Equity Frictions and Firm Ownership

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Abstract

In this paper, I document systematic heterogeneity in ownership and financing of firms across Eurozone countries. To rationalize these differences, I build a quantitative general equilibrium model of workers and entrepreneurs who choose debt and equity financing of their firms, subject to rich country-specific financial frictions. The novel data on firm ownership and financing, combined with the structure of the model, allows me to quantify the level of debt and equity frictions in each country. Quantitatively, I find much larger output effects from equity frictions: harmonizing them across countries would lead to nearly four times larger output effects compared to debt frictions, and removing them would increase aggregate output by 73% more. The larger impact on output is due not only to the estimated levels and dispersion of equity frictions but also to the greater risk sharing provided by equity, which further incentivizes entrepreneurs to expand their firms. Through their effect on risk sharing, equity frictions also rationalize the observed negative relationship between equity financing and wealth inequality. Quantitatively, they are responsible for over 70% of the explained variation in top wealth shares across countries.

KEYWORDS: financial frictions, entrepreneurship, aggregate output, wealth inequality

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1 Introduction

People ultimately own firms. Yet most quantitative models of entrepreneurship assume that large, corporate firms are dispersedly held and face no financing constraints. That benchmark view overlooks a key reality: in many countries, even large firms remain closely held, with entrepreneurs' wealth and firm financing decisions deeply intertwined. Who owns firms and how ownership is shared between insiders and outside investors is not merely a detail of corporate structure. It shapes how entrepreneurs finance their businesses, who bears risk, and ultimately how household wealth is distributed and how much output is produced.

This paper documents systematic cross-country differences in the distribution of firm ownership and the manner in which entrepreneurs finance their investments. In Austria, entrepreneurs directly own nearly 90% of total firm equity. In the Netherlands, that number is only 25%, suggesting that financing and risk exposure are shared much more broadly across households. To interpret these patterns and quantify their macroeconomic implications, I develop a quantitative model of heterogeneous workers and entrepreneurs who can finance investment not only with debt but also by issuing equity. Entrepreneurs make these choices in the presence of financial market frictions, which give rise to an endogenous distribution of firm ownership. Combined with new microdata on firm financing and ownership, the model allows me to quantify the level of debt and equity frictions in each country.

Across countries, the risk-sharing properties of equity financing rationalize the empirical relationship between firm ownership and the wealth distribution. I document that in countries with more equity and less debt financing, entrepreneurs hold a smaller share of aggregate wealth, and overall wealth inequality across households is lower. The model replicates this relationship, even though increased access to equity financing enables entrepreneurs to operate larger businesses with higher revenues. Quantitatively, the model explains three-quarters of the differences in wealth inequality across Eurozone countries, with financial frictions and firm productivity responsible for 73% of that variation.

The paper's main contribution is to assess the aggregate and distributional consequences of deviations from Modigliani and Miller (1958) as identified by a rich quantitative model matched to new data. Relative to the finance literature (Cooley and Quadrini (2001); Begenau and Salomao (2018); Hennessy and Whited (2007)), firms in this model are owned by risk-averse insiders, in line with the facts I document. Relative to the entrepreneurship literature (Buera and Shin (2008); Midrigan and Xu (2014); Cagetti and DeNardi (2006)), I endogenize the size of the entrepreneurial sector by modeling the choice to issue outside equity in addition to debt. Doing so allows me to rationalize the observed distribution of firm ownership and to generate new insights into the importance of equity frictions for aggregate output and the distribution of wealth.

I begin by combining microdata on households, firms, and their shareholders to document new facts on firm ownership and financing across Eurozone countries. Even in publicly traded firms, company insiders typically own a large share of the equity. I define insiders as the three individuals with the largest shares of the company, identified by tracing the multi-level ownership structures of public firms.

On average across countries and firms, the share of equity held by insiders is 40%.[1] Consequently, I measure a country's outside equity share as the fraction of public equity that is not held by insiders.

Across European countries, there is significant variation in the outside equity share: ranging from 10% in Austria to 50% in France, and up to 75% in the Netherlands. Differences in debt financing across countries are notable, yet smaller: aggregate leverage ranges from 43% in Belgium to 63% in Italy. I further present suggestive evidence that the extent to which firms rely on debt and equity correlates with the quality of legal debtor and investor protection, respectively. Lastly, I find that in countries with more debt and less equity financing, entrepreneurs hold a larger share of aggregate wealth, and overall wealth inequality in the population is higher.

Motivated by these facts, I propose a theory of entrepreneurship subject to country-specific frictions in debt and equity markets. I develop a quantitative model of a Bewley-Imrohoroglu-Huggett-Aiyagari economy, augmented to include production by entrepreneurial firms that have access to three types of financing: inside equity, debt, and outside equity. Workers supply labor to entrepreneurs; both workers' skill and entrepreneurs' productivity are subject to idiosyncratic risk. Entrepreneurs can either run a private firm and finance it with debt and inside equity or choose to go public and issue additional outside equity. If they go public, entrepreneurs also decide on the ownership structure of their firm, i.e., the fraction of firm equity to sell to outside investors. The size of the entrepreneurial sector is therefore endogenous, and publicly traded firms have entrepreneurial origins and are run by risk-averse insiders.

The extent to which firms rely on either type of external finance depends on three financial market frictions. First, the costs of going public, such as underwriting fees, are modeled as a fixed IPO cost. Second, selling equity leads to a separation of ownership and control of the firm. Resulting agency frictions between company insiders and outsiders are captured by a proportional cost that scales with the share of outside equity. Third, debt issuance is limited by a standard maximum leverage constraint. The choice to go public, as well as the share of equity sold to outsiders, depends on an entrepreneur's wealth, productivity, and the three financial frictions. The lower an entrepreneur's wealth and the higher their productivity, the greater their benefit from external finance and risk sharing, and the more likely they are to sell outside equity. At the same time, the lower the frictions in debt markets, the less entrepreneurs rely on equity for external finance. The resulting mapping between financial frictions and the distribution of leverage and outside equity underpins my quantitative strategy.

I use the model in conjunction with the data moments on firm ownership and financing to infer the level of financial frictions in France, Germany, Austria, and the Netherlands. The four countries were chosen to span the range of equity ownership across Europe. The shares of equity in private firms, the insider share of public firms, and aggregate leverage, together with the firm size distribution, enable me to determine the levels of the three financial frictions and the distribution of entrepreneurial productivity. To match each country's savings position vis-à-vis the rest of the world, I set the discount factor to match each country's net foreign asset position. The quantitative model fits the data along several important

[1] I show further that privately held firms in Europe are typically held by one single shareholder.

non-targeted dimensions. For instance, it reproduces the observed positive relationship between outside equity and firm size, as well as the share of wealth held by entrepreneurs and the differences in top wealth inequality across countries.

My results imply heterogeneity in equity and debt frictions across European countries. The share of firm assets that can be collateralized in debt markets ranges from 49% in the Netherlands to 63% in Germany. The fixed cost of going public is estimated at 7% of the median firm value in Germany and close to zero in Austria and the Netherlands. Any equity held by outsiders incurs a monitoring cost of up to 12% in Austria, 5% in Germany, and again close to zero in the Netherlands.

Using the quantified model, I show two main results. First, frictions in equity markets have a much larger impact on aggregate output than frictions in debt markets. Theoretically, increasing access to either kind of external finance allows productive entrepreneurs to increase investment in their firms and hire more workers. When this external finance comes in the form of equity, investment, and hence aggregate output is further boosted because, as entrepreneurs share more of the associated risk, they are willing to invest more in their firms. Quantitatively, harmonizing equity market frictions to the French level has a nearly four times larger effect on steady-state output than harmonizing frictions in debt markets. Not only is dispersion in equity frictions greater, but their level is also higher: Across the four countries, frictionless equity markets would lead to a 73% higher increase in aggregate output than frictionless debt markets.

Although the model somewhat overstates the absolute level of inequality, it explains 73% of the observed cross-country variation in top 10% wealth shares and correctly predicts the ranking of countries. Austria and Germany, where outside equity is limited, exhibit the highest wealth concentration, whereas the Netherlands, with widely dispersed equity ownership, has a more compressed distribution. Financial frictions, along with the estimated distribution of firm TFP, account for nearly three-quarters of the variation in inequality in the model.

As in the data, countries with lower debt frictions and higher equity frictions have a higher share of wealth held by entrepreneurs, and, consequently, a higher degree of wealth inequality. As in Cagetti and DeNardi (2006), there is an equality-efficiency trade-off with debt frictions: better access to debt allows entrepreneurs to increase investment in the firm, leading to higher output and greater wealth concentration. This trade-off is not present with equity. While output is also higher when access to outside equity is cheaper, wealth inequality is lower since entrepreneurs are better able to share risk. This final result highlights the importance of explicitly considering firm ownership decisions and incorporating equity frictions into models of entrepreneurship and macro models that aim to match the distribution of wealth across households.

1.1 Related Literature

This paper bridges two strands of the literature: the literature on the macroeconomic consequences of entrepreneurship and the literature on firms' capital structure in the presence of financial frictions. The former literature, pioneered by Evans and Jovanovic (1997), includes applications to development

and growth (Buera, Kaboski, and Shin (2011); Buera and Shin (2008, 2011); Moll (2014)), private businesses in the US (Bhandari and McGrattan (2020)), and wealth inequality (Quadrini (2000); Meh (2005); Cagetti and DeNardi (2006); Tan (2021); Irie (2025)). Models in this literature typically assume that entrepreneurs own 100% of the equity in their businesses and have access to debt financing only.[2,3] I add to this literature by endogenizing the size of the entrepreneurial sector via frictions in equity markets and by demonstrating that these novel frictions have first-order implications for aggregate output and the distribution of wealth.

There is a large macro-finance literature on the optimal capital structure of firms (Cooley and Quadrini (2001); Hennessy and Whited (2007); Jermann and Quadrini (2012); Begenau and Salomao (2018)). Firms are typically modeled as run by risk-neutral investors who choose debt and equity issuance, subject to the tax advantages of debt, as well as floatation costs, adverse selection premia, or other reduced-form costs of issuing outside equity. Relative to the tradition in this literature, I model publicly traded firms as run by risk-averse insiders who value equity over debt financing for its risk-sharing properties. This is motivated by my empirical findings of the importance of insider shares even in publicly traded firms.

Because of its focus on the decision to issue outside equity, this paper also relates to the finance literature on IPOs. Some elements of the key trade-off I consider – diversification benefits vs. the cost of separating ownership and control – are present in the literature, but to the best of my knowledge, this paper is the first to study the effects of this trade-off on aggregate output and the wealth distribution. The nature of the trade-off is most similar to Pastor, Taylor, and Veronesi (2009) and Chen, Miao, and Wang (2010).[4] Albuquerque and Wang (2008) develop a stochastic general equilibrium model to study the effect of investor protection on firm investment and return volatility. In their model, firms are entirely equity-financed, and the split between inside and outside equity is a fixed parameter. In this paper, the split between debt, inside equity, and outside equity is an endogenous choice that depends on financial frictions reflecting a country's legal and institutional environment.

One of the main contributions of this paper is to offer a quantitative evaluation of the importance of financial frictions across countries. By using a structural model to back out the level of these frictions, it complements the literature on law and finance, pioneered by LaPorta, Lopez-de Silanes, Shleifer, and Vishny (1998). Their objective is to construct indices measuring specific legal and institutional rules of corporate governance (LaPorta, Lopez-de Silanes, Shleifer, and Vishny (1997); Enriques and Volpin (2007); Fohlin (2005)), measure the value of corporate control (Barclay and Holderness (1989); Dyck and Zingales (2004)), or evaluate corporate governance across countries based on harmonized case studies (Djankov, La Porta, Lopez-de Silanes, and Shleifer (2005)). My paper is complementary to this literature in that I conduct a quantitative evaluation of the effect of the quality of investor protection

[2]One notable exception is Midrigan and Xu (2014), who focus on misallocation as opposed to savings behavior. In their model, entrepreneurs can raise funds by selling claims to an exogenous share of expected firm profits. In this paper, the share of the firm sold to outsiders is a key endogenous choice by the entrepreneur.

[3]David (2020) allows for mergers and acquisitions as an alternative form of ownership changes of firms.

[4]Pagano and Roell (1998) propose a trade-off between external finance and *over-* monitoring by shareholders. Chemmanur and Fulghieri (1999) focus on who to sell to (one large vs. many diversified shareholders), Jovanovic and Rousseau (2001) study when to go public.

– inferred from observable decisions by firms – on aggregate outcomes.

The paper is structured as follows. Section 2 introduces the datasets and presents the main facts. Section 3 presents a dynamic general equilibrium model in which entrepreneurs choose debt and equity financing of their firms. Section 4 quantifies the model and shows how moments on firms' external finance identify financial frictions. Section 5 presents the main quantitative results. Finally, Section 6 concludes.

2 Data and Facts

This section has two goals. First, I document a set of facts on firm ownership that are common across Eurozone countries. I show that the ownership of public firms is typically concentrated in the hands of a few shareholders, contrary to the standard assumption in the literature.[5] On average, insiders hold over 40% of the equity of each public firm. Private firms are predominantly owned by a single person. Taken together, these two facts imply that on average, 64% of firm equity is held by insiders. The new facts on ownership are essential for guiding the model of firms' endogenous capital structures in Section 3.

Second, I document systematic differences in firm ownership and financing across Eurozone countries. The share of total firm equity held by insiders, whether in private or public firms, ranges from less than 25% in the Netherlands to 90% in Austria. On the other hand, differences in firms' debt financing across countries are less pronounced. I further show that the extent to which countries rely on debt vs. equity financing correlates with measures of debtor and shareholder protection, respectively. Lastly, I find that in countries with less equity and more debt financing, entrepreneurs hold a larger share of aggregate wealth, and overall wealth inequality is higher.

I start by briefly describing the datasets I use and defining the main variables.

2.1 Datasets and Variable Construction

Eurosystem Household Finance and Consumption Survey (HFCS). Data on the value of private firms and household wealth come from the first wave of the HFCS, administered by the European Central Bank (ECB) in 2009-10. The HFCS is a comprehensive survey of household assets and liabilities. It is modeled after the US Survey of Consumer Finances and was specifically designed to be comparable across Eurozone countries. Oversampling rich households, it is particularly suited to study private businesses whose ownership is concentrated among wealthy households. I use nine out of the 15 countries in the sample, excluding both very small countries such as Luxembourg, Cyprus, and Malta, and former socialist economies, such as Slovenia and Slovakia.[6] I use Greece whenever data availability permits. The nine countries account for over 93% of Eurozone GDP.[7]

[5] Starting with Quadrini (2000), quantitative models of entrepreneurship typically feature a "corporate sector" in which firms are unconstrained and dispersedly held.

[6] Their relatively recent transition to market economies makes them unlikely to be at their steady-state wealth distribution.

[7] For facts on external finance across a large range of countries, see Yan (2024).

From this survey, I use two key variables: the value of privately held firms and household wealth. Household wealth is defined as the sum of all financial and real assets, net of outstanding liabilities. This includes bank accounts, the value of the main residence minus outstanding mortgages, investment in equity (either directly or through mutual funds), private pension savings, and the value of closely held private firms in which the household is an entrepreneur. I define an entrepreneur as any household in which a member owns (shares of) a privately held company in which they have an active management role. The value of privately held businesses is an estimate provided by the owner. Appendix A reports the exact phrasing of the question.

