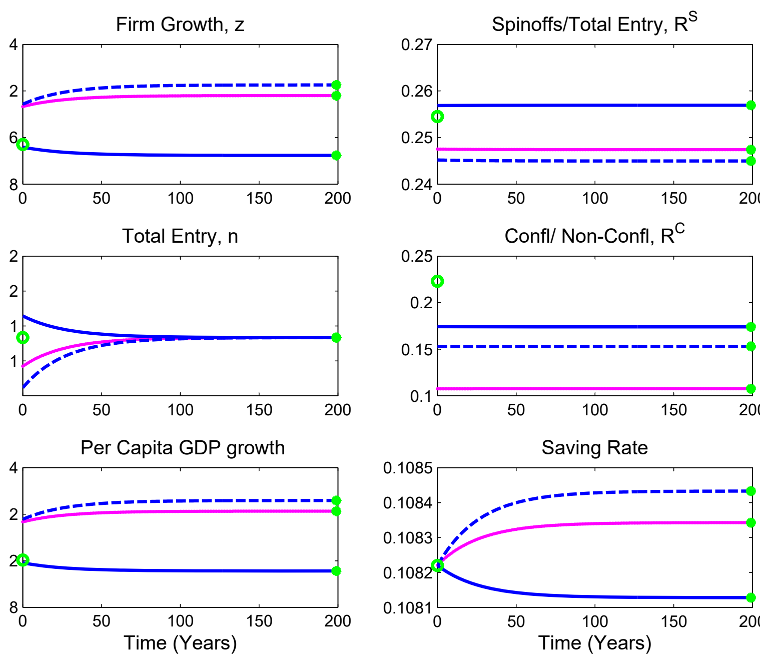
Note: In Panel A the shock to δ_I reduces S_I by half; in Panel B the shock to δ_J reduces S_J by half. See also Table 3.

Figure 5: Joint Shock to δ_I and δ_J (Policy Functions)



Note: In this figure the joint shock to δ_I and δ_J reduces both S_I and S_J by half.

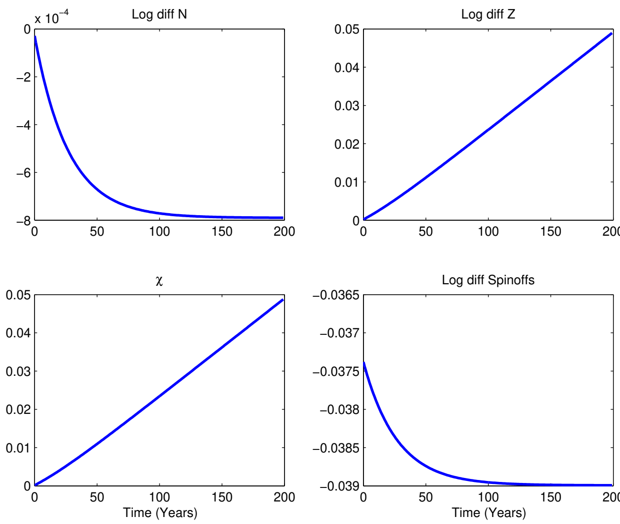
Figure 6: Time Series



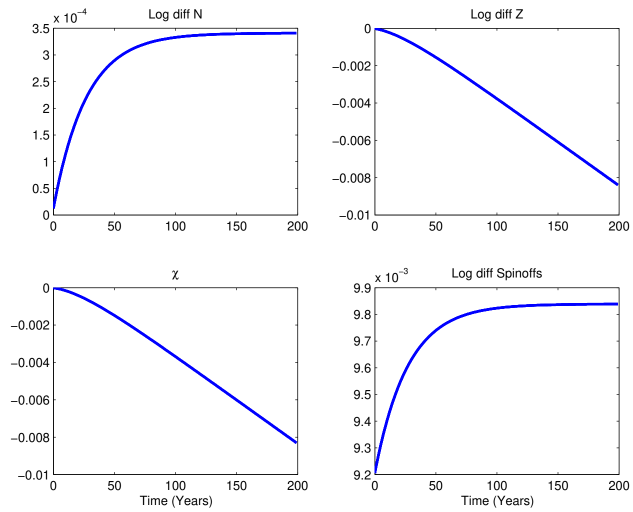
Note: Time series for the shock to δ_J (continuous lines), to δ_I (dashed lines), and joint shock (light colored lines). See also Table 3.

Figure 7: Welfare Analysis

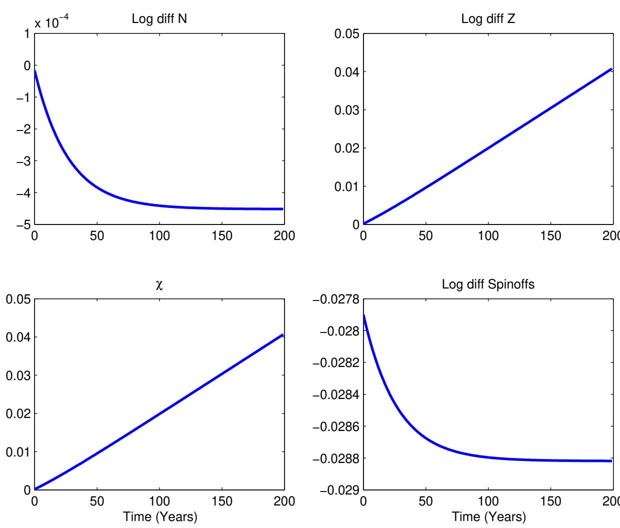
(a) R&D (shock to δ_I)



