Owning Up:
Closely Held Firms and Wealth Inequality

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July 31, 2020

Abstract

This paper studies how wealth inequality is shaped by frictions in debt and equity markets. Using micro data on households and firms for a set of Eurozone countries, I document that in countries with greater wealth inequality, there are more privately held firms and ownership of publicly traded firms is more concentrated. I develop a dynamic general equilibrium model in which entrepreneurs have the option to run a private firm and issue debt, or go public and also issue outside equity. Both forms of external finance are subject to country-specific frictions. More access to debt increases output as well as inequality. More access to outside equity also increases output, but reduces inequality. When parameters are chosen to match the facts I document on firm ownership and financing, the model predicts differences in wealth concentration across countries that closely fit the data. Quantitatively, I find that frictions in equity markets are the key driver of these differences in inequality – they are nearly six times as important as frictions in debt markets.

KEYWORDS: Wealth inequality, heterogeneous agents, financial frictions

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I would like to thank Monika Piazzesi, Martin Schneider, and Melanie Morten for their invaluable guidance. This paper benefited from insightful discussions with and comments by Adrien Auclert, Jose Barrero, Ricardo De La O, Paul Dolfen, Juliane Begenau, Eran Hoffman, Pete Klenow, Pablo Kurlat, Sean Myers, Michael Peters, Richard Rogerson, and Cian Ruane, as well as participants at the Stanford Macro Lunch and the Chicago CITE. Financial support from the Gale and Steve Kohlhagen Fellowship in Economics through a grant to the Stanford Institute for Economic Policy Research, the Dissertation Fellowship by the Ewing Marion Kauffman Foundation, and the Macro Financial Modeling Initiative is gratefully acknowledged.

1 Introduction

What are the main factors that influence wealth inequality? In this paper, I argue that frictions in equity markets play an important role in shaping the distribution of wealth across households. When issuance of outside equity is constrained or costly, entrepreneurs run more closely held firms and rely on their savings as well as debt contracts for investment. As a result, they are heavily exposed to business risk, which encourages precautionary savings and leads to a higher concentration of wealth at the top. Within the Eurozone, I show that frictions in equity markets are a key driver of observed differences in wealth inequality.

To establish this result, I proceed in three steps. First, I document new facts on equity ownership and wealth concentration for a set of Eurozone countries that exhibit large differences in wealth inequality. In particular, I show that in more unequal countries, there are more privately held firms and publicly traded firms tend to remain in the hands of just a few dominant shareholders. Second, to understand the joint determination of firm ownership and the wealth distribution, I develop a dynamic general equilibrium model of entrepreneurship with two types of external finance: debt, which is subject to a friction in the form of a maximum leverage constraint, and outside equity. Issuing outside equity separates ownership and control of the firm and gives rise to an agency conflict, captured in the model by an equity friction. Third, using the data moments previously documented, I identify the parameters governing financial market frictions across countries and quantitatively assess their impact on output and wealth inequality.

The key novelty of this paper is that I explicitly study the impact of equity frictions on the wealth distribution. As such, I extend the influential work of Quadrini (2000) and Cagetti and DeNardi (2006) who have emphasized the importance of debt frictions. Qualitatively, I demonstrate that frictions in debt and equity markets have opposite implications for wealth inequality, despite their similar effects on aggregate output. Lower frictions in either market lead to higher output by making it easier for productive entrepreneurs to access capital. With lower frictions in debt markets, wealth inequality is also higher as productive entrepreneurs expand their firms and accumulate wealth faster. This creates a trade-off between equality and efficiency, which is not present with equity frictions. With lower frictions in equity markets, entrepreneurs are better able to share risk and consequently reduce their precautionary savings. As a result, wealth inequality is lower. Quantitatively, I find that frictions in equity markets are crucial for understanding differences in the wealth distribution across Eurozone countries. They are responsible for over 80% of the explained variation in inequality, compared to 14% for frictions in debt markets.

I document several novel facts relating firm ownership and inequality by combining micro data on households, firms, and their shareholders. I define and measure two margins – intensive and extensive – of the concentration of equity ownership. The extensive margin measures the share of firms in each country that is privately held as opposed to publicly traded. The intensive margin measures the insider share of publicly traded firms, defined as the fraction of equity held by the top three shareholders. To measure the ownership concentration of public firms, I construct a

new dataset on ultimate domestic person shareholders. I find three key facts: First, in more unequal countries, corporate ownership is significantly more concentrated along the extensive margin. Second, on average across Eurozone countries, the insider share is high – 40% – and it tends to be higher in countries with more wealth inequality. Third, relying less on external finance in the form of outside equity, firms in more unequal countries take on more debt.

The model I develop is of a Bewley-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 and both workers' skill and entrepreneurs' productivity are subject to idiosyncratic risk. Entrepreneurs can either run a private firm and finance with debt and inside equity or choose to go public. If they go public, entrepreneurs also choose the ownership structure of their firm, that is, what fraction of the equity in the firm to sell to outside investors. Publicly traded firms therefore have entrepreneurial origins and are run by risk-averse insiders, in contrast to the typical assumption in the literature. How much entrepreneurs rely on either type of external finance depends on three financial market frictions: First, going public comes at a one-off fixed cost. Second, equity issuance entails a proportional cost that scales with the share of outside equity, capturing an agency friction between insiders and outsiders. Third, debt issuance is subject to a maximum leverage constraint.

Through their effect on entrepreneurs' choices, the model provides a mapping between financial frictions and the equilibrium distribution of firm ownership and financing. I leverage this mapping in conjunction with the data moments I document to infer the level of financial frictions, which are not directly measurable. To validate this approach, I show suggestive evidence that it lines up well with indices rating the quality of investor protection, which has been argued to be an important determinants of a countries' financial landscapes (LaPorta, Lopez-de Silanes, Shleifer, and Vishny (1998)). The three key moments that identify financial frictions are the share of private firms, the insider share of publicly traded firms, and leverage. When the cost of IPO is high, fewer entrepreneurs choose to go public and the share of privately held firms in the economy is higher. Similarly, when the agency friction between company insiders and outsiders is high, entrepreneurs keep more equity in their firms conditional on going public and the average insider share of public firms is higher. When debt frictions are high, firms have lower leverage.

I first quantify the model to France, chosen as the baseline country since it has the best coverage in terms of firm-level data. The quantification strategy leverages precisely the relationship between financial frictions and observable firm choices described above.[1] I confirm that the model closely fits non-targeted measures of wealth inequality such as the Gini coefficient, as well as other key moments including the share of total wealth held by entrepreneurs and the relationship between the size of a firm and its insider share. The model generates a high concentration of wealth even at the very top, contrary to existing quantitative models of the wealth distribution. This

[1]The financial frictions backed out by this methodology could in practice reflect other "wedges" such as taxes. I discuss evidence suggesting that the estimated parameters map to the strength of legal investor protection in Section 7.

highlights that correctly measuring and modeling firm ownership is crucial for explaining top wealth shares.