In most countries, entrepreneurs are asked which industry their business operates in. This information is useful for ensuring that businesses are indeed productive units, rather than investment vehicles or legal entities set up to optimize tax payments on wealth and income. Across all nine countries, the top three industries are "Wholesale and Retail Trade" (20% of firms), "Construction" (14%), and "Professional, Scientific and Technical Activities" (10%). By value, the top three industries are "Manufacturing" (25%), "Wholesale and Retail Trade" (15%), and "Other Service Activities" (14%).

Compustat Global. I use Compustat Global to estimate the value of publicly traded businesses in each country. Companies are assigned to the country in which they are headquartered.[8] Size is measured as market value in 2009, the year in which the HFCS was administered. I combine the aggregate value of privately held businesses from the household data with the aggregate value of publicly traded firms from Compustat to measure the share of firm value that is publicly traded in each country.

Amadeus Financials. Data on leverage and the firm size distribution come from Amadeus, a dataset on public and private companies collected by the Bureau van Dijk.[9] Importantly for this project, Amadeus has wide coverage, including small and private companies. See Kalemli-Ozcan, Sorensen, Villegas-Sanchez, Volosovych, and Yesiltas (2015) for details on the dataset, as well as a discussion of the representativeness of the sample.

Amadeus Ownership. Data on shareholders of publicly traded firms comes from the ownership module of Amadeus. It contains information on the share of the company owned, the shareholders' nationality, whether they are a person, a company, a financial institution, or a government body, and the shareholder's firm ID, if the shareholder is a company. Coverage is high: the average (median) share of total firm equity recorded in this dataset is 78% (86%). The average (median) number of shareholders recorded is 7.5 (5).

Ownership structures of public companies are often complex and multilayered, with firms being owned by other firms. This implies that an analysis based only on direct ownership risks overstating ownership concentration. For example, if firm B owns 90% of firm A, one would conclude that ownership of firm A

[8] Table C.2 in the Online Appendix shows the results of using country of incorporation as an alternative definition.

[9] I use the version of Amadeus available for download through the Wharton Research Data Service (WRDS). See Kalemli-Ozcan et al. (2015) for a discussion of the differences between the WRDS version and the historical disks provided by the Bureau van Dijk.

is very concentrated. If, however, firm B has atomistic shareholders, then firm A is, in fact, dispersedly held. It is common for shareholders of public companies to be companies themselves. Indeed, 36% of total recorded equity is directly held by firms, another 27% is held by banks and financial institutions, 31% is held by individuals, and the remainder is held by "other investors" which includes stakes owned by the government and NGOs.

In order to identify ultimate shareholders, I match firms that own shares of other firms to their respective owners. I proceed as follows: Shares of public firms owned by private firms are assigned to a person, since private firms are typically held by one shareholder (see Section 2.2). If shares of public firms are owned by another public firm, ownership is assigned in proportion to the parent company's shareholders. To illustrate, suppose 60% of firm A is owned by firm B. If firm B is a public company, I assign ownership of firm A to firm B's shareholders in proportion. For example, if firm B is split 1/3 between three individuals, I would record firm A as having three distinct person shareholders owning 20% each. I treat shares held by banks or financial institutions as if they were dispersed shareholders.[10] I define insiders of public companies as the top three shareholders, following LaPorta et al. (1997). Of these insiders, 64% are persons, 23% are firms that could not be matched in the procedure described, and the remaining 13% are "other investors".

The second round of matching makes a significant difference. At a first level of ownership, nearly 50% of insiders are firms themselves. This share decreases to 23% using the procedure described above. Further, firm owners that could not be identified are more likely to be smaller private companies, as coverage of these firms in the data is less comprehensive. Smaller private firms are typically fully owned by one household, which implies that the remaining 23% of firms can be classified as insiders. In terms of ownership concentration, accounting for second-level ownership reduces measured concentration, as expected. The magnitudes are modest, however. On average across all firms and countries, the measured insider share would have been 45.2% using the naive, direct ownership approach. After correcting for firms owning firms, the average insider share is 43.7%.

2.2 Firm Ownership in the Eurozone

Insider Shares Within and Across Countries. The average insider share is the first important fact I document in this section. I find that the top three shareholders of each publicly traded firm own, on average, 43.7% of the equity. Thus, they are likely crucial in decision-making and are further highly exposed to idiosyncratic risk of the firm.[11] As such, public firms in the Eurozone do not fit the standard assumption of being owned by atomistic shareholders.

The average insider share masks heterogeneity in two important dimensions. First, pooling across countries, there is a strong negative relationship between the size of a public firm and its insider share:

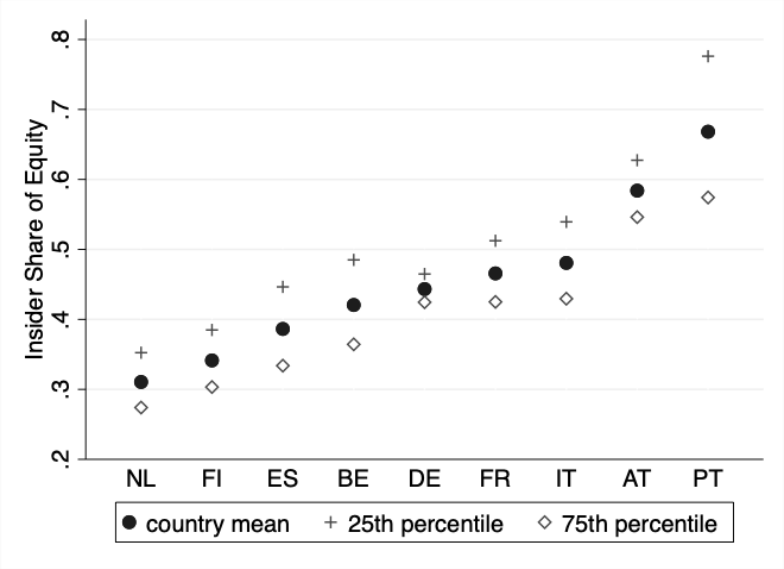
[10] This avoids treating, for example, a pension fund that owns a block of shares as an insider of the firm. These types of investors correspond more closely to atomistic shareholders for the purposes of the analysis in this paper, rather than to risk-averse owner-managers.

[11] While insiders could in principle diversify by holding multiple firms, they typically do not. Faccio et al. (2011) show that the median ultimate firm owner holds only one firm, with an average portfolio concentration of 83%.

larger firms are typically more dispersedly held than smaller firms. This is illustrated in Figure A.1 in Appendix A. Second, the average insider share differs across countries: in the Netherlands, the average insider share is modest at less than 30%. In Austria, insiders own almost twice that, on average, around 55% of the firm.

The differences in average insider shares across countries could, in principle, arise for two reasons: (i) firms of equal sizes have different insider shares, based on whether they are located in Austria or the Netherlands, or (ii) firms in Austria are, on average, smaller than Dutch firms, and hence observed insider shares are higher in Austria. Figure 1 shows that the negative relationship between size and insider share holds in all nine countries and that both size and country are important correlates of insider shares. For instance, large Austrian firms have lower insider shares than small Austrian firms, but still higher insider shares than small Dutch firms. Table C.1 in the Online Appendix formalizes that hypothesis (i) is correct: a firm's location correlates with its insider share even conditional on size; in other words, firm size and location are equally important predictors of its insider share.

Figure 1: Insider share and size country by country



Notes: Each dot is a country's "predicted average insider share", predicted at the Eurozone-wide average firm size. Pluses (diamonds) are predicted insider shares for a firm at the 25^{th} (75^{th}) percentile of the Eurozone size distribution. Predictions are based on a linear regression of insider shares on log assets, separately for each country.

Cross-Border Holdings of Equity. Despite the fact that capital markets in the Eurozone are fully integrated, there is home bias in portfolios. On average across the nine countries in my sample, only 12.7% of equity is held by people who live in a country other than where the company is listed. This share is higher in some, typically smaller, countries, but the maximum is below 21%. When conditioning on insiders, a similar picture emerges. The largest shareholder is a foreigner for only 16% of publicly traded firms, and in merely 2.2% of firms are all three largest shareholders foreigners. This confirms

that the typical publicly traded firm is owned by households in the country where it is listed, and its insiders are subject to the legal and institutional framework of their country.

The Ownership of Private Firms. In continental Europe privately held firms are typically owned by one person who actively manages the firm. This could reflect the fact that private equity markets are still less developed than, for instance, in the US or the UK. I confirm this using both the HFCS and, for Germany, Amadeus.

The HFCS record ownership shares of private businesses. On average, 74% of firms are owned 100% by a single household, and 90% are owned at least 50% by one household. When weighting by firm size, these numbers drop slightly to 61% and 89%. The HFCS also collects information about shares of private firms in which the household does not have an active management role. On average across all countries, these account for only 6% of the value of private firms.

For Germany, Amadeus records the owners of all firms, including privately held ones. Figure A.3 in Appendix A plots the share of the firm owned by the largest shareholder separately for private and public firms. This confirms that the majority of private firms are owned by one person.

2.3 Outside Equity and Debt Across Countries

Given the fact that (1) private firms are typically owned by one household and (2) insiders hold large individual shares of public firms, I measure the total quantity of outside equity as the share of total firm value that is in public firms and not held by insiders. The size of the entrepreneurial sector, or entrepreneurial equity, is everything else: the sum of private firms and inside equity in public firms.

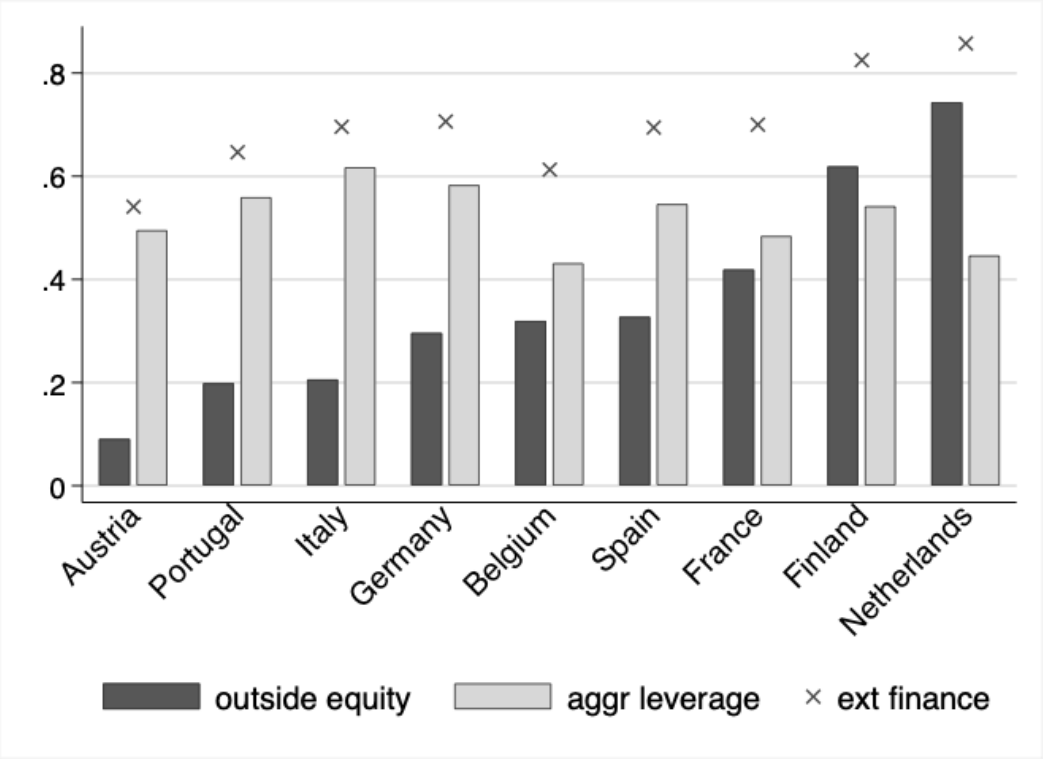
Figure 2 plots the amount of external finance in the form of debt and equity for each of the Eurozone countries. While there are notable differences in leverage across countries, the variation in outside equity is significantly larger. Aggregate leverage of firms, measured as the total value of outstanding debt relative to firm assets net of cash holdings, varies from 43% in Belgium to 63% in Italy. The share of total firm value that is not directly held by entrepreneurs – outside equity – ranges from around 10% in Austria to over 75% in the Netherlands.

Figure 2 also plots total external finance for each country (crosses). For the countries with very low outside equity (Austria, Portugal, Italy, and Germany), total external finance tracks debt relatively closely. The countries with more outside equity (Spain, France, Finland, and the Netherlands) have more external finance overall, and it is more driven by equity, rather than debt.

2.3.1 External finance and country-specific institutions.

Why do firms in Austria rely so little on outside equity, and why do Italian and German firms issue more debt than firms in other countries? A large literature, pioneered by LaPorta et al. (1997, 1998), has argued that laws and institutions, in particular the protection of creditor and shareholder rights, affect the availability of external finance across countries in economically significant ways. Following this

Figure 2: Outside equity and debt country by country



Notes: The dark bars measure the share of total firm equity in each country that is held by outsiders, as measured by the HFCS, Compustat Global, and Amadeus. The light bars measure aggregate leverage of all firms, as measured by Amadeus. Leverage is defined as total outstanding debt relative to total assets net of cash holdings. The crosses indicate total external finance in each country, which is the sum of debt plus the share of equity held by outsiders relative to total firm assets.

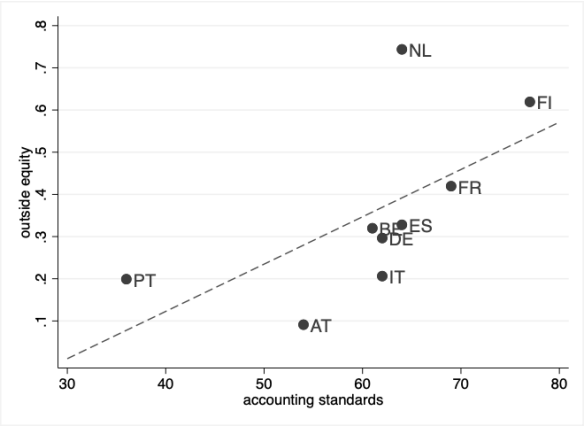
tradition, I document that the prevalence of different types of external finance correlates with specific laws and institutions.

When entrepreneurs issue outside equity, ownership and control of the firm are separated. This gives rise to the possibility of an agency conflict, the severity of which depends on a country's institutions set up to protect minority shareholders from expropriation by company insiders. LaPorta et al. (1998) argue that one such institution is the quality of a country's accounting standards and disclosure requirements. The authors also provide a measure of accounting standards across countries, based on examination of company reports. Figure 3a plots their measure against the share of outside equity in each of the nine countries. The positive relationship indicates that in countries with better accounting standards, more widespread corporate ownership is facilitated.[12]

The willingness to lend to firms depends on lenders' ability to recover their investment. The World Bank developed an index capturing the strength of creditor rights. It includes measurements of time,

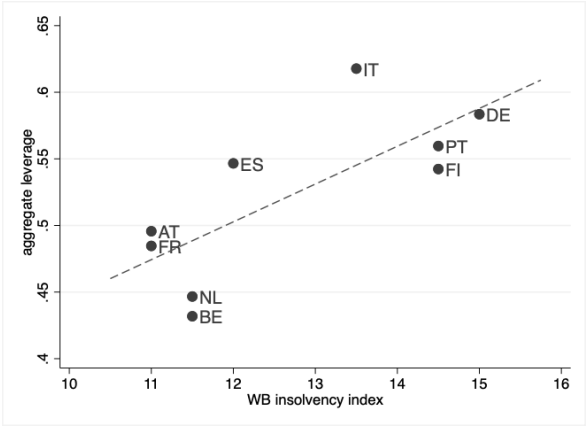
[12]This correlation is, of course, merely suggestive, as countries with more dispersed ownership of public equity could have developed better accounting standards.