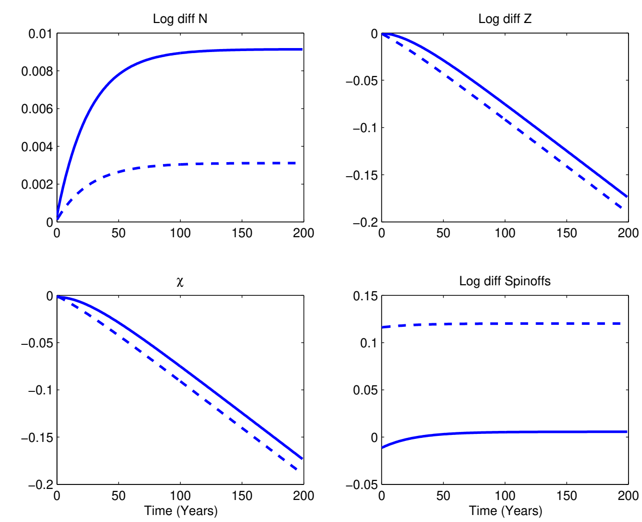
(b) Spinoffs (shock to δ_J)



(c) R&D and Spinoffs (shock to δ_I and δ_J)



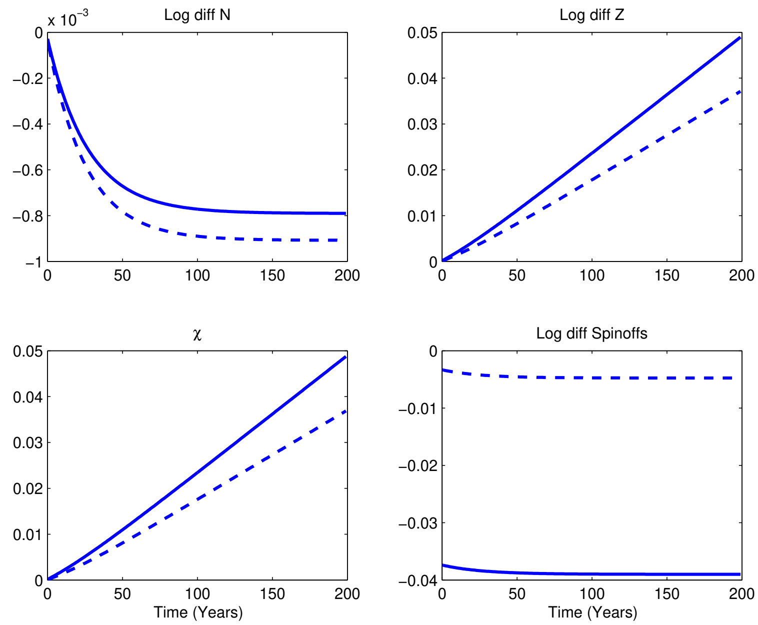
(d) Subsidy (shock to τ) and R&D (shock to δ_I)



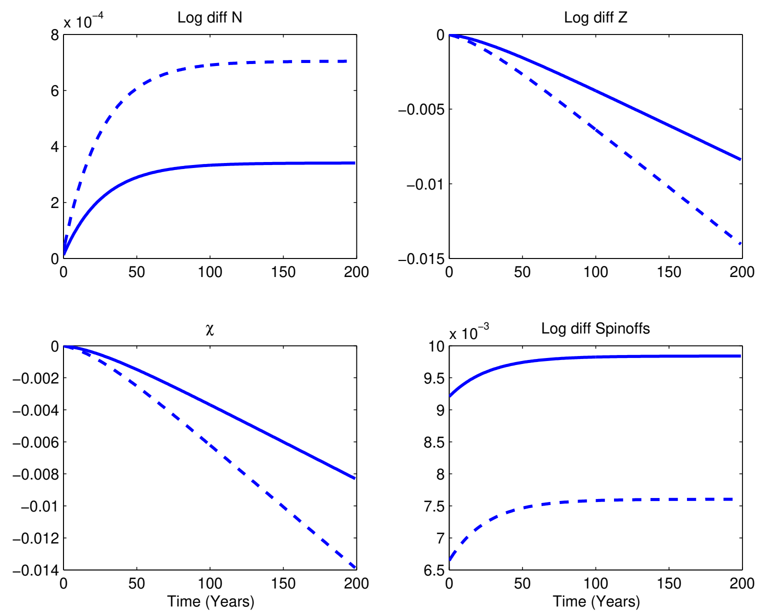
Note: Each panel plots, going clock-wise from the top, $\log(\tilde{N}/N)$, $\log(\tilde{Z}/Z)$, $\log(\tilde{N}^S/N^S)$, and the consumption equivalent welfare variable χ. In Panel D continuous lines refer to the subsidy shock and dashed lines to a reduction of δ_I.

Figure 8: Welfare Sensitivity Analysis

Panel A: R&D (shock to δ_I)



Panel B: Spinoffs (shock to δ_J)



Note: See note of Figure (7). The continuous lines refer to an economy with a value of e higher by 20% than the benchmark economy.