Having quantified the model to fit the French economy, I show that frictions in debt and equity markets have sizeable effects on aggregate output and the distribution of wealth. Starting from the French baseline, improving access to debt increases aggregate output and wealth inequality. This mechanism is similar to the existing literature: with more access to debt, entrepreneurs can increase investment in their firm, leading to higher output. They also make higher profits and accumulate wealth faster, leading to higher inequality. The new channel I propose – barriers to issuing outside equity – does not entail the same trade-off between equality and efficiency. Increasing entrepreneurs' ability to diversify risk while keeping maximum leverage constant reduces wealth concentration. This happens for two reasons: first, less risk exposure means less need for precautionary savings, and second, when entrepreneurial wealth is less exposed to idiosyncratic productivity shocks, the wealth distribution is less dispersed.

The above comparative statics suggest that differences in financial frictions could be an important source of differences in wealth inequality. To estimate how much these frictions vary across countries and to assess their contribution to differences in inequality, I quantify the model for three comparison countries. The countries were chosen to span the range of inequality across Europe, from a top 10% wealth share of 43% in the Netherlands, to 52.6% in France to over 59% in Germany and Austria. The quantification across countries proceeds as follows: All externally set or estimated parameters are kept constant at their baseline values. In the absence of direct measures of frictions in debt and equity markets, the three parameters governing financial frictions are inferred for each country by matching the same set of moments on firm financing and ownership as for France. Since firm financing choices are tightly linked to firm size, I also re-estimate the TFP process in each country to fit the firm size distribution.[2]

Three key results emerge from the quantitative model. First, financial frictions play an important role in explaining differences in wealth inequality across countries. The differences in financial frictions I back out are large – large enough to generate a range of wealth inequality across countries that is quantitatively close to the data. The model correctly predicts that in Germany and Austria, where equity frictions are higher and debt frictions are lower than in France, entrepreneurs own a larger fraction of aggregate wealth. As a result of the estimated frictions, top 10% wealth shares are more than 6 percentage points higher than in France. The opposite is true for the Netherlands, where inferred equity frictions and top wealth inequality are lower.

The second striking finding is that equity frictions are quantitatively much more important than debt frictions. I decompose the contribution of the different frictions to wealth inequality by moving them to the French level one at a time. On average, frictions in equity markets are responsible for about 80% of the explained variation in top wealth shares, compared to only 14%

[2]This approach avoids erroneously attributing any observed differences in firm ownership and financing that are driven by the underlying productivity distribution to frictions in financial markets. When decomposing the differences across countries however, I find that TFP differences play only a minor role.

for frictions in debt markets.

Third, I analyze the effects of a counterfactual harmonization of all financial markets within the Eurozone. More precisely, I set estimated frictions to the French level for all three comparison countries. Such a harmonization would have moderate effects on aggregate output – GDP would increase by about 3% in Austria and stay roughly constant in Germany –, but large effects on aggregate wealth and its distribution. Total wealth held by Germans would decline by about 18% and the share of wealth held by the richest 10% would decline from nearly 60% to about 53%. This is a result of German entrepreneurs switching from mostly debt-financed, risky investment, to running firms financed with outside equity, which improves risk-sharing and reduces the need for precautionary savings.

What do the estimated financial market frictions map to in practice? By using a structural model in combination with observable firm choices, the quantitative approach in this paper complements a qualitative literature arguing that financial market institutions differ across countries and matter for firm ownership and financing (LaPorta, Lopez-de Silanes, Shleifer, and Vishny (1998)). I show that my measures indeed correlate with various indices proposed by the literature on law and finance. First, I micro-found the agency conflict between insiders and outsiders of the firm and show that strong accounting standards could reduce the need to monitor controlling shareholders. Within Europe, I find that accounting standards indeed tend to be better in countries with more dispersed corporate ownership. Second, underwriting fees in German IPOs are on average higher than in the rest of Europe (Abrahamson, Jenkinson, and Jones (2010)). This could explain why there are more privately held firms in Germany, and hence why the quantitative model implies a higher fixed cost of going public in Germany. Third, in countries where firms are more highly levered, creditor rights in case of insolvency tend to be stronger. The stronger the creditor rights, the lower the debt market frictions in the model.

1.1 Related Literature

This paper is most closely related to a literature that focuses on the role of entrepreneurship in incomplete markets models à la Aiyagari (1994); Huggett (1996); Bewley (1977) for explaining the distribution of wealth across households (Quadrini (2000), Meh (2005), and Cagetti and DeNardi (2006)).[3] Models in this literature typically assume that entrepreneurs own 100% of the equity in their businesses and have access to only debt.[4] I add to this literature by demonstrating

[3]Other mechanisms that have been proposed to explain savings behaviors of the wealthy are heterogeneous returns to investment (Benhabib, Bisin, and Luo (2018), Lusardi, Michaud, and Mitchell (2017), and Kacperczyk, Nosal, and Stevens (2018)); high skewness in labor earnings (Castenada et al. (2003)) – Arellano, Blundell, and Bonhomme (2017) and Guvenen, Karahan, Ozkan, and Song (2016) provide empirical support of this mechanism; bequests and inheritances (DeNardi (2004), DeNardi and Yang (2004), and DeNardi and Yang (2016)); and preference heterogeneity (Krusell and Smith (1998) and Hendricks (2004)). DeNardi (2015) provides a comprehensive survey of quantitative models of the wealth distribution.

[4]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.

the importance of a different source of external finance – outside equity, which not only provides financing, but also reduces risk exposure.[5] By studying the effect of equity frictions on aggregate outcomes, this paper also contributes to a broader literature on entrepreneurship and financing constraints, started by Evans and Jovanovich (1997).[6] Quantitative models of debt frictions and entrepreneurial firms have been used in the contexts of development and growth (Buera, Kaboski, and Shin (2002); Buera and Shin (2008)), and private businesses in the US (Bhandari and McGrattan (2018)). I build on theoretical models of financial market frictions that have studied both the lack of external finance (Moll (2014) and Buera and Shin (2011)) and limits to insurance against production risk (Angeletos (2007), Covas (2006), and Meh and Quadrini (2006)).

On the empirical side, there is an active literature focused on documenting wealth inequality and its evolution over time. Saez and Zucman (2016) use data on capital income to infer wealth holdings; while Chetty, Hendren, Kline, and Saez (2014); Smith, Yagan, Zidar, and Zwick (2019); Fagereng, Guiso, Malacrino, and Pistaferri (2018) use administrative tax data for the US and Norway. While my paper is not primarily about measurement, it contributes to this literature by pointing out a correlation between wealth inequality and firm financing across countries.