Figure 3: Institutions and external finance across countries



Notes: Accounting standards are based on LaPorta et al. (1998). Average insider share as computed in Figure 2.

(a) Accounting standards and outside equity



Notes: Insolvency Index is from the World Bank's Doing Business Database. Leverage as computed in Figure 2.

(b) Creditor protection and leverage

cost, and outcome of insolvency proceedings as well as the strength of the insolvency framework. The strength of the insolvency procedure depends, for instance, on whether creditors can initiate liquidation and reorganization proceedings. Countries with a higher index protect creditors to a greater extent, allowing them to recover more of their investment. Figure 3b documents that leverage is indeed higher in countries with stronger creditor rights.

2.4 Firm Ownership, Financing, and Inequality Across Countries

This section analyzes the relationship between the two kinds of external finance – total outside equity and leverage – and the degree of wealth inequality in Eurozone countries. Wealth inequality is measured as the share of wealth held by the richest 10% of households in every country.[13]

2.4.1 Estimating Aggregate Wealth

One component of household wealth is not fully captured by the HFCS: inside equity in publicly traded firms. Using the insider shares of public companies described above and the value of total public equity from Compustat Global, I compute the aggregate value of public equity that is directly held by insiders in each country. If the sample of households in the HFCS were also representative of insiders of public firms, this number would be smaller than the total value of direct equity holdings captured in the survey.[14] In most countries, this is not the case, which indicates that the HFCS does not capture a sufficient number of insiders of large public firms. This interpretation is consistent with the assessment

[13]Results are qualitatively robust to using different quantiles of the wealth distribution.

[14]I do not expect the total value of public equity to match up with the total value of public firms as measured using Compustat Global. The reason for this is twofold: First, as mentioned in the previous section, cross-country holdings of (small) stakes in public companies are frequent. Second, smaller ownership stakes might be held by intermediaries such as banks or pension funds and would therefore not show up as direct equity holdings.

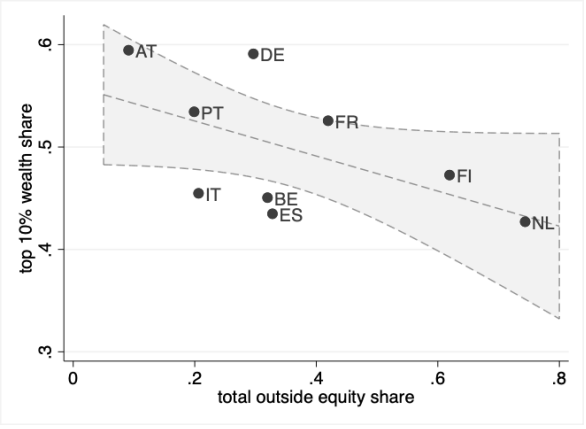
of the ECB: ECB (2013) compares aggregate household wealth as measured by the HFCS with the National Accounts. In general, wealth in the household survey is smaller than that measured by the National Accounts. One source of discrepancy mentioned is the failure to include some parts of the very wealthy population.

I correct for this by adding the aggregate value of inside equity in each country to the household data. Since insider shares of publicly traded firms are large, their owners belong to the top 10% of the wealth distribution. Aggregate inside equity is therefore part of the wealth held by the top decile of households. Appendix Table A.2 shows robustness to these assumptions.

2.4.2 External Finance and Wealth Inequality Across Countries

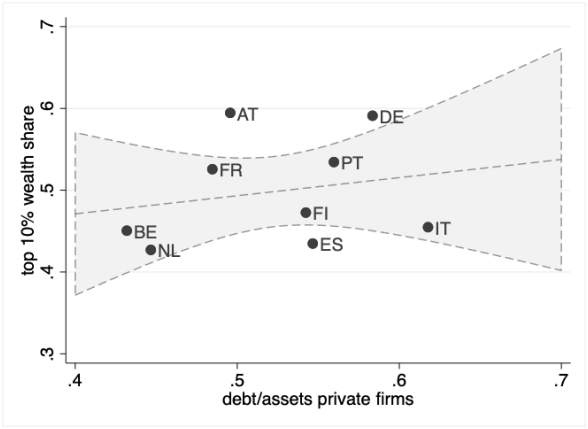
Figure 4 shows the main results. First, in countries where firms finance more with debt, top wealth inequality tends to be higher (Panel 4b). Although the relationship is weak, it is qualitatively consistent with the work of e.g. Cagetti and DeNardi (2006), who show that more access to debt leads to higher wealth inequality as successful entrepreneurs can grow their businesses faster and accumulate more wealth.

Figure 4: Firm financing and wealth inequality



Notes: The y-axis measures the share of wealth held by the richest 10% of households in each country. Total outside equity share as measured in Figure 2. The dashed line is a linear regression of top 10% wealth share on total outside equity; the shaded region represents the 90% confidence interval.

(a) Outside equity and inequality



Notes: The y-axis measures the share of wealth held by the richest 10% of households in each country. Leverage as measured in Figure 2. The dashed line is a linear regression of the top 10% wealth share on leverage; the shaded region represents the 90% confidence interval.

(b) Leverage and inequality

Panel 4a shows that the opposite relationship holds between external finance in the form of equity and wealth inequality. In countries in which less firm equity is held directly by entrepreneurs, the share of wealth held by the top 10% is lower. Further, the share of total wealth that is held by entrepreneurs is lower in these countries, as Figure A.4 in Appendix A shows. This relationship is consistent with

outside equity not only being a form of external finance that helps entrepreneurs grow their firms, but also allows them to share risk. When there is more outside equity, firm financing and risk exposure are more equally distributed, entrepreneurs are less exposed to idiosyncratic business risk, and accumulate less wealth to self-insure.

3 Model

To rationalize the systematic differences in firm ownership within and across countries, I develop a dynamic general equilibrium model of entrepreneurial firms. Each Eurozone country is a small open economy facing a common gross interest rate R, but labor markets clear domestically.[15] Countries are populated by heterogeneous workers and entrepreneurs, who hire workers and choose how to finance their firms. Both types of agents are subject to idiosyncratic, uninsurable risk. Since the focus is on long-run differences across countries, I abstract from business-cycle fluctuations and assume all risk is idiosyncratic. The importance of idiosyncratic risk for entrepreneurs is well documented, by, for example, Heaton and Lucas (2000) and Moskowitz and Vissing-Jorgensen (2002).

In the model, publicly traded firms have entrepreneurial origins. They are controlled by risk-averse entrepreneurs who choose the split between inside and outside equity, subject to an agency conflict with minority shareholders. This contrasts with the previous literature, which typically models public corporations as dispersedly held, maximizing the value to a representative shareholder.[16] My modeling choice is motivated by the findings in Section 2, where I show that in Europe, individual top shareholders hold large fractions of the equity in public companies.

3.1 Layout

Agents and Demographics. The economy is populated by a measure one of agents with finite, stochastic lifetimes. Agents are born as either one of two types: entrepreneurs e or workers ω. Workers are endowed with effective units of labor $\theta_t \in \Theta$, which they supply to entrepreneurs in exchange for labor earnings $w \times \theta_t$. Entrepreneurs have access to a production technology and differ in their productivity level $\tilde{z}_t \in \tilde{\mathbb{Z}}$. Every period, an entrepreneur's business might fail, in which case she becomes a worker.

Both types of agents die with probability π_d. The death shock is i.i.d. across agents and over time. For each agent who dies, a new one is born. New agents start life with assets equal to a weighted average of their " parents' " assets (with weight χ), and the economy's average assets (with weight 1-χ). If $\chi = 1$, wealth is fully passed on to the next generation and the model is effectively one of dynasties. If $\chi = 0$, all agents start off with an identical level of assets, irrespective of their parents. This setup flexibly captures the extent of redistribution through government-provided transfers, such as access to

[15] This assumption is motivated by the fact that less than 4% of the EU's working age population live in a member state other than their country of citizenship (Fries-Tersch, Tugran, and Bradley (2018)).

[16] See, for example, Cooley and Quadrini (2001), Frank and Goyal (2007), Hennessy and Whited (2007), Gomes and Schmid (2010), Bhamra, Kuehn, and Strebulaev (2010), and Begenau and Salomao (2018).

free education and child support. All bequests are accidental, and agents do not derive any utility from leaving money to their offspring.

Initial types $j \in \{e, \omega\}$ as well as corresponding skill or productivity level $i \in \{\tilde{\mathbb{Z}}, \Theta\}$ are potentially correlated with parents' types, capturing intergenerational transmission of skill.

Firms have two stages in life: young and old. All entrepreneurs are born running young firms; every period thereafter, their firms mature with constant probability. Young and old firms differ only in that old firms have the option to go public and issue outside equity. This is a reduced form way of modeling the fact that it takes time for firms to establish a reputation and signal their type, which is necessary for outsiders to be willing to invest. The two stages of life are useful for quantifying the model, but otherwise have no impact on the main mechanism.

Preferences. All agents have standard preferences over a single consumption good given by:

$$\mathbb{E}_0 \left[\sum_{t=0}^{\infty} [\beta(1-\pi_d)]^t \; u(c_t) \right], \tag{1}$$

where expectations are taken with respect to agents' idiosyncratic shocks.

Technology. Each entrepreneur has access to a production technology, which I refer to as their firm. Entrepreneurs invest capital k_t at time $t-1$ and hire labor l_t in period t, which generates revenues at t according to:

$$\tilde{y_t} = \tilde{z_t}^{1-\psi} \, (k_t^{\alpha} \, l_t^{1-\alpha})^{\psi} \tag{2}$$

As in Lucas (1978), the production function has decreasing returns to scale in (k, l). The third factor, entrepreneurial productivity $\tilde{z_t}$, represents the quality of the business idea. It is constant as long as the firm is in operation. Business investment is risky: in each period, an entrepreneur's business may fail with probability η. If the firm fails, the business idea loses its value forever ($\tilde{z_t} = 0$). The entrepreneur can then sell any undepreciated capital and start the next period as a worker. This simple shock structure abstracts from small, mean-reverting, TFP shocks for simplicity, but captures the most important uncertainty for entrepreneurs: business failure.[17]

Labor is hired in a spot market, *after* the entrepreneur observes whether the firm failed. Investment decisions depend on expected revenues net of labor costs, which are given by:

$$y_t \equiv \max_{l_t} \; \tilde{y_t} - w l_t = z_t(w) k_t^{\nu}, \tag{3}$$

[17] All heterogeneity in firm productivity is resolved ex-ante, when $\tilde{z}$ is drawn. I abstract from ex-post TFP shocks – other than the quantitatively most important one of business failure – for simplicity. This assumption is supported by the findings of Sterk, Sedláček, and Pugsley (2021) who show that ex-ante heterogeneity accounts for a large share of the cross-sectional dispersion in employment in the US.

where $z_t(w) = \tilde{z}_t^{\frac{1-\psi}{1-(1-\alpha)\psi}} \left(\frac{(1-\alpha)\psi}{w}\right)^{\frac{(1-\alpha)\psi}{1-(1-\alpha)\psi}} (1-\psi(1-\alpha))$ and $\nu = \frac{\alpha\psi}{1-(1-\alpha)\psi}$.
To simplify notation, I use net revenues for the remainder of the model description.

Assets. There are three assets in the economy. First, both entrepreneurs and workers can save in one-period bonds with gross return R, subject to a no-borrowing constraint. Second, entrepreneurs also hold equity in their firms. This consists of invested capital, net of outstanding debt, as well as the value of the firm's "blueprint". Given that the production technology has decreasing returns to scale, firms earn positive profits in equilibrium. Therefore, the right to operate a firm has value, which is what I refer to as the blueprint. The third asset is outside equity – shares of publicly traded firms not held directly by entrepreneurs. Outside equity is held by investment funds that hold a fully diversified portfolio of firm shares and therefore earn a rate of return R. From the households' point of view, shares in the investment fund and one-period bonds are perfect substitutes. I refer to the total net holdings of the two securities as bonds, a_t.

Firm Financing. Entrepreneurs can finance investment in their firms with debt or equity. Debt b_t comes in the form of a non-defaultable one-period bond. Its issuance is constrained by a standard limited enforcement problem. Lenders issue only risk-free debt; hence, the amount a firm can borrow is limited by the amount lenders can recover in the worst state of the world: firm failure. Assets are worth $(1-\delta)k_t$ in case the firm exits; lenders can seize a fraction λ of the recovery value. Section B.3 discusses micro-foundations of the borrowing constraint. These assumptions imply that debt is limited to a fixed fraction of the firm's capital stock:

$$b_t \leq \lambda \frac{(1-\delta)}{R} k_t \tag{4}$$

The parameter λ is the first of three financial market frictions that vary across countries. It captures the strength of creditor rights and determines how much they are willing to lend to entrepreneurs. Given the borrowing constraint (4), debt is risk-free and priced at the gross interest rate R.

Entrepreneurs can also adjust the equity in their firm to finance investment. Equity is a claim to a share of dividends $\{D_{t+s}\}_{s=0}^{\infty}$ in all future periods. Issuing new equity is costless, regardless of who owns the firm. An equity injection is therefore analogous to negative dividends. Dividends are equal to net revenues $z_t(w)k_t^{\nu}$ minus capital investment $(k_{t+1} - (1-\delta)k_t)$ and expenditure on debt $(Rb_t - b_{t+1})$:

$$D_t \equiv z_t(w)k_t^{\nu} - (k_{t+1} - (1-\delta)k_t) - (Rb_t - b_{t+1}) \tag{5}$$

Dividends are distributed in proportion to ownership shares each period. An entrepreneur who sold, say, 60% of the firm to outside investors will receive (or pay) 40% of dividends. In the event of firm failure, any undepreciated capital, net of debt repayment, is also split according to ownership shares.

Even after going public and selling a share $\varphi < 1$ of the equity, an entrepreneur remains fully in charge of investment and financing decisions.

Outside Equity. Outside equity is bought by investment funds. They observe firm productivity z_t as well as the entrepreneur's cash on hand and use these two state variables to forecast dividends.[18] Investment funds hold a fully diversified portfolio of firm shares. Therefore, they value shares using the risk-free interest rate R. There is a competitive market for firm shares, and hence the price paid by the investment fund is equal to the value of the shares.[19]

Going public and selling part of the company to outside investors leads to partial separation of ownership and control of the firm. The entrepreneur now only receives a fraction $(1-\varphi)$ of dividends, while remaining in full control of the firm's investment decisions. As a result, the entrepreneur might be tempted to misuse company funds. For example, she might invest in pet projects, hire less-qualified friends and relatives, or divert company funds for personal use. The entrepreneur would reap the full benefits of such a diversion, but she would only bear a share $(1-\varphi)$ of the resulting reduction in firm profits. To prevent the insider from engaging in such behavior, outside investors need to monitor her. Monitoring comes at a cost, which has the following functional form:

$$M(\varphi, z, k) = c_M \, \varphi \, z k^{\nu}. \tag{6}$$

Appendix B micro-founds the monitoring cost based on a game between the insider (entrepreneur) and outsiders (investment fund). The resulting functional form for the monitoring cost has three important features. First, it increases with the share sold to outsiders, φ. This captures the idea that the lower the share of dividends that accrue to the insider, the higher their incentive to misuse company funds. Outsiders, therefore, need to spend more resources on monitoring the insider. Second, the monitoring cost scales with firm revenues.[20] This reflects the idea that hiding any given amount of fund diversion is easier in a larger firm, so outside investors need to spend more resources monitoring the insider.