ONLINE APPENDIX

"Growing through Spinoffs. Corporate Governance, Entry, and Innovation"

This Online Appendix contains more details on data and data sources (A1), proofs omitted from the main text (A2), further details on the model extension with subsidies of Section 8 (A3), a discussion of the first best allocation (A4), and appendix tables and figures (A5).

A1. More Details on Data and Data Sources

Our main data sources are: the "Monitoraggio Economia e Territorio" (MET) survey of Italian firms, and the "Indagine sulle Imprese Manifatturiere", run by the Italian banking group UniCredit. We complement these main data sources with data of ISTAT on institutional and economic characteristics of the provinces; Bank of Italy data on the structure of Italian provincial banking sectors; and data of the Institute Guglielmo Tagliacarne for the quality of material infrastructures in the provinces.

The data regarding spinoffs are sourced from the MET survey, which surveys approximately 25,000 firms per wave, encompassing both corporations and partnerships. The sampling design aims to ensure representativeness at the industry, size, and region levels while also enabling oversampling of specific features of interest. In contrast to other Italian and European data sets, this survey includes information on firms of all sizes, including very small firms with fewer than ten employees. The key advantage of this survey is its coverage of a broad range of micro (1-9 employees) and small firms (10-49 employees) which have a critical role in the Italian economy and represent a significant share of Italian businesses. The MET survey is the largest firm survey conducted in a single European country.

Information on the share of innovative firms and on the share of firms with R&D investments in the provinces comes from the UniCredit survey. The UniCredit survey, which targets manufacturing firms within Italy, includes a representative sample of manufacturing firms with 10-500 employees (about 94% of the firms in the sample) and the universe of manufacturing firms with more than 500 employees (approximately 5,000 firms were interviewed in the survey). The firms in the survey represent about 9% of the population in terms of employees and 10% in terms of value added. Collected data include details about balance sheets, product and process innovation, R&D and other innovation variables, company characteristics and demographics, sources of finance, relationships with banks and mechanisms of information acquisition by banks. The surveyed firms have been in business on average for 22 years; 60% of them have fewer than 50 employees (less than 4% have more than 500 employees); 71% are based in the North. Only 1% are listed on the Stock Exchange, while 37% have balance sheets certified by external auditors.

A2. Proofs

A2.1 Founder's problem and Proposition 1

The Current Value Hamiltonian for the founder's problem is

$$CVH_i = [(1-a_i) + (e-\omega_{J_i})(1-S_{J_i})a_i][\Pi_i - I_i - \omega_{I_i} h(1-S_{I_i})I_i] + q_i\dot{Z}_i$$

subject to the three managers' reaction functions (12), (15), and (16), the one-to-one production technology for the intermediate good, and the R&D technology $\dot{Z}_i = h(1-S_{I_i})I_i$; q_i is the shadow value of knowledge accumulation. The first order conditions for ω_{I_i} and ω_{J_i} are

$$-\frac{\partial S_I(\omega_{I_i};\delta_I,h,e)}{\partial\omega_{I_i}}(q_i-\omega_{I_i}) = 1-S_{I_i}, \tag{A1}$$

and

$$(e-\omega_{J_i})(-\frac{\partial S_J(\omega_{J_i};\delta_J,e)}{\partial\omega_{J_i}})a_i + [(e-\omega_{J_i})(1-S_{J_i})]\frac{\partial a(\omega_{J_i};\hat{\delta}_J,e)}{\partial\omega_{J_i}} = (1-S_{J_i})a_i \tag{A2}$$

where the reaction functions $S_I(\omega_{I_i};\delta_I,h,e)$, $S_J(\omega_{J_i};\delta_J,e)$, $a(\omega_{J_i};\hat{\delta}_J,e)$ are derived from (12), (15), and (16). The optimal condition for in-house investment, I_i, is

$$(1-a_i) + (e-\omega_{J_i})(1-S_{J_i})a_i + \omega_{I_i}h(1-S_{I_i}) = q_ih(1-S_{I_i}). \tag{A3}$$

The combination of (A1) and (A3) gives

$$(1-S_{I_i})^2h = [(1-a_i)+(e-\omega_{J_i})(1-S_{J_i})a_i](-\frac{\partial S_I(\omega_{I_i};\delta_I,h,e)}{\partial \omega_{I_i}}).$$

The system consisting of the managers' and the founders' conditions (12), (15) and (16), (A1)-(A2), yield the solution $(S_{I_i}, S_{J_i}, a_i, \omega_{I_i}, \omega_{J_i})$. Such solution is time-invariant. It is also firm-invariant. Therefore, we drop the subscript i from the solution of the governance variables. We also drop the subscript i from q_i as this is also firm-invariant. Furthermore, q is constant: $\dot{q}=0$. Turning to the state variable, Z_i, we have that

$$r = \frac{\alpha}{q}\frac{\Pi_i}{Z_i}, \tag{A5}$$

where $q = \frac{\Sigma}{h(1-S_I)} + \omega_I$, with $\Sigma \equiv (1-a)+(e-\omega_J)a(1-S_J)$ (see A3). Equation (A5) corresponds to equation (25).