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

Lastly, 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 capital accumulation 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), who model outside equity as

[5]The risk-sharing benefits of equity are also present in Dyrda and Pugsley (2017). While they focus on the effect of tax reforms on *income* inequality, I show that debt and equity financing have opposite effects on *wealth* inequality. In their model, entrepreneurs face a binary choice between financing with inside or outside equity. In this paper, entrepreneurs also choose the intensive margin of equity – that is, how much of their firms to sell – and remain in charge of business decisions after going public.

[6]Buera et al. (2015) and Quadrini (2009) provide comprehensive surveys of macroeconomic models of entrepreneurship.

offering diversification at the cost of losing private benefits of control or introducing an agency cost.[7] 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.

The paper is structured as follows. Section 2 introduces the datasets and presents the main facts. Section 3 lays out a dynamic general equilibrium model in which entrepreneurs choose debt and equity financing of their firms. Section 4 quantifies the model, shows how moments on firms' external finance identify financial frictions, and contrasts the role of frictions in debt and equity markets. Section 5 repeats the quantification exercise for three comparison countries, assesses the effect of financial frictions on wealth concentration and conducts counterfactuals. In Section 6, I show robustness of the results to the choice of targeted moments. Section 7 discusses welfare implications and relates the financial frictions to different institutions across countries. Finally, Section 8 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. In particular, I show that public firm ownership is concentrated in the hands of a few shareholders, contrary to the typical assumption in the literature.[8] On average, insiders hold over 40% of the equity of each public firm. Further, large shareholders tend to be domestic. Private firms are predominantly owned by one person only, which might reflect the fact that venture capital and other forms of institutionalized private equity are not (yet) prominent in the financing landscape of continental Europe. The facts on ownership of public and private firms are essential for guiding the set-up of the model in Section 3.

Second, I analyze how patterns of firm ownership and financing vary across countries and how they correlate with wealth inequality. Countries within the Eurozone differ markedly in the aggregate importance of closely held firms (which comprises both private firms and concentrated ownership of public firms), as opposed to equity owned by dispersed shareholders. Further, this correlates with wealth inequality: in countries with more wealth concentration at the top, there are more privately held firms and ownership of public firms is more concentrated. In an accounting decomposition, I find that differences in firm ownership account for about two thirds of the standard deviation of wealth inequality across Eurozone countries. In more unequal

[7] 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), Jovanovich and Rousseau (2001) study when to go public.

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

countries, firms also tend to use more debt financing. These relationships indicate that firms' access to external finance, and in particular the split between debt and equity, is likely to be important for understanding differences in wealth concentration.

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 composition and distribution of household wealth comes from the first wave of the HFCS, which was 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 top wealth inequality. 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.[9] I use Greece whenever data availability permits. The nine countries account for over 93% of Eurozone GDP.

From this survey I use two key variables: household wealth and the value of privately held firms. 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 via mutual funds), private pension savings, and the value of closely held private firms where 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 by the owner of the company. Appendix A lists the exact phrasing of the question.

In most countries, entrepreneurs are asked which industry their business operates in. This information is useful to ensure that businesses are indeed productive units, as opposed to 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%). "Finance and Insurance Activities", the industry that is most likely associated with non-productive firms, accounts for only 2.5% of firms and 1.8% of value.

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.[10] Size is measured as market value in 2009, the year the household survey was administered. I combine the aggregate value of privately held businesses from the household data with the ag-

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

[10] Table C.2 shows the results of using country of incorporation as an alternative definition.

gregate 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.[11] 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, company, financial institution, or government body; and their firm ID if the shareholder is a company itself. 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. Because of this, it is easy to overstate the ultimate ownership concentration. For example, if firm B owns 90% of firm A, a naive approach would conclude that ownership of firm A 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 who 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 drop any shares held by banks or financial institutions, meaning I treat them as if they were dispersed shareholders.[12]

Using my constructed measure of ultimate shareholders, insiders of public companies are defined as the top three domestic 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

[11] 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 version provided as historical disks from the Bureau van Dijk.

[12] 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.

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

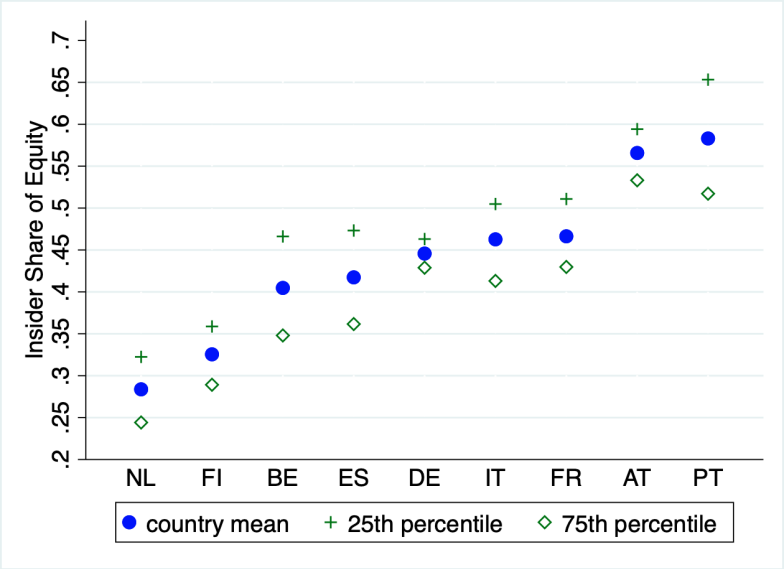
Insider Shares Within and Across Countries The average insider share is the first important fact I document in this section. I find that the top three shareholders of each publicly traded firm own, on average, 43.7% of the equity. Thus, they are likely crucial in decision-making and further highly exposed to idiosyncratic risk of the firm. 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: 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 a 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 Germany or the Netherlands, or (ii) firms in Germany are, on average, smaller than Dutch firms, and hence observed insider shares are higher in Germany. 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 German firms have lower insider shares than small German firms, but still higher insider shares than small Dutch firms. Table C.1 in Online Appendix C 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.

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

Figure 1: Insider share and size country by country



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

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 for 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, private equity markets are less important than in the US or the UK and privately held firms are typically owned by one person who actively manages the firm. I confirm this using both the HFCS and, for Germany, Amadeus. The HFCS asks entrepreneurs to report what share of their business they own. 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%. HFCS also asks 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 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 Firm Ownership, Financing, and Inequality Across Countries

This section analyzes the relationship between three components of firm ownership and financing – the share of public firms, the insider share in public firms, 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]

2.3.1 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 representative also 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 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 C shows robustness to these assumptions.