Third, the monitoring cost depends on the scale factor c_M, which is the second financial friction that differs across countries. It captures a range of institutional features across countries, including (minority) shareholder rights, in the spirit of LaPorta et al. (1998). In Section B.3, I discuss how the monitoring cost could reflect both the quality of ex-ante monitoring (e.g., accounting standards and disclosure requirements) and the availability of ex-post punishment (e.g., minority shareholders' rights).

After taking monitoring expenses into account, the per-period pay-off for outsiders, given that the firm did not fail, is given by:

$$\varphi D_t - c_M \, \varphi \, z_t(w) k_t^{\nu} = \varphi \left[(1-c_M) z_t(w) k_t^{\nu} - (k_{t+1} - (1-\delta)k_t) - (Rb_t - b_{t+1}) \right] \tag{7}$$

From the point of view of the outside investor, c_M acts like a reduction in firm productivity.[21]

[18] Cash on hand x_t is given by $Ra_t + z_t(w)k_t^{\nu} + (1-\delta)k_t - Rb_t$.

[19] This also implies that investment funds make zero economic profits and their ownership is irrelevant.

[20] Alternatively, one could assume that the monitoring cost is proportional to sales gross of labor payments: $M(\varphi, z, k) = \tilde{c}_M \, \varphi \, \tilde{z}_t^{1-\psi} (k_t^{\alpha} l_t^{1-\alpha})^{\psi}$. The two are equivalent for $\tilde{c}_M = c_M(1-(1-\alpha)\psi)$.

[21] Chemmanur et al. (2009) provide empirical support for this modeling choice by documenting that productivity of US

The decision to IPO, as well as the share of the firm sold to outsiders φ, is irreversible. While this assumption is primarily made to preserve tractability, it is consistent with the data. Figure A.2 in Appendix A shows that there is no systematic relationship between the insider share and firm age. Note, however, that although the firm's ownership split is fixed after the IPO, equity injections remain feasible. If an entrepreneur wishes to increase her firm's equity, she can do so by paying negative dividends. The only restriction imposed by the assumption of constant ownership shares is that these negative dividends (equity injections) are split in the same way as positive dividends, i.e., according to φ.

Finally, going public incurs a fixed cost c_{IPO} that captures underwriting fees and legal and administrative expenses associated with listing on the stock market.[22] This is the third financial market friction that varies across countries.

3.2 Choice Problems

Worker's Problem. Workers solve a standard consumption-savings problem with incomplete markets as in Bewley (1977); Huggett (1993); Imrohoroğlu (1989); Aiyagari (1994). I define a worker's beginning-of-period cash on hand as the sum of labor income and bond holdings, $x = w\theta + Ra$. Their state variables are (x, θ), and they choose how much to consume and save every period.

$$
\begin{aligned}
V_\omega(x;\theta) = \max_{c,a',x'} \; & u(c) + \beta(1-\pi_d)\mathbb{E}_{\theta'}[V_\omega(x';\theta')] \\
\text{s.t.} \;\; & c + a' = x, \\
& x' = w\theta' + Ra', \\
& a' \geq 0.
\end{aligned}
\tag{8}
$$

Young Entrepreneur's Problem. A young entrepreneur who has not been hit by the exit shock enters each period with cash on hand $x = Ra + z(w)k^\nu + (1-\delta)k - Rb$. Since firm debt and personal savings of the entrepreneur earn the same return, R, and neither are state-contingent, it suffices to keep track of $\tilde{a} \equiv a - b$, the entrepreneur's net savings. Young entrepreneurs cannot go public, so they choose

manufacturing firms drops after an IPO.

[22] In Section B.3, I discuss evidence of IPO cost declining in firm size, justifying a fixed cost of going public.

consumption, investment k', and net savings $\tilde{a}'$ to maximize:

$$
\begin{aligned}
V_Y(x;z) = \max_{\{c,\tilde{a}',k',x',x'_w\}} & \; u(c) + \beta(1-\pi_d)\{(1-\eta)\left(\pi_o\, V_O(x';z) + (1-\pi_o)V_Y(x';z)\right) + \eta\, \mathbb{E}_\theta[V_\omega(x'_\omega;\theta)]\,\} \\
\text{s.t.} \;\; & c + \tilde{a}' + k' = x, \\
& x' = R\tilde{a}' + zk'^{\nu} + (1-\delta)k', \\
& x'_\omega = R\tilde{a}' + (1-\delta)k' + w\theta', \\
& \tilde{a}' \geq -\lambda\frac{(1-\delta)}{R}k'.
\end{aligned} \tag{9}
$$

With probability $(1-\eta)$, the firm survives, in which case it either matures, which happens with constant probability π_o, or the entrepreneur remains the owner of a young firm. In both cases, cash on hand next period equals firm revenues net of labor costs and undepreciated capital, plus net savings. Note that the entrepreneur's problem in (9) already uses the fact that, if the firms survives, productivity z remains constant.

With probability η, the firm fails, that is, productivity z drops to zero forever. The entrepreneur becomes a worker with initial assets equal to undepreciated capital plus net savings. Failed entrepreneurs draw an ability type θ' which determines their labor income.

Old Entrepreneur's Problem. If their firm is old, entrepreneurs have an additional choice: going public and selling a share φ of the equity in their firm. If they choose to do so, their cash on hand $\tilde{x}$ is equal to pre-IPO cash on hand x plus the payment for firm shares by outside investors, V_{OI}. How much outside investors are willing to pay for firm shares is itself a function of the entrepreneur's post-IPO cash on hand. Therefore, $\tilde{x}$ is implicitly defined by

$$
\tilde{x} = x + V_{\text{OI}}(\tilde{x}, z, \varphi) - c_{\text{IPO}} \tag{10}
$$

The value function of an old entrepreneur is then simply equal to the maximum value between going public and remaining private:

$$
V_O(x,z) = \max\left\{V_{PRIV}(x,z), \max_{\varphi}\{V_{PUB}(\tilde{x},z,\varphi)\}\right\} \tag{11}
$$

If entrepreneurs choose to remain private, their continuation value includes the option to go public in

the future.

$$
\begin{aligned}
V_{PRIV}(x;z) = \max_{\{c,\tilde{a}',k',x',x'_\omega\}} & \; u(c) + \beta(1-\pi_d)\{(1-\eta)\, V_O(x',z) + \eta\, \mathbb{E}_\theta[V_\omega(x'_\omega;\theta)]\,\} \\
\text{s.t.} \;\; & c + \tilde{a}' + k' = x, \\
& x' = R\tilde{a}' + zk'^{\nu} + (1-\delta)k', \\
& x'_\omega = R\tilde{a}' + (1-\delta)k' + w\theta', \\
& \tilde{a}' \geq -\lambda \frac{(1-\delta)}{R} k'.
\end{aligned} \tag{12}
$$

Public Entrepreneur's Problem. Public entrepreneurs, that is, entrepreneurs who previously sold a share $\varphi > 0$ of their firm, enter each period with cash on hand $x = Ra + (1-\varphi)\,[zk^{\nu} + (1-\delta)k - Rb]$. Net savings are $\tilde{a} \equiv a - (1-\varphi)b$, which include *their* share of firm debt. Otherwise, their problem is similar to the private entrepreneur's:

$$
\begin{aligned}
V_{PUB}(x;z,\varphi) = \max_{\{c,\tilde{a}',k',x',x'_\omega\}} & \; u(c) + \beta(1-\pi_d)\{(1-\eta)\, V_{PUB}(x';z,\varphi) \; + \eta\, \mathbb{E}_{\theta'}[V_\omega(x'_\omega,\theta')]\} \\
\text{s.t.} \;\; & c + \tilde{a}' + (1-\varphi)k' = x, \\
& x' = (1-\varphi)\left[zk'^{\nu} + (1-\delta)k'\right] + R\tilde{a}', \\
& x'_\omega = (1-\varphi)(1-\delta)k' + R\tilde{a}' + w\theta', \\
& \tilde{a}' \geq -(1-\varphi)\lambda \frac{(1-\delta)}{R} k'.
\end{aligned} \tag{13}
$$

The Investment Fund. The investment fund holds a fully diversified portfolio of firm shares and has unlimited access to funds. Thus, the value of firm shares to the investment fund, V_{OI}, is the expected present discounted value of dividends received by shareholders net of the monitoring cost, plus the recovery value of capital in case of firm failure. The entrepreneur's choice of capital, and hence the value of the firm, depends on cash on hand, the share sold, and firm productivity. The value of firm shares V_{OI} solves the following recursive relationship:

$$
\begin{aligned}
V_{OI}(x,z,\varphi) = & \varphi\Big(D(x,z,\varphi) - c_M\, zk(x,z,\varphi)^{\nu}\Big) \\
& + \frac{1}{R}\Bigg[(1-\eta)V_{OI}(x',z,\varphi) + \eta\varphi\Big((1-\delta)k'(x,z,\varphi) - Rb'(x,z,\varphi)\Big)\Bigg],
\end{aligned} \tag{14}
$$

where dividends $D(x,z,\varphi)$ are as defined in Equation (5).

3.3 Equilibrium

The collection of individual state variables in the economy, $\sigma = \{x, i, \tau\}$, includes cash on hand as well as agent type, which are skill or productivity levels $i \in \{\Theta, \tilde{\mathbb{Z}}\}$ and entrepreneurial type $\tau \in \{Y, PRIV, PUB(\varphi)\}$. $\mu(\sigma)$ is the distribution of people over these states. Individual decision rules

derived from agents' problems, in combination with the three exogenous processes for birth and death, firm maturing and failure, and worker productivity, imply a transition rule $\mu'(\sigma|\mu)$.

Economies are open, but the labor market clears domestically. The labor market clearing condition states that total labor supply (i.e., the share of workers S_ω times the average labor productivity $\overline{\theta}$) needs to equal the total demand for workers by young, private, and public firms:

$$S_\omega \overline{\theta} = \sum_i \sum_\tau \int_x l_\tau(x,i)\, \mu(x,i,\tau)\, dx. \tag{15}$$

I focus on stationary equilibria, in which the joint distribution of assets and types in the economy μ is constant. Given an interest rate R, a stationary equilibrium is a set of value functions $\{V_{\mathrm{w}}, V_Y, V_O, V_{PRIV}, V_{PUB}\}$, policy functions for workers $\{c_{\mathrm{w}}, a'_{\mathrm{w}}\}$, young entrepreneurs $\{c_Y, \tilde{a}'_Y, k_Y, l_Y\}$, mature private entrepreneurs $\{c_{PRIV}, \tilde{a}'_{PRIV}, k_{PRIV}, l_{PRIV}, \varphi\}$, and public entrepreneurs $\{c_{PUB}, \tilde{a}'_{PUB}, k_{PUB}, l_{PUB}\}$, as well as prices $\{w, V_{OI}\}$ and a constant distribution over types $\{\mu^*\}$ such that

1. Given prices, allocations, and value functions solve agents' problems (8) - (13).
2. V_{OI} is given by equation (14).
3. The labor market clearing condition (15) holds.
4. The distribution of types satisfies $\mu'(\sigma|\mu^*) = \mu^*(\sigma)$.

Valuation of Firms. The value of a firm consists of the value of capital and the value of the blueprint, which is the expected value of future firm profits, or dividends. Public firms are traded, so their value is simply the market price, given by Equation (14). I use the same market price to value the share of the firm held by the entrepreneur. Private firms are not traded. To value them, I compute the present value of profits, discounted using the interest rate R. This is what entrepreneurs would receive if they could sell claims to dividends.

3.4 Frictions and the Choice of Firm Financing

This section provides intuition for the novel part of the model: an entrepreneur's choice of whether to sell outside equity and, if so, how much to sell. I begin by describing how the firm's market value depends on the share of equity sold. Then I analyze which types of entrepreneurs choose to go public and how much they sell. Lastly, I discuss how the choice of firm financing depends on the three financial frictions: the maximum leverage constraint λ, the IPO cost c_{IPO}, and the monitoring cost c_M. This mapping between frictions and observable firm choices is precisely what I leverage to quantify the level of frictions in the next Section. All graphs use the results of the quantification from Section 4.

Investment Policies and the Value of the Firm. Investment is increasing in the share of the firm held by outsiders. Entrepreneurs who sold more of their firm choose higher investment for three reasons. First, the more of the firm is sold, the less of any given amount of investment the entrepreneur

must finance themselves, thereby relaxing the borrowing constraint. Second, an entrepreneur who owns a smaller share of her firm faces less risk and is willing to invest more. Third, the entrepreneur has more cash—the proceeds of the IPO—to finance investment. The left panel of Figure 5 illustrates this: it plots the entrepreneur's investment during the IPO period as a function of the share of outside equity.

The market value of the firm is generally a non-monotonic function of the share sold. This is driven by a disagreement between insiders and outsiders on the optimal investment in the firm. The optimal investment from the point of view of the investment fund solves:

$$k^{OI} \in \underset{k}{\text{argmax}} \quad \left\{ -k + \frac{1}{R} \left[(1-\eta)(1-c_M) z k^{\nu} + (1-\delta) k \right] \right\} \tag{16}$$

Given that the share of the firm held by outsiders scales both the investment and the payout received, k^{OI} is independent of the share sold. Outsiders differ from entrepreneurs in two ways: they are risk-neutral, and they must pay the monitoring cost. For low values of the share sold, the former outweighs, and the optimal investment of outsiders exceeds what the entrepreneur chooses. As the entrepreneur sells more of her firm, she also chooses a higher firm-level investment k, and the losses from the monitoring cost increase.

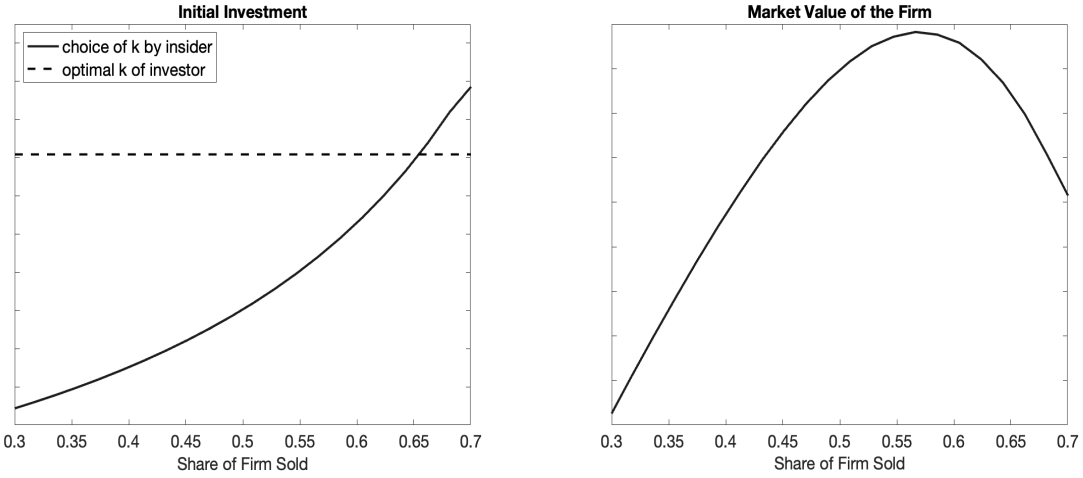
The left panel of Figure 5 illustrates this. The entrepreneur's choice of k (solid line) lies below the optimal investment from the outsiders' point of view (dashed line) for low values of the share sold, but above it as more of the firm is held by outsiders.