Resource Constraint and Household Budget Constraint

We show that the households' budget constraint reported in (33) can be derived from the economy's resource constraint. We have already argued that the governance solution is firm-invariant. We also use the general equilibrium symmetry property and omit the subscript i from the firm's variables. With these observations in mind, the economy's budget constraint is

$$C + C^m + N(X+\phi Q+(1-S_I)I+\dot{N}_F\frac{\beta X}{e}+\dot{N}_I\frac{\beta X}{e}+\dot{N}_J\frac{\beta X}{e})+\dot{N}^{ex-novo}\beta X = Y,$$

where on the left hand side we have, starting from the left, the households' consumption, the managers' consumption C^m, the production cost of intermediate firms, the outlays for spinoffs and the startup cost of ex-novo firms. Using (31), (8), (9), and (10) and the definition $F = \Pi - I - \omega_I h(1-S_I)I$, after some algebra, the above expression becomes

$$C+N\{[\omega_J e(1-S_J)a+eS_Ja]F+\omega_I h(1-S_I)I+eS_II\}+N[X+\phi Q+I+(1-S_F)aF+S_FaF]+\dot{N}^{ex-novo}\beta X = Y.$$

Making explicit the spinoff creation associated with resource diversion, we have

$$C+N[\omega_J e(1-S_J)aF+\omega_I h(1-S_I)I]+\dot{N}_I\beta X+\dot{N}_J\beta X+N[X+\phi Q+I+(1-S_F)aF+S_F aF]+\dot{N}^{ex-novo}\beta X = Y.$$

Using (5) the above relationship becomes

$$C + N[\omega_J e(1 - S_J)a]F + \omega_I h(1 - S_I)I] + N[\dot{N}_I\beta X + N\dot{N}_J\beta X]+$$
$$+N(X + \phi Q + I + (1 - S_F)aF + S_F aF) + \dot{N}^{ex-novo}\beta X = wL + NPX.$$

Subtracting variable and operating costs and investment outlays from both sides, after some algebra, we obtain

$$C + N(\dot{N}_I\beta X + \dot{N}_J\beta X) + \dot{N}^{ex-novo}\beta X = wL + NF(1 - a) - \omega_J e(1 - S_J)NaF.$$

Adding $N\dot{N}_F\beta X$ to both sides, and noticing that $\dot{N} = \dot{N}^{ex-novo} + N(\dot{N}_I + \dot{N}_J + \dot{N}_F)$, and that $\beta X = V$, we have

$$C + \dot{N}V = wL + N[(1 - a) + (e - \omega_J)(1 - S_J)a]F$$

which, using (20), reduces to

$$C + \dot{N}V = wL + N\Gamma.$$

Finally, combining this result with the entry arbitrage condition $r = \frac{\Gamma}{V} + \frac{\dot{V}}{V}$, the observation that $A = NV$ and that $\dot{A} = \dot{N}V + N\dot{V}$, delivers the houshehold budget constraint in (33):

$$\dot{A} = wL + rA - C.$$

Proposition 2 (Steady State)

The solution for x and z eqs. (42) ad (43) is the steady state firm size, x^* , and the in-house investment rate, z^*. The steady state entry rate n^* follows from setting $\dot{x} = 0$ in (46). The real interest rate r^* is computed through (37). The derivation of the expression for c^* in (44) is explained below.

Proposition 3 (Dynamic System)

The free-entry condition implies that $A = N\beta X$. Using the factor payments property (5) we have $A = \beta\theta^2 Y$ and $wL = (1-\theta)Y$. These results combined with budget constraint (33) and the Euler equation (34) yield

$$\frac{\dot{c}}{c} = \lambda - \rho - \frac{1}{\beta\theta^2}[(1-\theta) - c].$$

The unique solution of this unstable differential equation is

$$c^* = (1-\theta) - (\lambda - \rho)\beta\theta^2.$$

We obtain the growth rate of the firm size in (46) by log differentiation with respect to time of the two sides of (36).

We derive the entry rate, $n(x)$, from the economy's resource constraint. Specifically, starting from the result

$$C + \dot{N}V = wL + N\Gamma$$

(see section *Resource Constraint and Household Budget Constraint* of this Appendix), we use (20), (5), (7) and the free entry condition $\beta X = V$ to obtain

$$C + n\beta XN = (1-\theta)Y + [(1-a) + (e-\omega J)a(1-S)][N((P-1)X - \phi Z) - (\frac{1}{h(1-S_I)} + \omega_{I_i})zNZ].$$

Using the factor payment property $NPX = \theta Y$ and the definition $x \equiv \frac{X}{Z}$, we obtain

$$C + n\beta\theta^2 Y = (1-\theta)Y + [(1-a) + (e-\omega J)a_i(1-S)][\theta^2 Y((P-1) - \frac{\phi}{x}) - (\frac{1}{h(1-S_I)} + \omega_I)\frac{z}{x}\theta^2 Y].$$

Finally, dividing both sides by $\beta\theta^2 Y$ we get

$$n = [(1-a) + (e-\omega_J)a(1-S_J)][((P-1) - \frac{\phi}{x}) - (\frac{1}{h(1-S_I)} + \omega_I)\frac{z}{x}]\frac{1}{\beta} + \frac{(1-\theta)}{\beta\theta^2} - c\frac{1}{\beta\theta^2},$$

and, replacing c with its equilibrium solution $(1-\theta) - (\lambda - \rho)\beta\theta^2$, we have the expression in (47), reported here for convenience:

$$n = \frac{\Sigma}{\beta}[(\frac{1}{\theta} - 1 - \frac{\phi}{x}) - (\frac{1}{h(1-S_I)} + \omega_I)\frac{z}{x}] + (\lambda - \rho)$$

with $\Sigma \equiv (1-a) + (e - \omega_J)a(1 - S_J)$.