2.3.2 Correlates of Wealth Inequality Across Countries

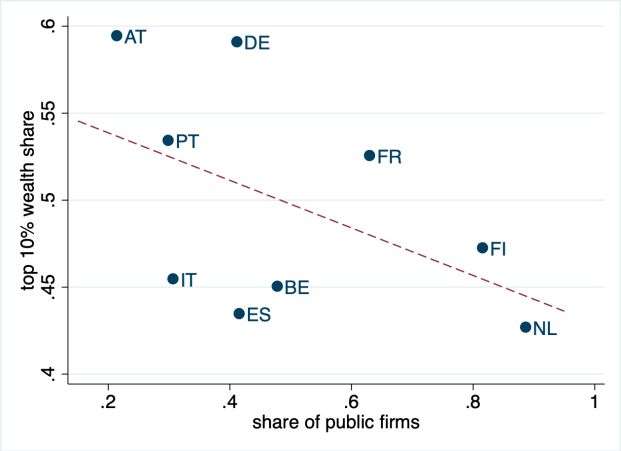
Panels (a) and (b) of Figure 2 illustrate how the importance of public equity varies across countries and how it co-moves with wealth inequality. The vertical axis on all panels measures the share of wealth held by the richest 10% of households. Panel (a) plots inequality against the extensive margin of public equity: the total share of firm value that is publicly traded as opposed to privately held. The range across countries is large: in the Netherlands, less than 20% of firm value is in privately held businesses, whereas in Austria, private firms account for nearly 80% of aggregate firm value. Further, the relationship is negative: in countries with more wealth inequality, publicly traded firms are less important.

Panel (b) plots wealth inequality against the intensive margin of public equity: the share of equity in public firms that is dispersedly held. This measure corresponds to one minus the insider share defined in Section 2.2. Similar to the extensive margin, in more unequal countries, there is a larger insider share conditional on a firm going public.

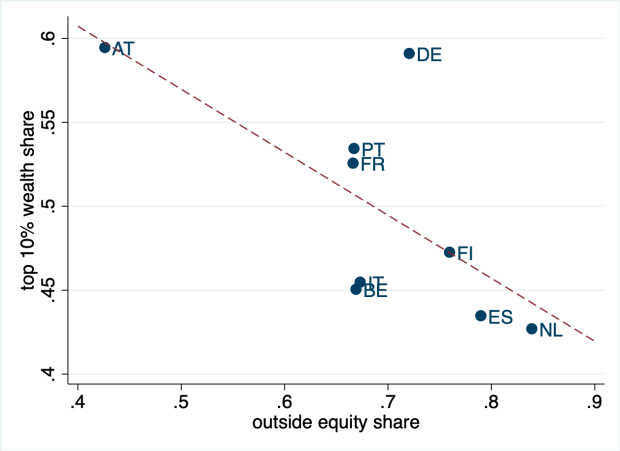
[13] Results are qualitatively robust to using different quantiles of the wealth distribution.

[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.

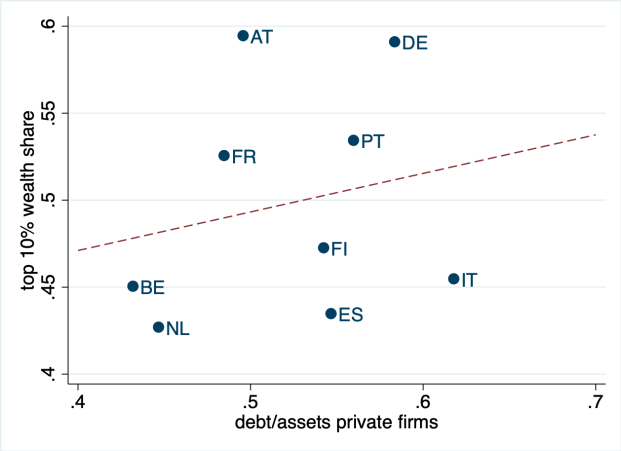
Figure 2: Firm financing and wealth inequality



(a) Share of public firms



(b) Share of outside equity in public firms



(c) Leverage

Notes: In all three panels, the y-axis measures the share of wealth held by the richest 10% of households in each country. Panel (a) plots inequality against the share of firms (measured as value) that is publicly traded. Panel (b) plots the average share of equity in public firms that is held by the top three domestic person shareholders. Panel (c) plots the aggregate debt/asset ratio for private firms in each country. All variables are computed using the HFCS, Amadeus Financials and Ownership, and Compustat Global. See text for details.

A corollary of panels (a) and (b) is that the two margins of outside equity move together across countries. On the one hand, in countries like Austria and Portugal, ownership and control of firms are tightly linked. Most businesses are privately held and even when firms go public, they remain closely held. On the other hand, in countries like the Netherlands or Finland, ownership and control of firms tend to be more separated: Most firm value is in publicly traded firms, and ownership of these public companies is more dispersed.

In the absence of outside equity, there are two ways firms can finance investment: personal savings (inside equity) and debt. How much firms rely on debt is important in the context of this

paper since the ability of entrepreneurs to lever up and increase investment in their firms impacts wealth accumulation. Panel (c) of Figure 2 plots the relationship between average leverage in the economy and wealth inequality. Leverage is defined as the ratio of total outstanding liabilities to total assets of the firm, netting out cash holdings. As we would expect based on, for example, the work of Cagetti and DeNardi (2006), this relationship is positive, albeit weak. In countries with more inequality, firms rely more on debt financing.

2.3.3 Differences in Wealth Inequality: An Accounting Decomposition

Figure 3 plots wealth inequality and its components across countries, separating Northern and Southern European countries.[15] The height of the bars measures the share of aggregate household wealth held by the richest 10%. Within Europe, the most unequal countries are Germany and Austria, where nearly 60% of wealth is held by the richest one-tenth of households. The Netherlands, Spain and Belgium are much more egalitarian by this measure; the share of wealth held by the richest 10% is less than 45%. The three colors decompose the top 10% wealth share into the two types of inside equity – private firms (the dark blue bars) and insider shares of public firms (the medium blue bars) – and all other types of wealth (the light blue bars).