The valuation of investment by outside investors then translates into the market value of the firm, which is depicted in the right panel of Figure 5. Initially, the market value increases with the share sold, as outsider investors value the additional investment in the firm. Eventually, however, the increase in the resource spent on monitoring dominates, and the value of the firm starts declining in the share sold.

The Optimal Choice of φ. There are two main benefits of selling equity to outside investors: access to additional external finance and diversification. Entrepreneurs face a trade-off between these benefits and the reduction in firm value. The wealthier an entrepreneur, the lower the benefits of diversification and access to finance relative to the reduction in firm value. This implies that the share of the firm sold to outsiders is decreasing in cash on hand of the entrepreneur, as Figure 6 shows. Further, the higher firm productivity z, the larger the optimal scale of the firm, and the larger the benefits of external finance and risk-sharing. This explains why, conditional on the same level of wealth, owners of more productive firms sell off a greater share of their firms. Through this mechanism, the model generates a negative relationship between firm size and the insider share, which is one of the robust facts on public firm ownership I document in Section 2.

The fact that the share sold to outsiders drops to zero at high levels of wealth is a result of the fixed cost of IPO. Entrepreneurs compare the value of remaining private to the value of selling the optimal share to outsiders—minus the fixed cost. The location of the IPO threshold and hence what share of

Figure 5: Investment and firm value as a function of the share sold to outsiders



Notes: Both panels are based on the results of the quantification in Section 4. The left panel plots the entrepreneur's current period investment as a function of the share of the firm sold. The dashed line corresponds to the choice of capital investment that the outside investor would make. The right panel plots the firm's market value, i.e., the price the outside investor would be willing to pay, as a function of the share sold.

firms are publicly traded depends on the two costs of outside equity, c_M and c_{IPO}, as well as on the maximum leverage constraint, λ.

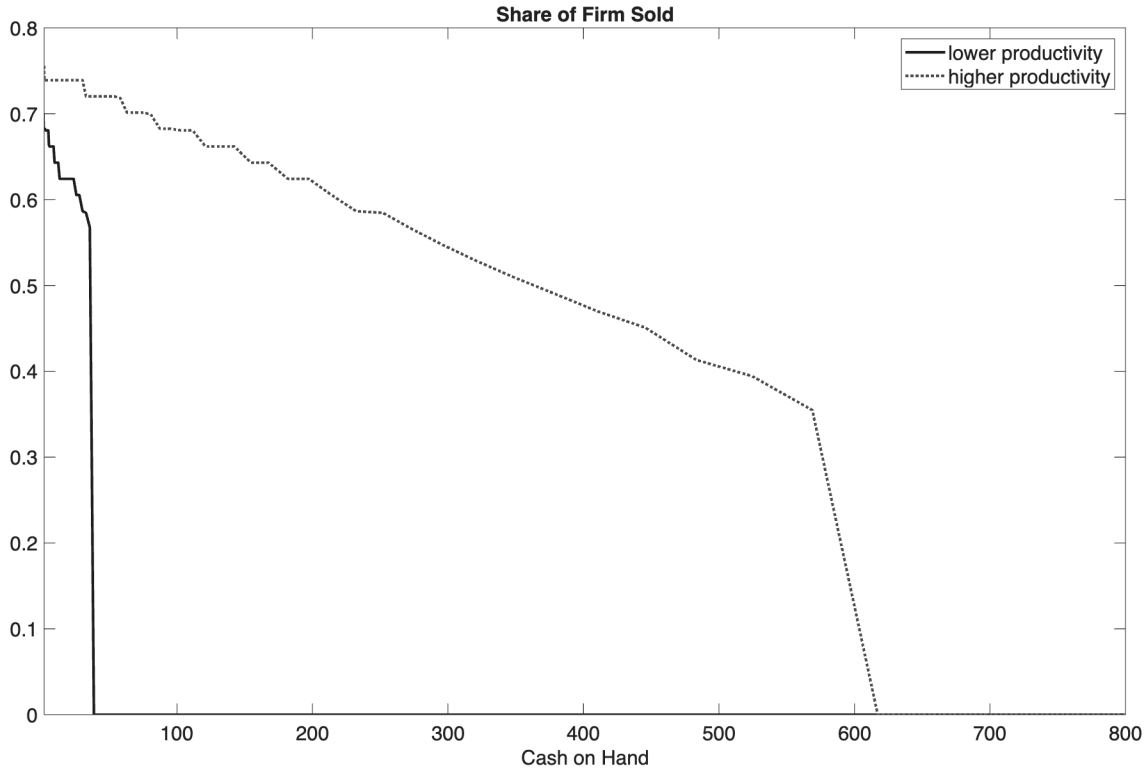
Financial Frictions and the Choice of External Finance. If the fixed cost were zero, but $c_M > 0$, all mature firms would go public and sell some – potentially very small – share. In such an economy, the share of private firms would be very low, and the average insider share would be moderate. If the monitoring cost were zero but $c_{IPO} > 0$, all differences between firms would lie along the extensive margin: below a certain wealth threshold, entrepreneurs would sell most of their firms, and above the threshold, they would remain private. Such an economy would be characterized by a very low insider share and a moderate share of private firms. Conditional on both equity costs, a tighter borrowing constraint reduces the value of operating a private firm and hence increases the value of issuing outside equity. In addition, debt constraints directly affect the level of borrowing by firms as reflected in their leverage ratio.

This mapping between financial frictions and equilibrium firm choices is precisely what I leverage in the next section to quantify the model. The share of private firms, the insider share of public firms, and leverage are the three key moments I use to infer the level of the IPO cost, the monitoring cost, and the tightness of the borrowing constraint.

3.5 Discussion

In this section, I discuss the main modeling choices and assumptions, as well as their importance for the paper's results.

Figure 6: Entrepreneurial wealth, productivity, and the optimal insider share



Notes: Figure 6 is based on the results of the quantification in Section 4. It plots the optimal share of the firm sold as a function of the entrepreneur's beginning-of-period cash on hand X. The dotted line corresponds to an entrepreneur with high productivity $z = z_3$; the solid line corresponds to one with medium productivity $z = z_2$.

Occupational Choice Agents are born as either entrepreneurs or workers and do not choose their occupation. I make this assumption primarily for computational reasons; adding an endogenous occupational choice would increase the complexity by an order of magnitude.

In terms of the steady-state equilibrium, the model is isomorphic to one in which agents are born with an entrepreneurial productivity and then choose their occupation. All agents born as "workers" have a low enough potential $\tilde{z}$ to ensure they do not want to start a business. Depending on the exact calibration, some, especially low-productivity, entrepreneurs may need to enjoy non-pecuniary benefits of entrepreneurship to justify their occupational choice (as argued, for example, by Hurst and Pugsley (2015)).

While the steady-state of the model would not be affected by an endogenous occupational choice, any counterfactuals may give different results. First, a change in financial frictions would change the number of entrepreneurs. Second, the general equilibrium effect on wages could be dampened or amplified, depending on the specific model of occupational choice as well as the latent distribution of entrepreneurial ability.

Reversible Investment In the model, entrepreneurs can resell their capital stock frictionlessly. A recent literature (see, e.g., Tan (2021)) has argued that resale frictions are an important source of entrepreneurial risk. In the absence of fluctuations in firm TFP, such a resale friction would affect the entrepreneur's problem only in the case of firm failure. Instead of recovering $\lambda(1-\delta)/R$ of the capital stock, one could only recover a fraction of this, the fraction that can indeed be resold. In the model, this would be isomorphic to tighter debt frictions. Hence, the parameters λ can be viewed as the combination of resale frictions and frictions in debt markets.

Asset-based borrowing constraints Entrepreneurs can borrow up to a fraction of their installed capital stock (Equation (4)). While this type of borrowing constraint has long been standard in the entrepreneurship literature, Lian and Ma (2021) have pointed out that, in the US, around 80% of corporate debt is earnings-based. If borrowing capacity depended on earnings, low-wealth entrepreneurs who run high-productivity firms would be able to borrow more than their lower-productivity counterparts. Establishing which type of borrowing constraint is more prevalent in European countries and how that affects firm financing is a promising avenue for future research. [23]

4 Quantifying Debt and Equity Frictions

In this section, I leverage the novel data moments documented in Section 2 to discipline my framework. I use the model to quantify the level of frictions in debt and equity markets across Europe. To balance richness with feasibility and data availability, I perform my quantitative analysis for four countries: France, Germany, Austria, and the Netherlands. These countries were chosen because they span the range of prevalence of outside equity in Europe—from very high in the Netherlands, dominated by public firms, to very low in Germany and Austria, where most firm equity is closely held.

In bringing the model to the data, I assume that some parameters are common across countries (e.g., demographics, depreciation) and calibrate them directly to observables as described below, without the need to solve for the equilibrium process of the model. These parameters are listed in detail in Table 1 and discussed below. I specify the distribution of worker skills for each country to match cross-country data as described in the following subsection.

Finally, using simulated method of moments (SMM), I estimate the financial market frictions, the distribution of firm productivity, and the discount factor β for each country to match salient moments related to wealth, public and private equity, and the firm-size distribution.

All parameters jointly determine all moments of the model. To explain the intuition behind the identification, when discussing moments to discipline model parameters, I refer to the parameter to which the moment is most sensitive in the SMM.

[23] See Yan (2024) for a first step in this direction.

4.1 Calibration

Table 1: Externally calibrated parameters

Parameter	Value	Description	Calibration moment
R	1.02	Risk-free rate	Eurozone 1-year bond yield
σ	2	Risk aversion	-
π_d	0.02	Death probability	Working life of 50 years
δ	0.06	Depreciation	Stokey and Rebelo (1995)
η	0.056	Exit probability	Mean firm age 14 years (Amadeus)
π_o	0.1	Probability firm matures	Age at IPO, Jovanovic and Rousseau (2001)
ν	0.9	Returns to scale	–
α	1/3	Exponent on capital	Capital share
ρ_θ	0.9	Persistence of worker prod	–
S_{w}	0.924	Share of workers	France (HFCS)
χ	0.18	Parent wealth in start assets	Share of wealth inherited (HFCS)

Notes: Table 1 lists the parameters that were set or estimated prior to the main quantification exercise. The average firm age of 14 years is an average across all four countries, computed using Amadeus Financials. The share of workers is the number for France, taken from the HFCS. Share of inherited wealth is estimated as described in Section 4.

Demographics The model period is set to one year. The death probability, π_d, is set to 2% so as to create an average working life of 50 years. New agents are born at the same rate to keep the population constant in steady state.

Preferences All agents have CRRA utility with risk aversion σ: $u(c) = c^{1-\sigma}/(1-\sigma)$. I set $\sigma = 2$ as this value is standard in macro models of household heterogeneity. The discount factor for country j, β_j, is chosen to match a country's level of savings vis-a-vis the rest of the world, measured as the net foreign asset position (NFA). Since I model all countries as small open economies, choosing the discount factor this way helps match the empirical difference between domestic asset supply and asset demand. Given the small-open-economy assumption, I calibrate the gross risk-free rate to $R = 1.02$.

Endowments The skill level of a worker i in country j, θ_{ijt}, follows an AR(1) in logs: $\log(\theta_{ijt}) = \rho_\theta \log(\theta_{ijt-1}) + (1-\rho_\theta)\mu_\theta + \sqrt{(1-\rho_\theta^2)}\sigma_{\theta,j}\epsilon_{ijt}$, where $\epsilon_{ijt} \overset{\text{i.i.d}}{\sim} \mathcal{N}(0,1)$. I assume that the persistence of productivity shocks is common across countries and set it to 0.9, consistent with a large literature on income process estimation. The variance of the shocks, $\sigma_{\theta,j}$, is pinned down to match the dispersion of log earnings in each of the four countries in cross-sectional data from the Luxembourg Income Survey (LIS) in 2010. The mean of the process is normalized such that the average endowment of effective units of labor is 1 in each country (see Table B.1 in Appendix B for data and model parameters in each country).

Technology As is standard in the heterogeneous firms literature, I set the capital depreciation rate $\delta = 0.06$, the capital share $\alpha = 1/3$, and the returns-to-scale parameter $\nu = 0.9$. To discipline the firm productivity distribution in each country j, I choose two parameters: the number of productivity

states and the relative productivity between states. To keep the model tractable while allowing for significant dispersion and concentration across firms, I set the number of productivity states to three. The majority of firms (80%) have low productivity $\tilde{z}_{1j}$, 18% of firms have higher productivity $\tilde{z}_{2j}$, and the remaining 2% of firms are of the largest type, $\tilde{z}_{3j}$. I normalize $\{\tilde{z}_{1j}, \tilde{z}_{2j}, \tilde{z}_{j3}\}$ such that the average level of productivity in the economy is 1. I then target two moments in firm-size distribution for each country: the employment share of the top 25% and top 1% of firms to pin down the dispersion of firm productivity, $\tilde{z}_{2j}/\tilde{z}_{1j}$ and $\tilde{z}_{3j}/\tilde{z}_{1j}$.

Shocks to entrepreneurs Young entrepreneurs are subject to a "maturing" shock as they age and become eligible to sell private equity. I calibrate the probability of receiving this shock, π_o, to 0.1 to match the fact that firms on average IPO ten years after incorporation (Jovanovic and Rousseau (2001)).

Entrepreneurs are subject to idiosyncratic business failure shocks, η. Further, entrepreneurs are subject to the same death shocks as workers, requiring me to specify what happens to the going concern after the death of the entrepreneur. I assume that the probability of firm survival conditional on owner death depends on $\tilde{z}$. For simplicity, this probability is either 0, for $\tilde{z}_1$ firms, or 1, for firms with $\tilde{z}_2$ and $\tilde{z}_3$. The first assumption is motivated by the fact that low-productivity firms are typically mom-and-pop stores with just a few employees, relying primarily on debt and internal equity.[24]. Larger firms, on the other hand, have sufficient brand value that another agent can manage them if the owner dies. This assumption is not only empirically grounded but also guarantees that large firms have effectively lower exit rates.

Given these assumptions, I set η to match the average firm age in Amadeus across the four countries, which is 14 years. This implies a value of η of 5.7%. As a result, the exit rate of high-productivity entrepreneurs is 5.7%, and that of low-productivity entrepreneurs is 33% higher at 7.5%.

I calibrate the share of workers to 92.4%, since the share of private business owners in the HFCS in France is 7.6%.[25] I keep this number constant across countries, since the exact definition of what constitutes an entrepreneur may vary. As I discuss below, despite the share of entrepreneurs remaining constant, the model accurately replicates the difference in wealth held by private entrepreneurs.

Dynasties, Population Shares, and Inheritance The "children" of entrepreneurs are born as entrepreneurs. Moreover, consistent with the assumption about the survival of the firm after owner death, heirs of owners of type 2 or type 3 firms inherit their parents' firm, and hence are entrepreneurs with productivity $\tilde{z}_2$ or $\tilde{z}_3$ themselves. The distribution of entrepreneurial productivity of all other newly born agents is chosen to match the steady-state distribution of firm types. New workers draw an initial skill level θ_t from the unconditional distribution. The probability that a worker's offspring is an entrepreneur is chosen to match the steady-state share of entrepreneurs.

[24] Smith, Yagan, Zidar, and Zwick (2019) document that, for pass-through businesses in the US, unexpected death of the owner leads to a drastic reduction in profits and a spike in exit rates.

[25] I choose France since the counterfactuals in the next section are done relative to France, the country with an intermediate level of financial frictions.