Turning to z, we combine the two arbitrage conditions (38) and (37) and obtain

$$\frac{\Sigma}{\beta}[(\frac{1}{\theta} - 1) \ - \frac{\phi}{x} - (\frac{1}{h(1-S)} + \omega_I)\frac{z}{x}] + \frac{\dot{x}}{x} + z = \frac{\alpha}{q}[\left(\frac{1}{\theta} - 1\right) x - \phi]$$

where we recall that $q = \frac{\Sigma}{h(1-S_I)} + \omega_I$. Using (47) and the definition of x in (36) the above expression becomes

$$n - (\lambda - \rho) + (\sigma - 1)n + \lambda + z = \frac{\alpha}{q}[\left(\frac{1}{\theta} - 1\right) x - \phi]$$

that is

$$z = \frac{\alpha}{q}[\left(\frac{1}{\theta} - 1\right) x - \phi] - \sigma n - \rho.$$

Finally, this equation and (47), after some algebra, yield (48), that is

$$z(x) = \frac{1}{1 - \frac{\sigma\Sigma}{\beta x}(\frac{1}{h(1-S_I)} + \omega_I)}\{(\frac{\alpha}{q} - \frac{\sigma\Sigma}{\beta x})[\left(\frac{1}{\theta} - 1\right) x - \phi] - \rho(1-\sigma) - \sigma\lambda\}.$$

The solution assumes a value of x sufficiently large that entry and in-house innovation are both active, that is, the equity and internal return, (38) and (37), are equal to the return on saving (34). If $r_Z < r = r_N$, that is

$$\frac{\alpha}{q}[\left(\frac{1}{\theta} - 1\right) x - \phi] < \frac{\Sigma}{\beta x}[(\frac{1}{\theta} - 1)x \ - \phi] + (\sigma - 1)n + \lambda$$

$z = 0$, and $n > 0$. We then assume that the initial condition $x(0) > x_Z$ where

$$\arg solve_{x_Z} = \{(\frac{\alpha}{q} - \sigma\frac{\Sigma}{\beta x}) \times [\left(\frac{1}{\theta} - 1\right) x - \phi] = (1-\sigma)\rho + \sigma\lambda\}$$

Similarly, equation (47) implies that a sufficient condition for $n(x) > 0$ is that

$$x(0) > x_N \equiv \frac{\phi}{(\frac{1}{\theta} - 1) + (\lambda - \rho)\frac{\beta}{\Sigma}}.$$

A3. Model Extension: Entry and R&D Subsidies

This section gives additional details on how key equations of the baseline model are to be modified to incorporate the role of a government that collects a labor tax on labor τwL and that uses the proceeds to subsidize the creation of new firms or to subsidize R&D. The dynamic arbitrage entry conditions (38) becomes

$$r = r_N \equiv \frac{\Sigma}{\beta(1-\gamma)x}[(\frac{1}{\theta} - 1)x \ - \phi - (\frac{1}{h(1-S_I)(1+\xi)} + \omega_I)z] + \frac{\dot{x}}{x} + z. \tag{61}$$

The expressions for the return on innovation and on savings are the same as in (37) and (34), respectively, except that the expression for q now is:

$$q = \frac{\Sigma}{h(1-S_I)(1+\xi)} + \omega_I$$

Combining (61) with (37), (34), and (57), and with the aggregate resource constraint gives the following dynamic system (when both entry and innovation are active)

$$\frac{\dot{c}}{c} = \frac{1}{\beta(1-\gamma)\theta^2}[(1-\theta)(1-\tau) - c] - (\lambda - \rho),$$

$$n = \Sigma[((P-1) - \frac{\phi}{x}) - (\frac{1}{h(1-S_I)(1+\xi)} + \omega_I)\frac{z}{x}]\frac{1}{\beta(1-\gamma)} + \frac{(1-\theta)}{\beta(1-\gamma)\theta^2} - \frac{c}{\beta(1-\gamma)\theta^2}$$

$$z = \frac{\alpha}{q}[\left(\frac{1}{\theta} - 1\right)x - \phi] - \sigma n - \rho.$$

Combining the previous two equations we get:

$$z = \frac{1}{\psi}\{(\frac{\alpha}{q} - \frac{\sigma}{\beta(1-\gamma)}\frac{\Sigma}{x})[\left(\frac{1}{\theta} - 1\right)x - \phi] - \rho - \frac{\sigma}{\beta(1-\gamma)\theta^2}(1-\theta-c)\},$$

where $q = \frac{\Sigma}{h(1-S_I)(1+\xi)} + \omega_I$, $\psi \equiv 1 - \frac{\sigma\Sigma}{\beta(1-\gamma)x}(\frac{1}{h(1-S_I)(1+\xi)} + \omega_I)$.