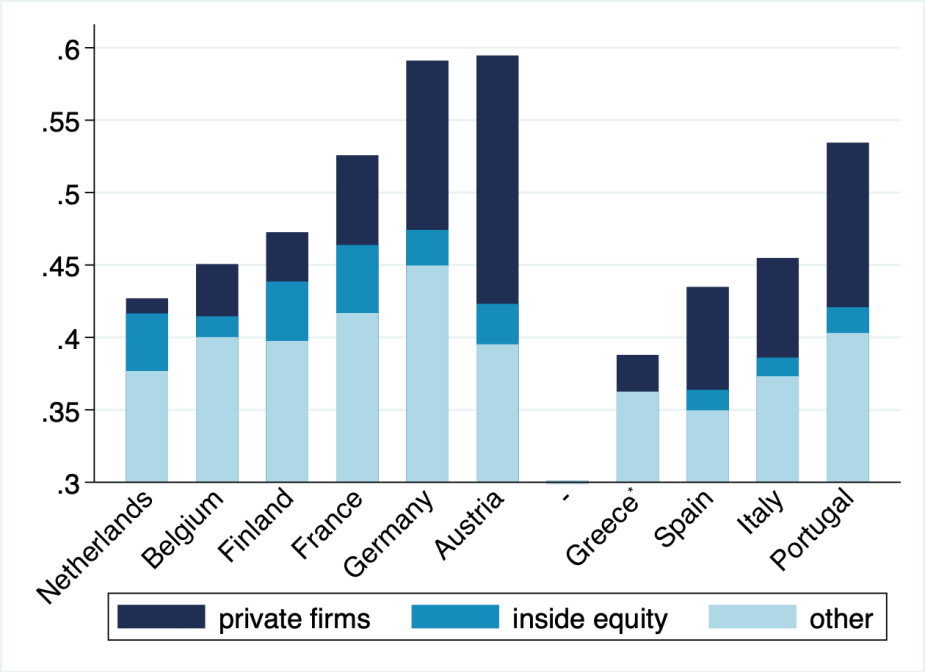
The two types of inside equity account for a large share – about two thirds – of the differences in wealth inequality across countries. Visually, the dispersion in wealth inequality is much smaller when counting only non-business wealth (the light blue bars). Quantitatively, the cross-sectional standard deviation of wealth inequality is reduced by 62% when removing private businesses and by a total of 65% when also removing insider shares of public firms.

Figure 3 also illustrates that both kinds of inside equity are important for understanding differences in wealth inequality. Take, for example, Finland and France: by measuring only privately held firms, one would have missed about half the difference compared to the Eurozone average. Comparing the Netherlands and Spain highlights that different aspects of firm ownership are more important in different countries. In Spain, it is mostly privately held firms that contribute to wealth inequality, while insider shares of public firms are more important in the Netherlands.

In summary, this section documents that there are large differences across countries in terms of the ownership of productive capital. In Germany for example, around three quarters of firm value is closely held, either in private or in public firms, whereas in the Netherlands, around three quarters of firm value is held by atomistic shareholders. In an accounting sense, these differences in ownership are responsible for about two-thirds of the differences in top wealth concentration. To understand why ownership structures differ across countries, how that depends on debt and equity markets and how it affects wealth accumulation of entrepreneurs, one needs a quantitative model.

[15] The main pattern, namely that there is more of both types of inside equity in more unequal countries, is present in both sets of countries. Since there is a level difference in terms of wealth inequality between the North and the South of Europe, I separate the two sets of countries for visual clarity.

Figure 3: The contribution of closely held firms to differences in wealth inequality



Notes: The full bars show the share of wealth held by the richest 10% of households. The dark blue bars measure the value of private firms held by the richest 10%. The medium blue bars measure the total value of public equity held by insiders. Data comes from the HFCS, Amadeus Ownership, and Compustat Global; see text for details. For Greece, I do not have data on insiders of public firms.

3 Model

The facts documented in the previous section suggest that heterogeneity in wealth inequality across European countries is tightly linked to ownership and financing structures of firms. In order to understand how firm ownership and financing are chosen, and how these choices shape the distribution of wealth in the economy, I develop a dynamic general equilibrium model. Each European country is a small open economy facing a common gross interest rate R, but labor markets clear domestically.[16] 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 all risk is idiosyncratic. The importance of idiosyncratic risk for private business owners is well documented, by, for example, Hurst, Lusardi, Kennickell, and Torralba (2010) and Moskowitz and Vissing-Jorgensen (2002).

In the model, publicly traded firms have entrepreneurial origins. They are controlled by risk-

[16]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)).

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.[17] 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 one of two types: entrepreneurs e or workers w. Workers are endowed with a skill level $\theta_t \in \Theta$ every period, which they supply to entrepreneurs in exchange for labor income $w\theta_t$. Entrepreneurs have access to a production technology and differ in their productivity level $\tilde{z} \in \tilde{\mathbb{Z}}$. 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. An agent who dies is replaced by a new one who starts life with assets equal to a weighted average of the assets of the deceased agent they replaced, and average assets in the economy. χ is the weight on inheritance, that is, parents' assets. The dependence on average wealth $(1-\chi)$ captures any government provided "starting wealth", such as access to free education and child support, that is equally distributed among the population. Newly born agents draw a type $j' \in \{e, w\}$ and corresponding skill or productivity level $i' \in \{\tilde{\mathbb{Z}}, \Theta\}$. The correlation between parent and child type is governed by an exogenous transition matrix.

Firms have two stages in life: young and old. 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 are allowed 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 the quantification of the model, but otherwise have no impact on the main mechanism.

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

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

Implicit in this formulation is that agents derive utility only when alive, and do not care about their offspring. The expectation is taken with respect to the agent's idiosyncratic shocks. The felicity function $u_j(.)$ is type-specific, allowing for non-pecuniary benefits of entrepreneurship.[18]

[17] 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 (2016).

[18] See for example Hurst and Pugsley (2015).

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:

$$\tilde{y}_t = \tilde{z}_t^{1-\psi} \left(k_t^{\alpha}\, l_t^{1-\alpha}\right)^{\psi} \tag{2}$$

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. Business investment is risky: $\tilde{z}_t$ follows a Markov chain with an absorbing state at $\tilde{z}_t = 0$. At birth, entrepreneurs draw a level of $\tilde{z}$, which thereafter either remains constant, or drops to 0.[19] The absorbing state captures firm failure. It is i.i.d. across firms and over time and occurs with probability η. If the firm fails, the business idea loses its value forever, installed capital can be resold, and the entrepreneur starts the next period as a worker. This simple shock structure captures the most important uncertainty for entrepreneurs: business failure.