Newly born agents start their working life with assets equal to $\chi \times$ parental wealth $+ (1 - \chi) \times$ average wealth. The only exception to this inheritance rule is children of productive entrepreneurs, who inherit their parents' entire firms and thus experience full intergenerational pass-through of wealth. I use data from the HFCS to estimate the weight of parental bequests in the initial assets of newborn agents (χ). In the survey, respondents are asked to report the value of all inheritances and gifts received over their lifetime. I choose χ to match the value of such transfers relative to total wealth held by young households. I consider three definitions of young households: those aged less than 25, 30, or 35 years. Depending on the age cut-off, this fraction ranges from 16% to 20%. I therefore set $\chi = .18$.

Debt and equity frictions The country-specific debt and equity frictions are estimated via SMM country by country. The maximum leverage constraint λ_j is pinned down by aggregate leverage. The two parameters governing equity markets—the fixed cost of going public and the proportional monitoring cost paid by outside investors—are identified by the share of total firm value that is privately held and the insider share of public firms. As discussed in Section 3.4, the fixed cost of IPO primarily impacts the extensive margin, i.e., which firms choose to go public. The monitoring cost primarily affects the intensive margin, i.e., the amount of equity sold when going public.

This approach leverages the mapping between frictions and observable firm choices described in Section 3.4 together with the facts I document on firm ownership and financing. It enables me to quantitatively assess the importance of frictions in debt and equity markets, complementing the literature on law and finance that directly constructs ordinal measures of financial frictions, such as the quality of investor protection (LaPorta et al. (1998)). Of course, the level of frictions inferred by my methodology could also capture other "wedges", such as taxes. I discuss this in more detail in Appendix B.3.

Computation Firm and worker policy functions are solved using the Endogenous Grid Point method of Carroll (2006). The market-clearing wage is solved with a bisection algorithm. To smooth the discrete choice of going public, I add a taste shock drawn from a Fréchet distribution. The SMM estimation is performed separately for each of the four countries. Given a guess for the country-specific parameters, I solve for the equilibrium of the economy and compute the relevant moments. I update the parameters to minimize the distance between model and data moments. While the complexity of the model precludes a formal proof of identification of the internally estimated parameters, Figure D.1 in the Online Appendix shows how the moments are affected by each parameter, starting from their baseline values.

4.2 Cross-country Parameterization

I now briefly describe the quantification and resulting parameters for each of the four countries. I start by discussing the calibration to France, since it lies in the middle of the four countries in terms of both debt and equity frictions, and is used as a benchmark country in later sections.

All parameters and moments are listed in Table 2.

Table 2: Calibration: Parameters and Targeted Moments

Estimated parameter		Targeted moment		
Parameter	Value	Moment	Data	Model
Panel A. France				
z_2/z_1	13.1	Employment share, top 25%	81.1%	81.5%
z_3/z_1	58.3	Employment share, top 1%	18.3%	18.1%
λ	0.53	Aggregate leverage	48.5%	48.5%
$\widetilde{c}_M$	0.05	Aggregate insider share	33.4%	32.8%
c_{IPO}	0.04	Share of private firms	37.0%	36.1%
β	0.995	NFA/wealth	34.6%	34.5%
Panel B. Germany				
$\tilde{z}_2/\tilde{z}_1$	20.7	Employment share, top 25%	82.6%	81.8%
$\tilde{z}_3/\tilde{z}_1$	78.2	Employment share, top 1%	16.1%	17.3%
λ	0.63	Aggregate leverage	58.3%	58.3%
$\widetilde{c}_M$	0.05	Aggregate insider share	28.0%	29.1%
c_{IPO}	0.07	Share of private firms	58.9%	58.9%
β	0.996	NFA/wealth	43.0%	42.2%
Panel C. Austria				
$\tilde{z}_2/\tilde{z}_1$	14.5	Employment share, top 25%	74.0%	74.3%
$\tilde{z}_3/\tilde{z}_1$	40.2	Employment share, top 1%	13.1%	13.0%
λ	0.56	Aggregate leverage	49.6%	49.6%
$\widetilde{c}_M$	0.12	Aggregate insider share	57.4%	57.4%
c_{IPO}	0.04	Share of private firms	78.6%	78.8%
β	0.994	NFA/wealth	51.0%	50.3%
Panel D. Netherlands				
$\tilde{z}_2/\tilde{z}_1$	4.3	Employment share, top 25%	67.1%	66.1%
$\tilde{z}_3/\tilde{z}_1$	21.1	Employment share, top 1%	12.7%	12.7%
λ	0.49	Aggregate leverage	44.7%	44.7%
$\widetilde{c}_M$	0.00	Aggregate insider share	16.2%	25.2%
c_{IPO}	0.004	Share of private firms	11.4%	16.1%
β	0.996	NFA/wealth	33.5%	33.3%

Notes: The table reports the estimated parameters and corresponding targeted moments for each country. c_{IPO} is reported relative to the value of firms at IPO. $\widetilde{c}_M$ is the share of output net of labor payments used to monitor insiders. Employment shares are measured as the wage bill from the Amadeus Financial Module, with the top and bottom 1% winsorized. The NFA position is measured as net foreign assets over GDP from the World Bank's WDI series plus government debt to GDP from Eurostat, averaged over 2008–2010. Government debt is added to the NFA position because the model does not include a supply of public-sector bonds. All other moments are described in Section 2.

France Firms borrow, on average, close to half of their capital stock. Approximately 37% of firms (by value) are privately held, and insider ownership is also moderate, at approximately one-third. To rationalize the extensive and intensive margins of outside equity, the model predicts that going public entails costs on the order of 4% of the value of the firm. This value is consistent with Abrahamson et al. (2011), who find that fees for European IPOs average just over 4%.

The monitoring cost, on the other hand, is relatively high. With a calibrated $\widetilde{c}_M$ of 5%, outside investors in the typical firm (with an insider share of 33%) need to spend about 3.5% of revenues monitoring insiders. The estimated magnitudes are consistent with other empirical measures of the costs of monitoring insiders. For example, Chemmanur et al. (2009) estimate that profits of US manufacturing firms decline, on average, by just over 14% from the year of the IPO to three years after the IPO. Using the model calibrated to France, the average drop in profits at IPO due to monitoring costs (holding capital fixed) is 13%.

In addition to matching the targeted moments above, the model also replicates the fact that entrepreneurs running large firms sell a larger share of the equity to outside investors. A regression of the insider share on size yields a coefficient of $-.05$ in the model, compared to $-.024$ in the data.

France is overall a net saver — its net foreign asset position amounts to just over one-third of aggregate wealth. To match this, the model requires a discount factor close to one. The effective discount factor (incorporating the probability of death) is equal to 0.976, such that $\beta(1-\pi_d)R < 1$.

Germany Germany and France differ significantly in the ownership and financing structures of firms. German firms are more highly levered (58.3% compared to 48.5% in France) and are more likely to remain private. In France, only 37% of firm value is accounted for by privately held firms, while this number is 60% higher in Germany, at 59%. Conditional on going public, however, German entrepreneurs sell a slightly larger fraction of the firm to outside investors. A smaller share of public firms, together with a smaller insider share, is indicative of a higher fixed IPO cost in Germany, but a (slightly) lower monitoring cost. I also infer a higher maximum leverage constraint in Germany, which could be a reflection of stronger creditor rights in case of firm failure.

In Germany, mid-sized firms are more important than in France. While the employment share in the top 25% of firms is higher, the top 1% account for a smaller fraction of the wage bill. Still, I estimate more dispersion in firm productivity in Germany. This is a consequence of high equity frictions in Germany, which particularly constrain the highest productivity firms.

Austria The main difference between France and Austria is the insider share of public firms. In Austria, nearly 60% of public equity is held by insiders, which is the highest share among Eurozone countries. As a result, I estimate a monitoring cost more than twice as large as in France. Since the monitoring cost is very high, the fixed cost of going public in Austria must be low enough for any firm to be willing to jump over that hurdle. Consequently, I estimate a very low fixed cost of IPO for Austria. Aggregate leverage of firms is similar in the two countries, and so is the estimated debt constraint, λ.

The Netherlands The Netherlands is unique among Eurozone countries in that outside equity plays a significant role. Less than 15% of the value of firms is privately held, and the insider share is very low at 16.2%. At the same time, firms' aggregate leverage is low. Further, the firm size distribution is less concentrated than in other countries, with the top 25% of firms accounting for only 67.1% of the country's wage bill, compared to 81.1% in France.

Relative to peer countries, the Netherlands features double the maturity rate ($\pi_o = 0.2$). This is chosen to help match the high share of public firms, possibly due to faster firm 'seasoning' and listing throughput. The higher rate of maturing can be viewed as yet another dimension – in addition to the IPO cost and the monitoring cost – in which frictions in equity markets are low in the Netherlands.

The results are displayed in the last panel of Table 2. I set the monitoring cost to zero and choose the fixed cost of IPO (in combination with all other parameters) to match the share of private firms. Despite a zero monitoring cost, the model over-predicts the insider share for two reasons. First, insiders discount the future at $\beta(1 - \pi_d)$, which is calibrated to be less than the $1/R$, the discount rate of outside investors. Secondly, for low-productivity firms, the entrepreneur's death triggers firm failure. Entrepreneurs assign zero weight to firm profits in that state of the world, whereas outside investors account for the fact that firm revenues fall to zero when the owner dies.

Since leverage is relatively low in the Netherlands, I estimate a lower value of λ than in France.

What do the estimated financial frictions correspond to in practice? In Appendix B.3, I briefly discuss each of the three in turn and point to specific laws and institutions that might be captured by the parameters implied by the quantitative model. I then discuss the potential role of taxes for explaining differences in firm ownership and financing across countries.

4.3 Top Wealth Inequality Across Countries

Through their effects on the choice of firm ownership and financing, frictions in debt and equity markets affect entrepreneurs' wealth accumulation and, consequently, the distribution of wealth across households in the steady state. Although not explicitly targeted in the estimation, in this subsection, I report the model's performance in explaining wealth concentration across the four countries. Table 3 summarizes the model prediction for the distribution of wealth and compares them with the data.

While the model overpredicts the level of top wealth inequality in all four countries, it can generate 73% of the differences in the top 10% wealth share relative to France. It also correctly predicts the ranking of countries. Austria and Germany, countries with very low levels of outside equity, have the highest degree of wealth inequality. The wealth distribution is much less compressed in the Netherlands, where most firm equity is dispersedly held.

As is evident in the data, higher wealth inequality in the model is accompanied by a larger fraction of wealth held by entrepreneurs. The last column of Table 3 compares model and data in this respect. In Germany and Austria, which are the two most unequal countries in the sample, a greater proportion of

Table 3: Wealth inequality across countries: model and data

	Top 10% Wealth Share		Top 1% Wealth Share		Wealth Gini		Wealth Share of Private Entrep	
	Data	Model	Data	Model	Data	Model	Data	Model
France	52.6%	59.0%	22.6%	26.9%	0.66	0.64	23.7%	17.8%
Germany	59.1%	62.7%	26.2%	30.5%	0.72	0.67	32.4%	25.4%
Austria	59.5%	63.9%	26.4%	30.8%	0.72	0.69	31.3%	30.4%
Netherlands	42.7%	49.8%	12.2%	17.4%	0.55	0.56	8.2%	8.0%

Note: Table 3 compares the model predictions for inequality, measured as the share of wealth held by the richest 10% and 1% and the Gini coefficient of wealth, as well as the distribution of wealth between private entrepreneurs and all other agents in data (left columns) and model (right columns). The data moments are based on my calculations in Section 2. The model numbers correspond to the value in the stationary equilibrium.

wealth is held by entrepreneurs. In the Netherlands, the share of aggregate wealth held by entrepreneurs is smaller, and wealth inequality is lower.

The fact that the model over-predicts wealth inequality is itself instructive. Bewley-Huggett-Aiyagari-Imrohoroglu-type models are well known to struggle to generate sufficient top wealth inequality (DeNardi (2015); De Nardi (2016)). At the same time, a large literature in firm dynamics documents that the firm size distribution is highly concentrated. This paper combines that insight with the novel observation that a significant share of firm equity—even for publicly traded firms—is directly held by households. As a result, the wealth distribution inherits the concentration of the firm distribution, generating substantial wealth concentration at the top.

In the next section, I explore the extent to which financial frictions alone explain these differences in wealth concentration across countries.

5 Financial Frictions, Aggregate Output, and Wealth Inequality

This section quantifies the effects of debt and equity frictions on output and wealth. I proceed in two steps. First, I compare each calibrated economy to a frictionless benchmark to answer whether debt or equity frictions are larger in Europe. Unsurprisingly, lower debt or equity frictions both increase output by reallocating capital toward more productive firms. Quantitatively, however, equity frictions are much more important. Removing them increases output by an average of 5.3%, compared to only 3% for debt frictions.

Second, I harmonize each friction to France's level to assess how much cross-country differences in frictions account for dispersion in outcomes. Mirroring the previous result on the level of frictions, I find that equity frictions are also more dispersed than debt frictions. The output effect of harmonizing them to the French level is nearly four times that of debt frictions. Next, I turn to the relationship between financial markets and wealth inequality. In combination with differences in the firm productivity distribution, financial frictions are responsible for more than 70% of the explained differences in wealth inequality. Finally, I show that while lower debt frictions raise both output and inequality, lower equity

frictions improve risk sharing and thereby generate higher output alongside lower inequality.

5.1 Comparison to frictionless benchmark

The first set of counterfactuals compares the level of debt and equity frictions in Europe. To this end, I compare the gains in aggregate output from fully frictionless financial markets. In the debt counterfactual, I set the maximum leverage constraint λ to one. In the equity counterfactuals, I set both the fixed cost of IPO and the monitoring cost to zero and allow young firms to issue outside equity.

Recall that the model estimates significant financial frictions across the four countries. The share of capital that can be collateralized, λ, ranges from 49% in the Netherlands to 63% in Germany. Going public costs on average 7% of the value of the firm in Germany, but nearly zero in the Netherlands. Any equity held by outsiders incurs a monitoring cost of up to 12% in Austria, 5% in Germany, and again close to zero in the Netherlands.

Table 4: Counterfactuals: output effects — frictionless markets

	Frictionless Economy	
Country	**Debt**	**Equity**
France	+2.7%	+5.3%
Germany	+2.1%	+5.8%
Austria	+4.7%	+8.3%
Netherlands	+2.7%	+1.7%

Note: "Frictionless Debt" sets $\lambda = 1$. "Frictionless Equity" sets $c_M = c^{\text{IPO}} = 0$ and allows young firms to issue equity ($\pi_o = 1$). TFP dispersion remains at each country's estimated level. Steady-state to steady-state comparisons.

The last two columns of Table 4 show that there are larger gains in aggregate output from full access to equity than from perfect access to debt. Frictionless debt sets $\lambda = 1$, frictionless equity sets $c^{\text{IPO}} = c^M = 0$ (and allows young firms to issue equity). The average increase in GDP from removing debt frictions is 3%, significantly lower than the 5.3% gains from frictionless equity markets.

The reason equity markets are more important than debt markets is that equity not only provides funds but also allows entrepreneurs to offload risk. Improved risk-sharing further encourages entrepreneurs to increase investment in their firms, and productive businesses grow faster. In an economy with frictionless debt markets, entrepreneurs who hold large shares of their firms would still ratchet up investment slowly as they accumulate wealth to self-insure. In an economy with frictionless equity markets, all firm risk is shared across the population, and firms can reach their efficient scale instantly.

5.2 Harmonizing Frictions to France

I proceed with the second counterfactual, harmonizing financial frictions across countries to the French level, in three steps. First, I harmonize debt frictions to the French level, keeping equity frictions at

baseline. Second, I harmonize equity frictions to the French level, keeping debt frictions at baseline. Finally, I harmonize both types of financial frictions to the French level. All counterfactuals in this section are comparisons of steady states.