The evolution of x is characterized by the expressions in (46) of Proposition 1, that for convenience we report here:

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

The dynamics of this extended model differ from the baseline because the consumption-output ratio, c, is no longer time-invariant as the tax rate τ in general depends on the firm size x. Also, under an alternative tax-subsidy scheme in which the government fixes τ and allows the subsidy γ to adjust, c would still depend on x through γ. In our quantitative experiments, however, the consumption-output ratio, c, is nearly constant, that is the saddle path is nearly flat in the (x, c) space.

A4. First Best Allocation

Several features of the economy suggest that the decentralized equilibrium can be significantly different from the planner's allocation. Detailing a social planner solution is beyond the scope of the current analysis. Nevertheless, the welfare analysis already shed some light on what type of government interventions is more likely to approach the first best allocation. The decentralized equilibrium is characterized by three kinds of inefficiencies. One source of inefficiency is the monopolistic price, which reduces the flow of intermediate products and hence of final output, given the state of the technology. None of the reforms or policy interventions we considered corrects for this distortion. Second, because each intermediate firm benefits from a knowledge externality, the amount of R&D resources invested by incumbents is below that of the first best. The R&D subsidies considered in the extended economy, which are financed through non-distortionary taxes, partly correct such distortion. But also an improvement of the R&D governance (δ_I) helps to get closer to the first best. In other words, R&D agency issues tend to push the decentralized economy away from the first best allocation. A third source of inefficiency can be excessive entry. On the one hand a new firm tends to raise productivity through variety expansion. On the other hand it consumes set up resources, and more importantly, it requires a continuous flow of resources for its operation. A social planner may find it optimal not to allow entry if the social variety σ is sufficiently small. Further, this would have the advantage of increasing the size of existing firms and thus increase the social return on R&D. However, if the social planner determines that it is optimal to allow some entry (i.e. if σ is sufficiently high), it would privilege spinoffs, as these allow a more efficient use of existing knowledge.

A5. Appendix Tables and Figures

Table A1: Variables Definitions and Data Summary Statistics

Variable	Definition	Mean	Std dev
Main variables			
Spinoff rate	Percentage ratio in province between spinoffs (firms in which the founders of the firm were previously managers or employees of incumbent firms operating in the sector) and total entrants.	0.248	0.324
Innovation probability	Dummy variable equal to one if the firm reports to have realized innovations aimed at product improvement over the three years covered by the survey, zero otherwise.	0.640	0.482
R&D/Sales	R&D investments scaled by total sales.	0.041	0.019
Consensual spinoff	Dummy variable equals to one if the firm reports to have realized a consensual spinoff over the three years covered by the survey, zero otherwise.	0.035	0.184
Consensual/Total spinoffs	Ratio between consensual and total spinoff in the province.	0.753	0.618
Trial length	Average duration of the trials in the courts located in the province.	0.630	0.226
Clearance rate	Ratio between the total number of incoming cases by the total number of outgoing cases.	0.829	0.224
Other variables			
Unemployment rate (log)	Logarithm of provincial unemployment rate.	2.030	0.587
Population growth	Growth rate of population in province.	0.003	0.005
Bank branches density	Number of bank branches in province, per 1,000 inhabitants.	0.547	0.193
Bank concentration (HHI)	Herfindahl-Hirschman index of bank branches in province.	0.101	0.054
Trade openness (log)	Logarithm of ratio of trade to GDP in province in 2001.	-1.238	0.930
Material infrastructures (log)	Index (0-100) of material infrastructures in province. Infrastructures: Road Network, Railways, Ports, Airports, Environmental Energy Networks, Broadband Services, Business Structure.	4.473	0.440

Note: This table reports definitions and summary statistics for the variables used in the analysis.

Table A2: Robustness and Further Sensitivity ($\hat{\delta_J}$ 50% higher)

Panel A: $\Delta\delta_I$=0.0044									
				Governance					
a	S_J	ω_J	S_I	ω_I					
0	0	0	-4.3	2.774					
				Macroeconomy					
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	0.0171	-0.0028	0	0	0	0.0167	-7.6707	-0.9897	0.0209
Long Run	0.0251	0	0.1034	0	0.0205	0.0251	-7.6651	-1.0104	0.0215
Panel B: $\Delta\delta_J$=0.0339									
				Governance					
a	S_J	ω_J	S_I	ω_I					
0.0665	-4.873	5.1	0	-0.0024					
				Macroeconomy					
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	-0.0002	0.0003	0	0	0	0	-5.9119	0.3104	0.0061
Long Run	-0.0011	0	-0.0119	0	-0.0024	-0.0011	-5.9159	0.3125	0.006
Panel C: $\Delta\delta_I$=0.0044 and $\Delta\delta_J$=0.0339 (joint)									
				Governance					
a	S_J	ω_J	S_I	ω_I					
0.0665	-4.873	5.1	-4.3	2.7713					
				Macroeconomy					
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	0.0169	-0.0024	0	0	0	0.0166	-13.1004	-0.6787	0.0276
Long Run	0.024	0	0.0916	0	0.0181	0.024	-13.096	-0.6973	0.0281

Note: Percentage points variations; changes of x multiplied by 100.