Labor is hired in a spot market after the entrepreneur observes the realization of $\tilde{z}_t$. Investment decisions depend on expected revenues net of labor costs, which are given by:

$$y_t \equiv \max_{l_t} \tilde{y}_t - w l_t = z_t k_t^{\nu}, \tag{3}$$

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

Assets. There are three assets agents can hold. First, both entrepreneurs and workers can save in one-period bonds with gross return R. Neither entrepreneurs nor workers can borrow directly. Second, entrepreneurs also hold equity in their firms. This consists of invested capital net of outstanding debt as well as the value of the "blueprint" of the firm. Given that the production technology has decreasing returns to scale, firms make positive profits in equilibrium. The right to operate a firm therefore has value, which is what I refer to as the blueprint. The third asset is outside equity – shares of publicly traded companies that are not held directly by entrepreneurs. Outside equity is held by investment funds, which have a fully diversified portfolio of firm shares and therefore also earn a rate of return R. From the point of view of households, shares of the investment fund and one-period bonds are perfect substitutes. I refer to holdings of either of the two securities as bonds, a. Total wealth of agents comprises their holdings of bonds and, in the case of entrepreneurs, the equity they hold in their firm.

[19] 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 Pugsley, Sedlacek, and Sterk (2020) who show that ex-ante heterogeneity accounts for a large share of the cross- sectional dispersion in employment in the US.

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 and is constrained by a limited enforcement problem. Lenders can only issue risk-free debt, and hence the amount a firm can borrow is limited by how much lenders can recover in the worst state of the world: firm failure. Assets are worth $(1-\delta)k_t$ in case the firm exits, of which lenders can seize a fraction λ. Section 7 discusses micro-foundations of the borrowing constraint. These assumptions imply that the amount of debt a firm can issue is constrained by its 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 as such determines how much they are willing to lend to entrepreneurs. Given the return structure and the borrowing constraint (4), debt is risk-free and priced at the gross interest rate R.

The firm can also adjust equity 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, which can be positive or negative, are by definition equal to net revenues minus capital investment $(k_{t+1} - (1-\delta)k_t)$ and debt expenditure $(Rb_t - b_{t+1})$:

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

Dividends of the firm are split according to ownership shares every period. An entrepreneur who sold, say, $\varphi = .6$ of the firm to outside investors will receive (or pay) 40% of dividends, while investors receive the remaining 60%. Even after going public and selling a share $\varphi < 1$ of equity in the firm, an entrepreneur remains fully in charge of making investment and financing choices.

Outside Equity. Outside equity is bought by investment funds. They observe firm productivity z_t and the entrepreneur's current assets and use these two state variables to forecast dividends. 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, implying that the price paid by the investment fund is equal to the value of the shares.[20]

Going public and selling part of the company to outside investors entails a 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 literally divert company funds by using them for personal purposes. Since decisions of the firm are at her discretion, the entrepreneur would reap the full benefits of such a diversion, but she would only bear a share $(1-\varphi)$ of the resulting reduction

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

in firm profits. In order 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:

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

Section 7 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 is increasing in the share sold to outsiders, φ. This captures the idea that the higher is φ, the lower the share of dividends that accrues to the insider, and hence 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 zk^{ν}.[21] This reflects the idea that hiding any given amount of fund diversion is easier in a larger firm, so again, outside investors need to spend more resources monitoring the insider. Third, the monitoring cost depends on the scale factor c_M. c_M is the second financial friction that differs across countries. It captures a range of institutional features across countries, such as (minority) shareholder rights in the spirit of LaPorta et al. (1998). In Section 7 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. rights of minority shareholders vis-a-vis management).

After taking monitoring expenses into account, the per-period pay-off for outsiders is given by:

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

From the point of view of the outside investor, c_M acts like a reduction in firm productivity. Chemmanur et al. (2009) provide empirical support for this modeling choice by documenting that productivity of US manufacturing firms drops after an IPO.

The IPO decision and the share of the firm sold to outsiders φ are irreversible choices. The data support this assumption. Figure A.2 in Appendix A shows that there is no relationship between the insider share and firm age. While the ownership split of the firm, φ and $(1-\varphi)$, cannot be changed after the IPO, firms can still raise money from outside investors by diluting equity. For example, if a firm needs to raise an extra \$100 of equity, outside investors will contribute \$100φ, while the entrepreneur puts up the remaining cash.

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

[21] 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 $(1 - \tilde{c}_M) = (1 - c_M)^{(1-\alpha)\psi}$.

[22] In Section 7, I discuss evidence of IPO cost declining in firm size, justifying a fixed cost of going public.

3.2 Choice Problems

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

$$\begin{aligned} V_{\mathrm{w}}(X;\theta) = \max_{c,a',X'} \; & u_{\mathrm{w}}(c) + \beta(1-\pi_d)\mathbb{E}_{\theta'}[V_{\mathrm{w}}(X';\theta')] \\ \text{s.t.} \;\; & c + a' = X, \\ & X' = w\theta' + Ra', \\ & a' \geq 0. \end{aligned} \tag{7}$$

Young Entrepreneur's Problem. A private entrepreneur who has not been hit by the exit shock enters each period with cash on hand $X = Ra + zk^{\nu} + (1-\delta)k - Rb$. 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 consumption, investment k', and net savings $\tilde{a}'$ to maximize:

$$\begin{aligned} V_Y(X;z) = \max_{\{c,\tilde{a}',k',X',X'_w\}} \; & u_{\mathrm{e}}(c) + \beta(1-\pi_d)\{(1-\eta)\left(\pi_o\, V_O(X';z) + (1-\pi_o)V_Y(X';z)\right) \\ & \qquad + \eta\, \mathbb{E}_{\theta}[V_{\mathrm{w}}(X'_{\mathrm{w}};\theta)]\,\} \\ \text{s.t.} \;\; & c + \tilde{a}' + k' = X, \\ & X' = R\tilde{a}' + zk'^{\nu} + (1-\delta)k', \\ & X'_{\mathrm{w}} = R\tilde{a}' + (1-\delta)k' + w\theta', \\ & \tilde{a}' \geq -\lambda\frac{(1-\delta)}{R}k'. \end{aligned} \tag{8}$$

With probability $(1-\eta)$, the firm survives, in which case it either matures, which happens with constant probability π_o, or the entrepreneur remains an owner of a young firm. In both cases, the cash on hand next period is equal to firm revenues net of labor cost and undepreciated capital, plus net savings. With probability η, the firm fails, and the entrepreneur becomes a worker with starting assets given by the 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 of the equity in their firm. Cash on hand in the period of the

IPO $\tilde{X}$ is equal to pre-IPO cash on hand X plus the proceeds V_{IPO}, minus the fixed cost.

$$V_O(X,z) = \max\left\{V_{PRIV}(X,z), \max_{\varphi}\{V_{PUB}(\underbrace{X + V_{\text{IPO}}(X,z,\varphi) - c_{\text{IPO}}}_{=\tilde{X}}, z, \varphi)\}\right\} \tag{9}$$