5.2.1 Implications for Output

The first three columns of Table 5 summarize the output effect of harmonizing financial markets to the French level. All counterfactuals compare steady states at country-specific TFP and worker productivity distributions. "French frictions" harmonize λ, then c^{IPO} and c^{M}, and then all three together to France's estimated value.

I find that differences in equity markets between these countries are substantially more important for aggregate output than differences in debt markets. The average change in aggregate production from adopting France's protection of creditor rights is a modest 0.5% of GDP. The change in output from adopting French equity market frictions is nearly four times as large at 1.9%.

Table 5: Counterfactuals: output effects — harmonizing to French financial markets

	French Financial Markets		
Country	**Debt**	**Equity**	**Full CF**
France	–	–	–
Germany	-0.7%	+0.8%	+0.1%
Austria	-0.6%	+2.7%	+2.7%
Netherlands	+0.2%	-2.2%	-1.8%

Note: Entries are percent changes in steady-state aggregate output relative to each country's baseline. TFP is held fixed at the country's estimated level. "Debt" harmonizes the collateral tightness λ to France; "Equity" harmonizes c_M and c^{IPO} to France; "Full CF" harmonizes all three.

The aggregate gains of harmonization to France—as well as of frictionless debt and equity markets discussed in the previous section—may very well be significantly smaller if these were closed economies in which the interest rate adjusts to clear the capital market domestically. However, the fact that equity market frictions are larger and more dispersed across European countries is likely to continue to hold when interest rates fully or partially adjust.

5.2.2 Implications for Wealth Inequality

Next, I examine the implications of harmonizing financial frictions across countries for wealth inequality. Recall from the previous section that the estimated model explains roughly three-quarters of the variation in wealth inequality across the four countries. The first three columns in Table 6 report the effects on top wealth inequality of harmonizing financial frictions to the French values in the same three steps. In addition to the counterfactuals underlying Table 5, column 4 considers harmonizing both the financial frictions and the TFP distribution to the French level.

Two main results emerge. First, I find that financial market frictions contribute considerably to differences in top wealth inequality across European countries. On their own, debt and equity market frictions explain 26% of the variation in top 10% wealth shares in the model. Together with the distribution of firm productivity, the share of explained variation increases to over 73%.[26] Next, I shed light on the various forces at play in driving these results.

The first two columns report the results of setting either borrowing constraints (λ), or the costs of issuing outside equity (c_M and c_{IPO}) to the French level. As predicted by Cagetti and DeNardi (2006), tighter debt frictions lead to lower levels of wealth concentration. For example, if creditor rights in Germany were to worsen to the French level, the share of wealth held by the top 10% would decline by approximately 1.5 percentage points. As shown in Table 5, this would come hand in hand with a decline in aggregate output.

Tighter equity frictions would also reduce output. For example, if issuing outside equity were as costly in the Netherlands as it is in France, output would decline by 2.2%. In contrast to frictions in debt markets, however, this would lead to an increase, rather than a decrease, in top wealth inequality. To understand the subtle link between firm financing and wealth inequality, it is useful to examine how frictions in debt and equity markets affect entrepreneurs' savings behavior.

Table 6: Counterfactuals: inequality effects of debt and equity frictions

		French Financial Markets			
Country	**Baseline**	**Debt**	**Equity**	**Full CF**	**Full CF + TFP**
France	59.0%	–	–	–	–
Germany	62.7%	61.1%	61.8%	61.0%	58.9%
Austria	63.9%	63.1%	62.8%	62.7%	62.8%
Netherlands	49.8%	50.1%	50.0%	50.5%	58.5%

Note: Entries are Top 10% wealth shares. "French Financial Markets" harmonizes the indicated frictions with France. "Full CF" sets both debt and equity frictions to France; "Full CF + TFP" also harmonizes TFP dispersion. Steady-state to steady-state comparisons.

5.2.3 Inspecting the Mechanism

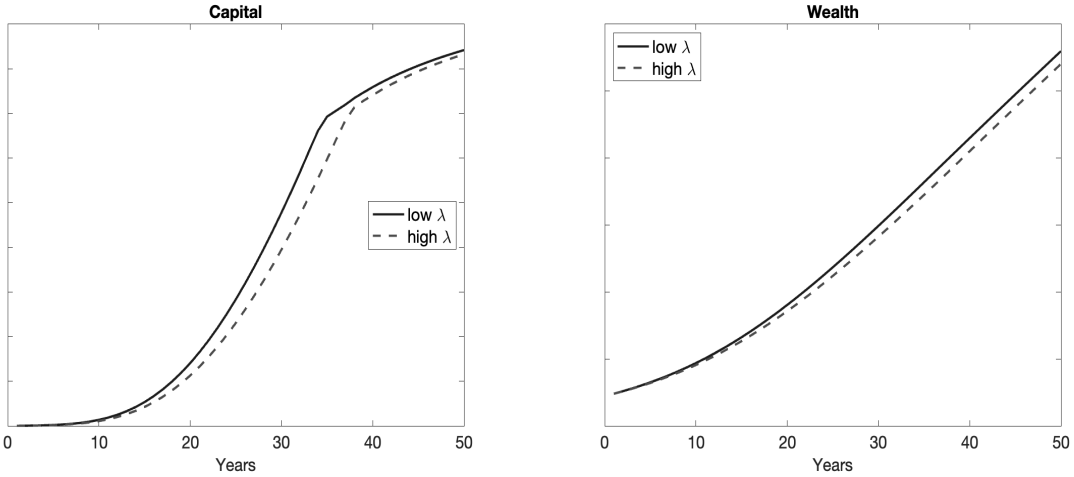
Leverage and Wealth Accumulation. The effect of the maximum leverage constraint λ on entrepreneurs' savings is similar to that found in other quantitative papers on entrepreneurship (e.g., Cagetti and DeNardi (2006)). Although the details of the model differ, the mechanism remains similar: the looser the debt constraint, the more capital entrepreneurs can invest in their firms, the greater the profits they make, and the more they save. Figure 7 illustrates this: It plots the evolution of capital, savings in bonds, and household wealth over time for two entrepreneurs: one who faces the baseline French debt constraint $\lambda = 0.53$, and one who faces a 50% less tight borrowing constraint. Both en-

[26] To the extent that financial market frictions influence the kind of projects or firms that get started, this counterfactual can be viewed as an upper bound on the contribution of financial markets to wealth inequality.

trepreneurs have the same level of productivity, start out with the same level of wealth, and their time paths are simulated assuming that they are not hit by any shocks.

With a higher λ, the entrepreneur can borrow more, invest more in the firm (left panel), and reach the optimal level of investment faster than the entrepreneur in the baseline economy. Since entrepreneurs have a more levered position in their own firms, they make higher profits when λ is higher. All else equal, this leads to faster wealth accumulation, as the right panel shows.

Figure 7: The role of λ for capita and wealth



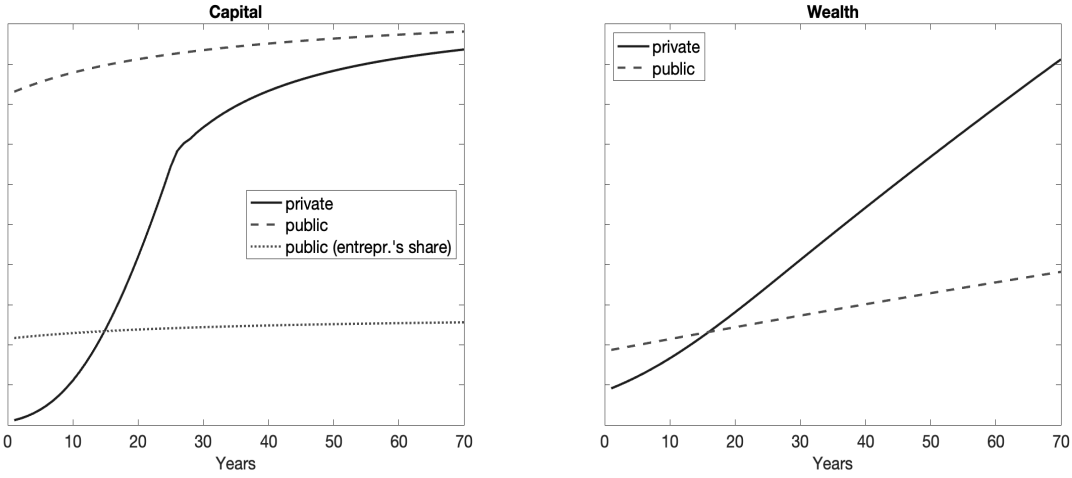
Notes: Evolution of capital and wealth for two entrepreneurs who face $\lambda = 0.53$ and $\lambda = 0.78$ respectively. All other parameters used for the simulation are set to the values estimated for France. Entrepreneurs start with the same level of cash on hand and their time paths are simulated assuming neither the death nor the firm exit shock hit.

Outside Equity and Wealth Accumulation Figure 8 compares two entrepreneurs facing different fixed costs of IPO. The solid line corresponds to an entrepreneur (she) operating in the baseline economy, whose initial wealth is such that she chooses not to go public. The dashed line corresponds to the time path of an entrepreneur (he) who faces a 50% lower fixed cost. All other parameters are kept at baseline values.

At $t = 0$, the counterfactual entrepreneur (dashed line) sells 40% of his company. As depicted in the left panel of Figure 8, the IPO allows him to rapidly increase investment in his firm. He can do that for two reasons: first, he must finance only 60% of any given investment amount. Second, the proceeds of the IPO provide additional cash, which is the reason why *his* share of capital (dotted line) is higher than the capital invested by the baseline entrepreneur who remained private (solid line). In contrast, the baseline entrepreneur only slowly saves out of the borrowing constraint and expands her firm.

Finally, the right panel shows the evolution of wealth resulting from differences in equity market frictions.

Figure 8: The role of c_{IPO} for capital and wealth



Notes: Evolution of capital and wealth for two entrepreneurs who face $c_{IPO} = .04$ and $c_{IPO} = .02$ respectively. All other parameters used for the simulation are set to the values estimated for France. Entrepreneurs start with the same level of cash on hand, and their time paths are simulated assuming neither the death nor the firm exit shock hits.

Initially, the counterfactual entrepreneur who faces a lower fixed cost of IPO is wealthier. This is because the availability of financing through outside equity increases the value of the firm. Eventually, however, the wealth level of the baseline entrepreneur is higher, a feature driven primarily by precautionary savings. After 15 model periods, the baseline (private) entrepreneur still runs a smaller firm than the public one. At this point, she is no longer at the borrowing constraint and is wealthier than the public entrepreneur. Why does she choose lower investment? The reason is that her portfolio is much riskier. She owns 100% of the firm, so she would absorb 100% of the losses if the firm exits, as opposed to 60% for the counterfactual entrepreneur. This leads her to save more, accumulate more wealth, and run a smaller firm.[27]

Since each entrepreneur owns less capital when equity frictions are tighter, labor demand in the economy drops, and the equilibrium wage is lower. With a lower wage, workers are poorer and have lower wealth holdings, contributing to the increase in wealth inequality. In the steady state with higher equity frictions, there is also more inequality among workers, since some workers are former entrepreneurs or offspring of now wealthier business owners.

6 Conclusion

Why do German firms rely extensively on debt financing, while many more Dutch entrepreneurs go public and sell shares of their firms? This paper argues that systematic differences in firm ownership

[27] A similar mechanism would be at play when comparing two public entrepreneurs with different insider shares, resulting from low and high monitoring costs.

and financing reflect the degree of creditor and investor protection, as captured by debt and equity frictions across countries. As such, this paper contributes to an active literature on entrepreneurship and firm financing. My contribution is to extend the baseline framework to allow for explicit frictions in equity markets. These new frictions enable me not only to rationalize the distribution of firm ownership within and across countries, but also to demonstrate that equity markets are of much greater importance for aggregate output and the wealth distribution than debt markets.

Combining microdata on households and firms in nine Eurozone countries, I showed that even in publicly traded firms, insiders typically hold large shares of the equity. The share of firm equity that is then truly dispersedly held varies significantly across countries, ranging from 10% in Austria to 75% in the Netherlands. I presented suggestive evidence that the extent to which firms rely on equity financing is related to a country's strength in protecting minority shareholders, just as the availability of debt correlates with creditor protection. In countries in which outside equity is predominant, entrepreneurs hold a smaller share of aggregate wealth, and the degree of wealth concentration across households is lower.

Using my quantitative model, disciplined by microdata, I estimated country-specific frictions that capture the strength of creditor and shareholder protection in four Eurozone countries. Equity frictions are more important than debt frictions for aggregate output. This can be seen in three ways: First, equity frictions are more dispersed, and harmonizing them would lead to a nearly four times larger change in aggregate output than a similar policy for debt frictions. Second, their level is, on average, higher. Frictionless equity markets increase aggregate output by 73% more than frictionless debt markets. Furthermore, improved access to outside equity boosts investment and hence aggregate output not only by providing external finance, but also by allowing entrepreneurs to share risk. Third, the risk-sharing properties of equity also contribute to the model's ability to quantitatively match the empirical negative relationship between the share of outside equity financing and wealth inequality across countries.

Finally, note that because equity reduces self-insurance needs, reforms that lower equity frictions can deliver higher output with lower wealth concentration, unlike relaxing leverage constraints, which increase both. While a normative analysis is beyond the scope of this paper, future work could explore these equity and efficiency tradeoffs for generating equitable growth.

Data Availability Statement

The data and code underlying this research are available on Zenodo at `https://doi.org/10.5281/zenodo.21105829`.

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A Data

A.1 Insider Share

Table A.1: Summary Statistics, Insider Share Sample

Country	# Firms	Avg Insider Share (%)	Aggr Insider Share (%)
AT	60	56.9	57.4
BE	143	38.9	33.1
DE	685	45.0	28.0
ES	439	42.6	21.0
FI	132	31.0	24.1
FR	747	46.2	33.4
IT	276	46.6	32.5
NL	143	28.7	16.2
PT	54	58.7	33.3

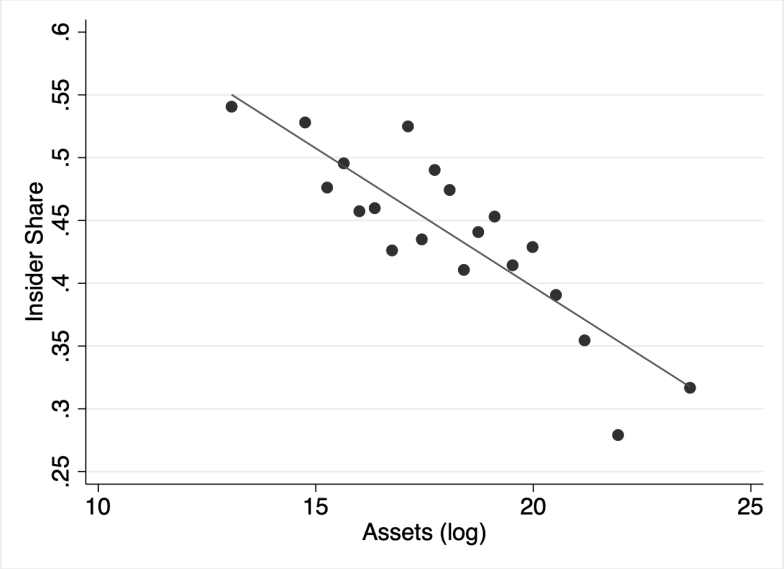
Notes: Column 1 reports the number of public firms for which the insider share is available. Column 2 reports the raw average insider share, while column 3 reports the aggregate insider share, where each firm is weighted by its total assets. Data are from Amadeus Ownership.