Table A3: Robustness and Further Sensitivity ($1-\alpha = 0.35$)

Panel A: $\Delta\delta_I$=0.0044									
				Governance					
a	S_J	ω_J	S_I	ω_I					
0	0	0	-4	2.7366					
				Macroeconomy					
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	0.0229	-0.0028	0	0	0	0.0226	-13.6133	-1.8478	0.0303
Long Run	0.0343	0	0.1237	0	0.0217	0.0343	-13.5875	-1.8683	0.031
Panel B: $\Delta\delta_J$=0.0339									
				Governance					
a	S_J	ω_J	S_I	ω_I					
0.0432	-4.0042	4.3	0.2	-0.1609					
				Macroeconomy					
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	-0.0014	0.0013	0	0	0	-0.0013	-5.1758	0.2808	0.0028
Long Run	-0.0067	0	-0.0578	0	-0.0102	-0.0067	-5.2005	0.2894	0.0025

Note: Weaker knowledge externalities. In the baseline case (Table 3, Panels A and B) $1-\alpha = 0.7$.

Table A4: Entry Subsidy and Easying Spinoffs

Panel A: $\Delta\tau$=0.1%									
Governance									
a	S_J	ω_J	S_I	ω_I					
0	0	0	0	0					
Macroeconomy									
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	-0.0045	0.0337	0	-0.0233	0.0881	0.0001	-0.0426	-0.2947	0.0014
Long Run	-0.0996	0	-1.2325	-0.0443	-0.0808	-0.0996	-0.6431	-0.0886	-0.0043
Panel B: $\Delta\delta_I$=-0.0156 (1.75% drop)									
Governance									
a	S_J	ω_J	S_I	ω_I					
0	0	0	12	-9.7358					
Macroeconomy									
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	-0.0671	0.0113	0	0	0	-0.0656	23.8709	3.1327	-0.0718
Long Run	-0.099	0	-0.4203	0	-0.0842	-0.099	23.2896	3.1637	-0.0729

Note: Percentage points variations; changes of x multiplied by 100.

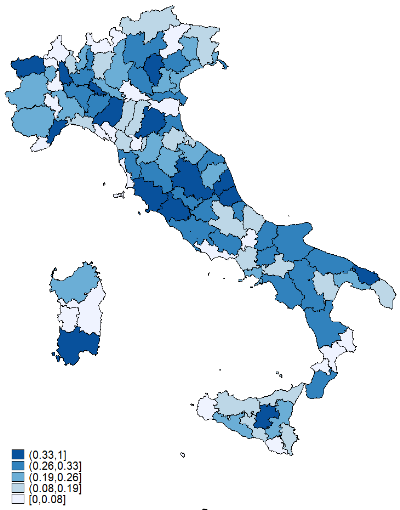
Table A5: R&D Subsidy and Stronger R&D Investment Protection

$\Delta\xi$=0.34%									
Governance									
a	S_J	ω_J	S_I	ω_I					
0	0	0	0	-0.0847					
Macroeconomy									
	z	n	x	c	s	r	R^C	R^S	R^m
Impact	0.0174	-0.0029	0	-0.0003	0.0011	0.017	0.1105	0.0404	0.0003
Long Run	0.0256	0	0.1062	-0.0003	0.0223	0.0256	0.1612	0.0223	0.0008

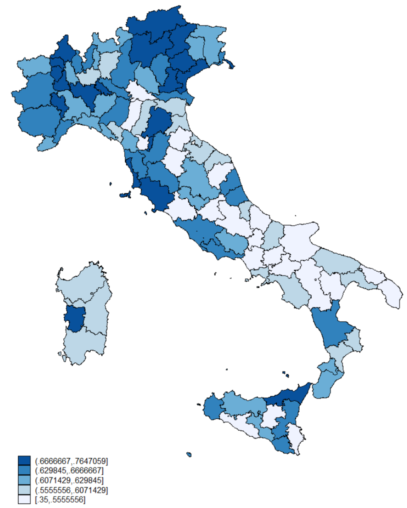
Note: Percentage points variations; changes of x multiplied by 100. Compare with the results in Table 3, Panel A.