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

$$\begin{aligned} V_{PRIV}(X;z) = \max_{\{c,\tilde{a}',k',X',X'_f\}} & u_{\text{e}}(c) + \beta(1-\pi_d)\{(1-\eta)\, V_O(X',z) + \eta\, \mathbb{E}_\theta[V_{\text{w}}(X'_{\text{w}};\theta)]\,\} \\ \text{s.t.}\quad & c + \tilde{a}' + k' = X, \\ & X' = R\tilde{a}' + zk'^{\nu} + (1-\delta)k', \\ & X'_{\text{w}} = R\tilde{a}' + (1-\delta)k' + w\theta, \\ & \tilde{a}' \geq -\lambda\frac{(1-\delta)}{R}k'. \end{aligned} \tag{10}$$

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 $X = Ra + (1-\varphi)\left[zk^{\nu} + (1-\delta)k - Rb\right]$. Net savings are $\tilde{a} \equiv a - (1-\varphi)b$, which include *their* share of firm debt. The public entrepreneur's problem is similar to the private entrepreneur's:

$$\begin{aligned} V_{PUB}(X;z,\varphi) = \max_{\{c,\tilde{a}',k',X',X'_f\}} & u_{\text{e}}(c) + \beta\{(1-\eta)\, V_{PUB}(X';z,\varphi) \; + \eta\, \mathbb{E}_{\theta'}[V_{\text{w}}(X'_{\text{w}},\theta')]\} \\ \text{s.t.}\quad & c + \tilde{a}' + (1-\varphi)k' = X, \\ & X' = (1-\varphi)\left[z'k'^{\nu} + (1-\delta)k'\right] + R\tilde{a}', \\ & X'_{\text{w}} = (1-\varphi)(1-\delta)k' + R\tilde{a}' + w\theta', \\ & \tilde{a}' \geq -(1-\varphi)\lambda\frac{(1-\delta)}{R}k'. \end{aligned} \tag{11}$$

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 present discounted value of expected future profits, discounted at the interest rate R. The entrepreneur's choice of capital, and hence the value of the firm, depends on *post-IPO* cash on hand, the share sold, and firm productivity. The value of firm shares V_{OI} solves the following recursive relationship

$$\begin{aligned} V_{OI}(\tilde{X},z,\varphi) =& \varphi k(\tilde{X},z,\varphi)\left(-1 + \frac{1-\delta}{R}\right) \\ & + \frac{(1-\eta)}{R}\left(\varphi\, zk(\tilde{X},z,\varphi)^{\nu}\,(1-c_M) + V_{OI}(X'(\tilde{X}),z,\varphi)\right). \end{aligned} \tag{12}$$

Using the definition from (9), each level of post-IPO cash on hand $\tilde{X}$ maps to a level of pre-IPO cash on hand $X = \tilde{X} - (V_{OI}(\tilde{X}, z, \varphi) - c_{\text{IPO}})$. The proceeds of the IPO received by the entrepreneur, V_{IPO}, were defined as a function of pre-IPO cash on hand. The two definitions are linked through the identity $V_{OI}(\tilde{X}, z, \varphi) = V_{\text{IPO}}(\tilde{X} - (V_{OI}(\tilde{X}, z, \varphi) - c_{\text{IPO}}), z, \varphi)$.

3.3 Equilibrium

The collection of individual state variables of agents in the economy, $\sigma = \{X, i, \tau\}$, includes cash on hand as well as the type of each agent, which are skill and 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 – the share of workers S_{w} – needs to equal the total demand for workers by young, private, and public firms:

$$S_{\text{w}} = \int_i l_Y(i; w)di + \int_i l_{PRIV}(i; w)di + \int_i l_{PUB}(i; w)di. \tag{13}$$

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 $\{V_{\text{w}}, V_Y, V_O, V_{PRIV}, V_{PUB}\}$, allocations for workers $\{c_{\text{w}}, a'_{\text{w}}\}$, allocations for young entrepreneurs $\{c_Y, \tilde{a}'_Y, k_Y, l_Y\}$, allocations for mature private entrepreneurs $\{c_{PRIV}, \tilde{a}'_{PRIV}, k_{PRIV}, l_{PRIV}, \varphi\}$, allocations for public entrepreneurs $\{c_{PUB}, \tilde{a}'_{PUB}, k_{PUB}, l_{PUB}\}$, prices $\{w, V_{OI}\}$, and a constant distribution over types $\{\mu^*\}$ such that

1. Given prices, allocations and value functions solve agents' problems (7) - (11).
2. V_{OI} is given by equation (12).
3. The labor market clearing condition (13) holds.
4. The distribution of types satisfies $\mu'(\sigma|\mu^*) = \mu^*(\sigma)$.

Wealth Holdings and the Value of Firms. One of the objects of interest that come out of the model is the distribution of wealth across agents in the stationary equilibrium. There are two types of wealth agents can hold: bonds and firms. The value of firms consists of the value of capital, net of outstanding debt, and the value of the blueprint, which is the expected value of future firm profits, or dividends. I refer to the combination of the two as the value of the firm and use the term blueprint for the value of the right to operate a production technology. For public firms, the blueprints are traded, and their market price is the value of shares to outside investors, given by Equation (12). The market price of shares is used to value the inside equity

of an entrepreneur with a given level of cash on hand, productivity, and insider share. Private firms are not tradable. 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 future dividends.

3.4 Frictions and the Choice of Firm Financing

This section provides intuition for the key novel part of the model: the choice of whether and how much outside equity to issue. I start by describing how the market value of the firm – that is, the proceeds of an IPO from the point of view of the entrepreneur – depends on the share of outside equity. Then I analyze which types of entrepreneurs choose to go public and how much they sell. The last part discusses how the choice of firm financing depends on the three financial frictions: the maximum leverage constraint λ, the cost of IPO c_{IPO}, and the monitoring cost c_M. This mapping between frictions and observable firm choices is precisely what I will leverage to infer the level of frictions and quantify the model. All graphs use the results of this quantification from Section 4.

Investment Policies and the Value of the Firm. Investment in the firm is increasing in the share φ sold to outsiders. This can be seen most easily from the public entrepreneur's problem in Equation (11). If there were constant returns to scale ($\nu = 1$), the entrepreneur's own investment in the firm, $(1-\varphi)k'$, would be independent of the share sold. The overall investment in the firm k' would scale one for one with the share sold to outsiders. With decreasing returns to scale, investment k' is still increasing in the share sold to outsiders, albeit less than one for one.