A.2 Private Firms

HFCS In the HFCS, surveyed households are asked to report the value of any private businesses they own. The exact wording of the question is:

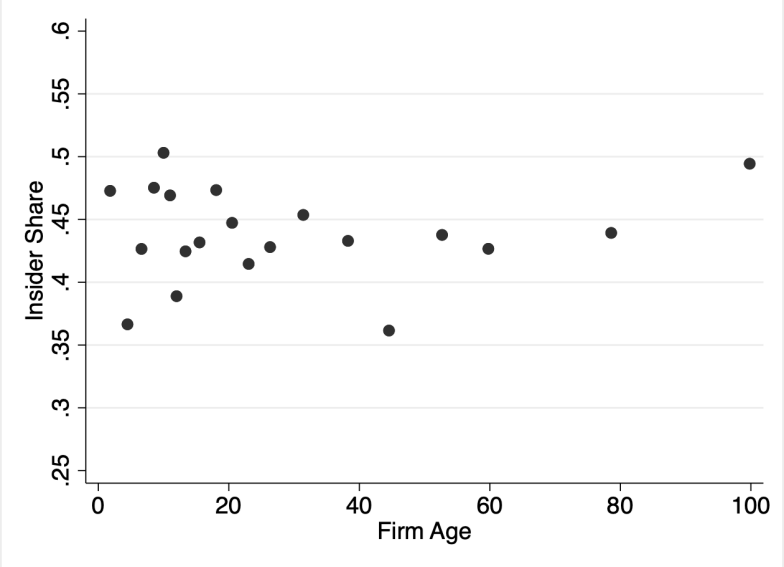
> Aside from any assets and debts connected with this business that I may have already recorded: What is the net value of (your /your household's) share of the business? That is, what could you sell it for, taking into account all (remaining) assets associated with the business and deducting the (remaining) liabilities?

Figure A.1: Insider share and size pooling across all countries



Notes: Binscatter of insider share again log of firm assets, pooling all countries. Insider share is share of equity held by top three shareholders, calculated as described in Section 2.

Figure A.2: Insider share and age pooling across all countries

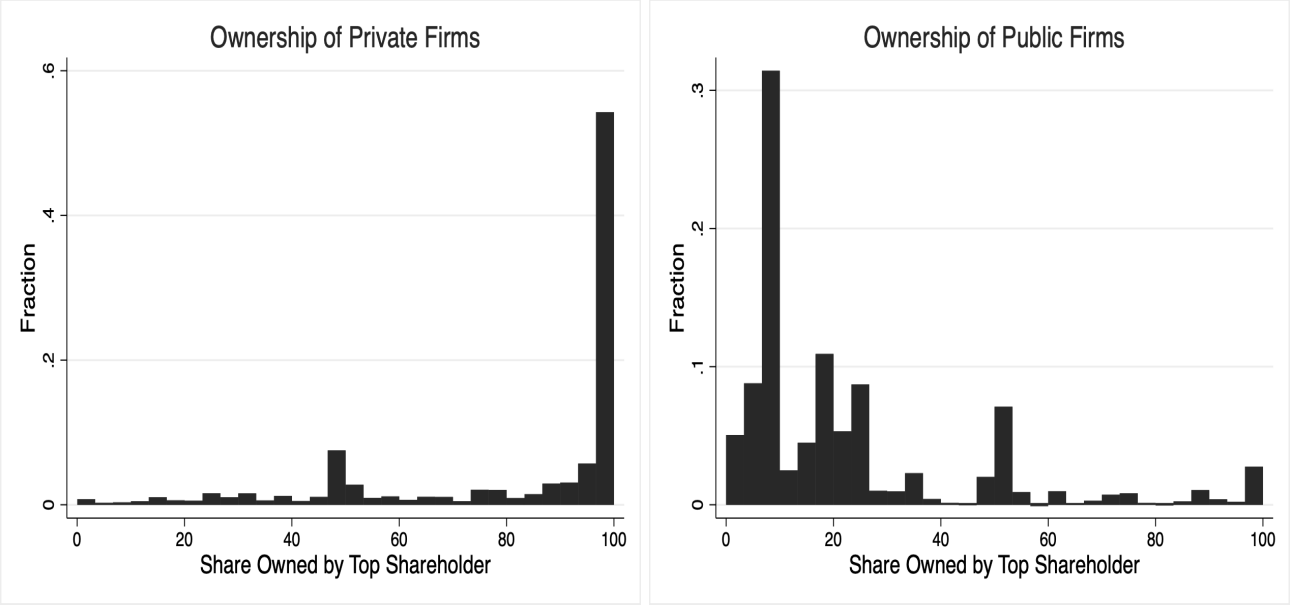


Notes: Binscatter of the insider share by age groups, pooling all publicly traded firms across countries. Insider share is share of equity held by top three shareholders, calculated as described in Section 2. Firm age is years since incorporation. Age winsorsized at 100.

A.3 Aggregate Wealth and its Distribution

Estimating aggregate wealth. In the baseline version, I assume that the HFCS does not survey any public firm insider. Alternatively, I can classify equity holdings in the household data into two

Figure A.3: The ownership of private and public German firms



Notes: Histogram of the share of each firm held by the largest shareholder. For public firms, I use the second-level ownership measure as described in Section 2. Observations are asset-weighted.

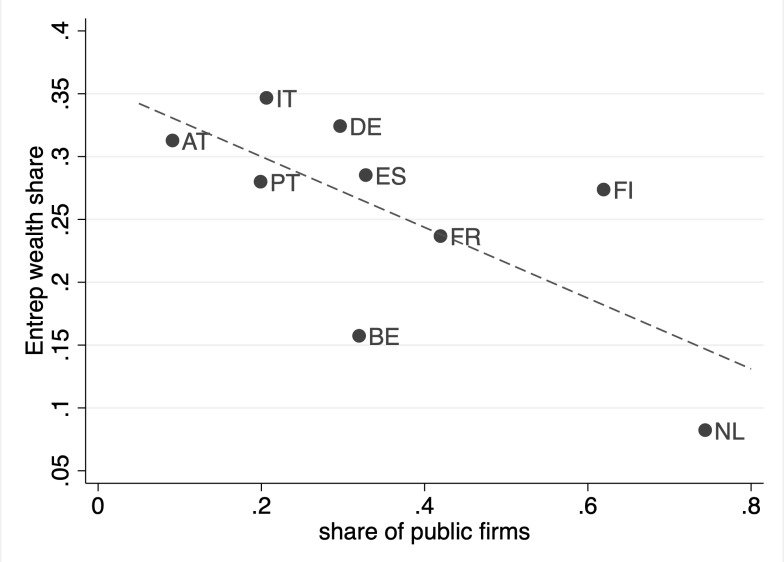
categories: small ones and those large enough to potentially be inside equity. I do not observe the distribution of equity holdings across different types of stock, so this procedure gives an upper bound on public firms insiders in the survey data. I proceed as follows: I classify any value of stock holdings by individual households as inside equity if the holdings are larger than 1% of the value of the lowest quartile of public firms in that country. In all countries but Belgium, this estimate of households' inside equity is much lower than the aggregate value of inside equity as computed using the firm data. I add the difference between the two measures to the HFCS data on household wealth, and count it as part of wealth held by the top 10%. This procedure is the most conservative one, in that I assume all households with large holdings of public equity are "insider". Table A.2 compares these two procedures and confirms that the two polar ways of dealing with inside equity have very similar results.

Table A.2: Aggregate wealth, inside equity, and wealth inequality

	Wealth	Wealth top 10%		Stocks/Wealth		Inside Equity/Stocks	
	(2)/(1)	(1)	(2)	(1)	(2)	(1)	(2)
AT	.997	.59	.59	.03	.03	.81	.88
BE	.986	.45	.44	.05	.03	.31	.71
DE	.992	.59	.59	.04	.03	.61	.76
ES	.999	.43	.43	.02	.02	.57	.60
FI	.974	.47	.46	.09	.06	.47	.68
FR	.984	.53	.52	.07	.06	.66	.85
IT	.999	.46	.45	.02	.02	.73	.79
NL	.995	.43	.42	.05	.05	.75	.83
PT	.997	.53	.53	.03	.02	.66	.75

Notes: Version (1) refers to the baseline assumptions on coverage of insiders. Version (2) refers to that in which all large equity holdings in the household data are counted as insiders. Column 1 compares wealth of version (2) relative to the baseline version (1). Columns 2-7 compare aggregate statistics for the baseline version and alternative version in three areas: the share of wealth held by the richest 10%, the share of total wealth that is accounted for by public equity, and the share of all equity holdings in the augmented HFCS data that are classified as inside equity.

Figure A.4: Outside equity and share of wealth held by entrepreneurs



Notes: The x-axis measures the total share of firm equity that is held by outsiders, analogous to Figure 4a. The y-axis measures the share of wealth held by entrepreneurs in each country.

B Model

B.1 Calibration Details

Table B.1: Worker Income Process

Country	$\sigma_{\theta j}$	Targeted moment: standard deviation(log income)
France	0.326	.749
Germany	0.299	.687
Austria	0.358	.822
Netherlands	0.272	.624

Notes: This table reports the variance of the innovation to worker TFP ($\sigma_{\theta j}$) as well as the data moment used to calibrate it. The data moment is the standard deviation of log income in the 2010 cross-section. Data comes from the Luxemburg Income Survey.

B.2 Micro-founding the Monitoring Cost

The following two-period model micro-founds the functional form of the monitoring cost used in the quantitative model in Section 3 and illustrates how institutional features such as a country's accounting standards or the right of shareholders to sue directors map into the cost shifter c_M.

Consider a risk-neutral entrepreneur who has an idea for a business project. Capital k needs to be invested at $t = 0$ and generates revenues in the following period equal to $y = zk^\nu$ if the project succeeds ($\eta = 0$) and $y = 0$ if the project fails ($\eta = 1$). In period 0, the entrepreneur can sell a fraction $\varphi \in [0, 1]$ of period 1 profits to an outside investor. In period 1, η is realized, but it is only observable to the entrepreneur. If the project succeeds, the entrepreneur can either report truthfully, and receive $(1 - \varphi)\, z\, k^\nu$, or lie and keep the entire output. In the corporate governance literature, such shareholder expropriation is referred to as self-dealing or tunneling and can take the form of excessive compensation, nepotism in hiring, transfer pricing, or outright theft of company assets (see, for instance, Djankov et al. (2005)).

With probability p, insiders are caught, at which point they receive none of the output and pay a fine C. In this simple set-up, entrepreneurs will truthfully report the realization of η iff $(1 - \varphi)zk^\nu \geq (1 - p)zk^\nu - pC$.

Ex-Ante Monitoring Setting the punishment $C = 0$, the minimum level of detection probability p such that insiders are incentivized to report truthfully is simply φ, the share of the project financed by outside equity. The larger is φ, the less skin in the game insiders have, and the more they need to be monitored. Suppose that outside investors can spend resources to monitor the insider, that is, to increase the detection probability p. To achieve a given level of p, the outsider needs to spend resources

$e(p) = c_M\, p\, zk^\nu$. This cost is increasing in zk^ν since it involves, for instance, monitoring the firm's books, which is more costly in a larger firm. This formulation exactly maps into the monitoring cost used in the quantitative model. Further, the better accounting standards in a country, the harder it is for insiders to hide any fund diversion, and the less effort $e(p)$ is required by individual investors for monitoring.

Ex-Post Punishment Fixing the probability of detection, the minimal level of punishment required to induce truthful reporting is $C = (\varphi - p)/p\, zk^\nu\varphi$. Again, this is increasing in output and the share of the company sold to outside investors.

B.3 Determinants of Firm Ownership and Financing

B.3.1 Monitoring Cost

In the quantitative model, minority shareholders of public firms need to pay a monitoring cost to prevent the insider from misusing company funds. In Appendix B.2, I lay out a two-period model that micro-founds the specific functional form used. The model also illustrates two main ways to ensure that insiders do not divert company funds: ex-ante monitoring, to increase the probability that such a diversion is detected, and ex-post punishment. In practice, the former could be greatly facilitated by a country's accounting standards, as argued by LaPorta et al. (1998). Figure 3a in Section 2 shows that there is indeed a positive correlation between a country's share of outside equity and its accounting standards and disclosure requirements.

Concerning ex-post punishment, LaPorta et al. (1998) argue that legal mechanisms which can be used by minority shareholders against perceived oppression by directors are a key component of corporate governance. In the US, derivative suits give shareholders such legal recourse. In Europe, this is much less common, which might be one explanation why corporate ownership is more concentrated in general. According to the World Bank's International Finance Corporation IFC (2015), Germany and Austria are the only two of the nine countries covered in this paper where shareholders cannot enforce directors' duties in their own name. These two countries have among the lowest shares of publicly traded firms.

B.3.2 Cost of IPO

Underwriting fees are arguably the single largest expense associated with an IPO. Abrahamson, Jenkinson, and Jones (2011) collect data on gross spreads for IPOs across countries between 1998 and 2007. Although their focus is on the comparison between the US and Europe, two interesting facts within Europe emerge. First, spreads are decreasing in proceeds, which justifies the assumption of a fixed cost component of going public. Second, Germany has larger spreads than any other European country considered. In particular, spreads on German IPOs of all sizes are significantly larger than in France. This is one promising explanation for the difference in IPO cost I estimate between France and Germany.

B.3.3 Maximum Leverage Constraint

The formulation of debt market frictions in the quantitative model is standard in the entrepreneurship literature. A collateral constraint of the forms $b \leq \lambda (1-\delta)/R\, k$ can for example arise as a result of a limited enforcement problem (see, among many others, Buera and Shin (2011) and Moll (2014) for a microfoundation). Figure 3b in Section 2 illustrates that leverage is indeed higher in countries with stronger creditor rights. In the model, better creditor protection is reflected in a higher λ.

B.3.4 Taxes

Another natural candidate for the underlying drivers of differences across countries in firm ownership and financing is taxation. It should be noted that while this would change the interpretation of the financial frictions, it would have no effect on either the validity of the inference approach in the cross-country quantification or the counterfactuals in the next section. Two features in particular have been argued to affect firms' financing choices: the capital gains tax (e.g., Chari, Golosov, and Tsyvinski (2005)) and the extent to which interest on debt is tax deductible (see e.g. Frank and Goyal (2007) for a comprehensive survey).

However, comparing for example France to Germany or Austria, there does not seem to be an obvious tax-based explanation for the fact that German and Austrian firms use more debt and less outside equity. The capital gains tax is higher in France than in Austria, which implies that selling shares of a firm to outside investors is more expensive.[28] Yet Austrian entrepreneurs are more likely to keep their firms private and not sell any shares. The rules surrounding interest deductibility of debt are similar in the three countries. Corporate taxes, however, are higher in France than in Germany or Austria and therefore, French firms should have more of a tax incentive to take on debt.[29] Again, this is the opposite of what is observed in the data, where French firms have less leverage.

These examples of course do not rule out that taxes are part of the cross-country differences I estimate. However, given that firm ownership and financing lines up well with measures of investor protection, financial frictions arguably play a key role in shaping entrepreneurs' choices and as a result, the distribution of firm ownership in different countries.

[28] The OECD estimates that the effective tax rate on capital gains was 46% in Austria and 56% in France in 2016 (Harding and Marten (2018)).

[29] The statutory corporate tax rate in 2018 was close to 35% in France, just below 30% in Germany and 25% in Austria (OECD (2019)).