Figure A1: Spinoffs, Innovation and Judiciary in Italy

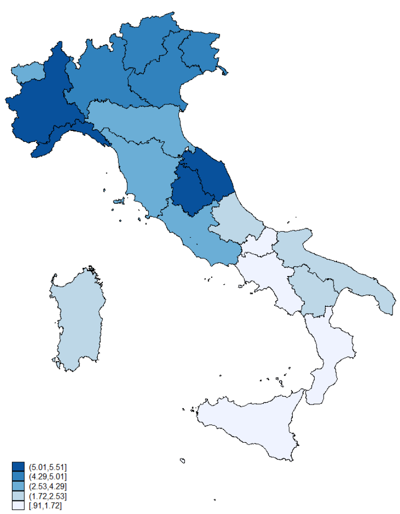
(a) Spinoff Rate



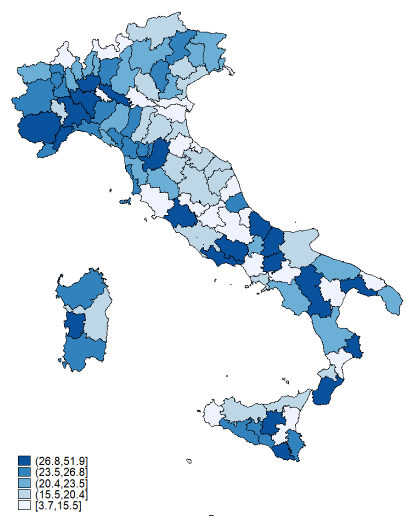
(b) In-house Innovation Intensity



(c) R&D Workers

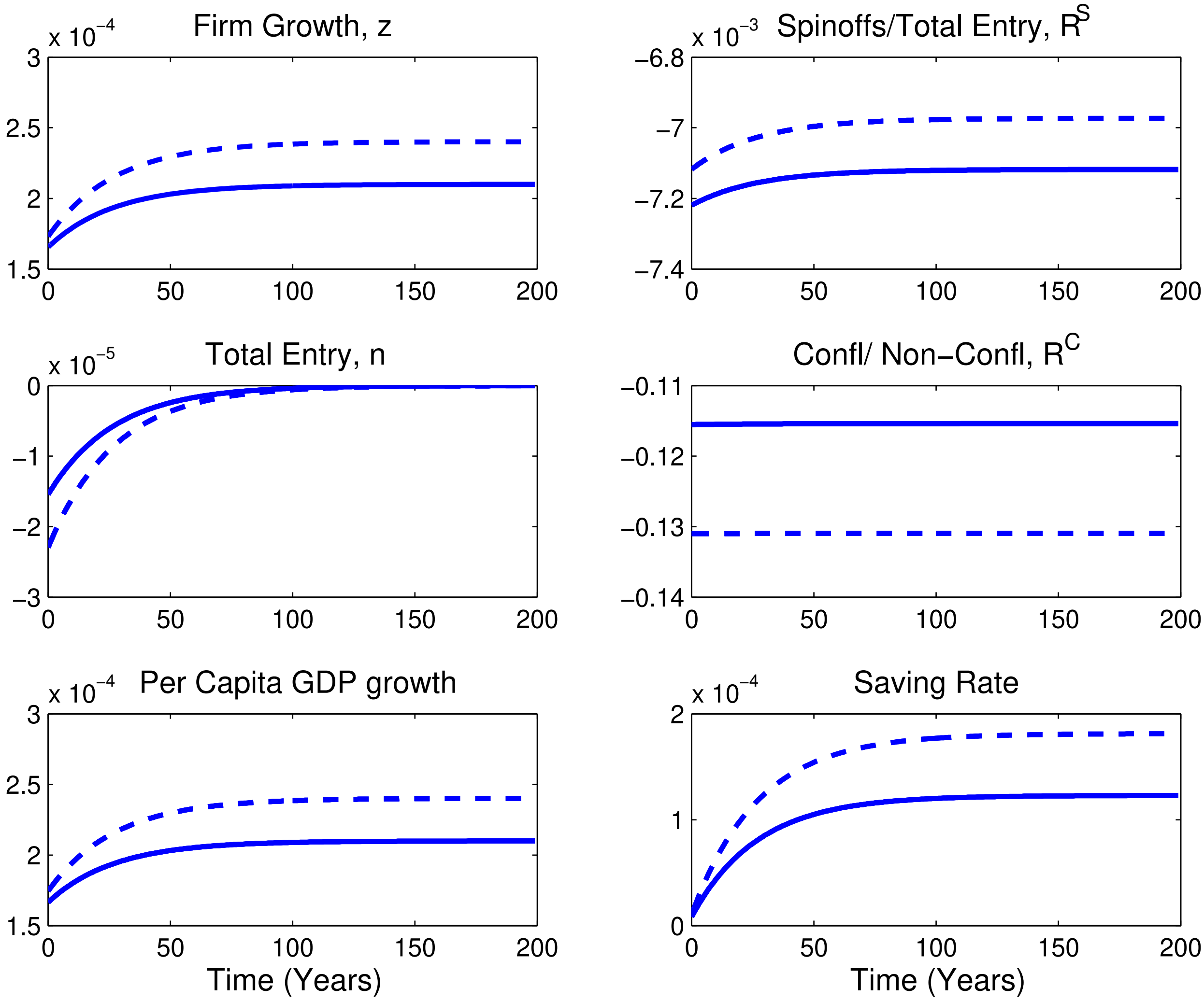


(d) Cost of Judiciary



Note: The maps display the spinoff rates drawn from the "Rilevazione sul Sistema delle Start-up Innovative", a survey of start-ups carried out by the Italian Ministry of Economic Development (Panel A), innovation intensities sourced from the "Survey of Italian Manufacturing Firms" conducted by the Italian banking group UniCredit (Panel B), the number of R&D workers over population using data from the survey of innovative firms conducted by ISTAT (Panel C), and the cost of accessing courts from ISTAT (Panel D) in Italian provinces (Panels A, B and D) or regions (Panel C). See Section 3 for detailed definitions.

Figure A2: Robustness Analysis



Note: Joint shock to δ_I and δ_J. The continuous lines represent the response of the baseline economy. The dashed lines represent the response of an economy with $\hat{\delta}_J$ 50% higher than the baseline economy. They are differences with respect to relevant pre-shock steady state values.

Figure A3: Entry Subsidy (Policy Functions)