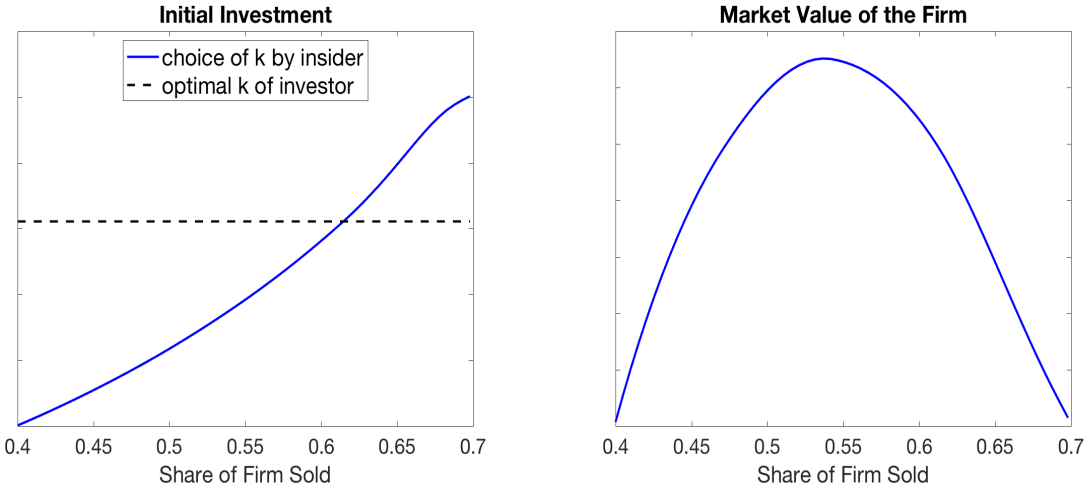
Entrepreneurs who sold more of their firm choose higher investment for three reasons. First, the more of the firm is sold, the less of any given amount of investment the entrepreneur must finance, making the borrowing constraint less likely to bind. Second, an entrepreneur who owns less of the firm faces less risk and is more willing to invest in capital. Third, an entrepreneur who sold more of their firm has more liquid cash – the proceeds of the IPO – to finance investment. The left panel of Figure 4 illustrates this: it plots the initial investment of the entrepreneur – in the period in which the firm goes public – as a function of the share of outside equity.

The market value of the firm, that is, the value of the firm to outside investors is in general a non-monotonic function of the share sold.[23] This is driven by the insider's investment policy in combination with the monitoring cost. From the point of view of outsiders, the optimal investment in the firm is lower than what an unconstrained entrepreneur would choose. This is because outside investors need to pay the monitoring cost, which scales with output. Their optimal investment level is depicted as the dashed line in the left panel of Figure 4. For low values of φ, the entrepreneur is constrained and invests an initial amount below what outsiders consider optimal. In this region, the market value of the firm is increasing in the share sold. Eventually, however, the fact that more and more resources need to be spent monitoring insiders

[23] For very low (high) levels of cash on hand, the market value of the firm is increasing (decreasing) everywhere.

dominates, and the value of the firm starts declining in the share sold.

Figure 4: Investment and firm value as a function of the share sold to outsiders

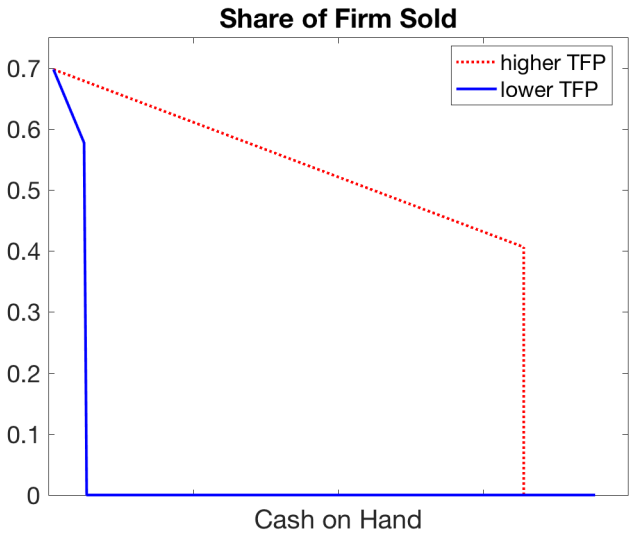


Notes: Both panels are based on the results of the quantification in Section 4. The left panel plots the entrepreneur's current period investment as a function of the share of the firm sold. The dashed line corresponds to the choice of capital investment the outside investor would make. The right panel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

The Optimal Choice of φ. There are three main benefits of selling equity to outside investors: access to additional external finance, diversification, and "cashing out". The third benefit refers to the fact that agents would like to front-load consumption and selling a claim to future profits allows them to do so. 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 5 shows. Further, the higher the 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 more of their company. 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 a certain level of wealth is a result of the fixed cost of IPO. Entrepreneurs compare the value of selling the optimal share to outsiders to the value of remaining private and choose to go public whenever the difference in values is large enough to justify paying the fixed cost. Where that threshold lies exactly, and hence what share of 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.

Figure 5: Entrepreneurial wealth, productivity, and the optimal insider share



Notes: Figure 5 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 dashed red line corresponds to an entrepreneur with high productivity $z = z_3$, the solid blue to one with medium productivity $z = z_2$.

Financial Frictions and the Choice of External Finance. If both the fixed cost of IPO and the monitoring cost were zero, all mature firms would go public immediately, and sell 100% of their company to outsiders. This is true irrespective of the tightness of borrowing constraints. In the absence of any frictions, selling the company is simply selling a risky asset for its expected value. If the fixed cost were zero, but $c_M > 0$, all mature firms would go public and sell some – potentially very small – share $\varphi < 1$. 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 of the differences between firms would be along the extensive margin: below a certain wealth threshold, entrepreneurs would sell 100% of their firm, and above the threshold, none. 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 also reduces the value of running 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.

4 Quantification: Financial Frictions in France

In order to infer the level of frictions in debt and equity markets and to assess their contribution to differences in wealth inequality across Eurozone countries, I now quantify the model. I start by describing the parametrization of the model and then discuss the quantification strategy in more detail.

4.1 Parametrization

Preferences. Workers have CRRA utility u_{w} with risk aversion σ. In the spirit of Hurst and Pugsley (2015), entrepreneurs derive non-pecuniary benefits $\bar{c}$ from running their own firm: $u_{\mathrm{e}}(c) = (c + \bar{c})^{1-\sigma}/(1-\sigma)$

Entrepreneurial Productivity. I approximate the firm productivity distribution using three values. The lowest type, $\tilde{z}_1$, represents mom-and-pop stores with just a few employees, and 80% of entrepreneurs belong to this category. In most countries, these firms never go public, as the fixed cost of doing so is high and their optimal size is small. For the lowest type of firms, $\tilde{z}_1$, death of the owner triggers firm failure.[24] The larger firms, $\tilde{z}_2$ and $\tilde{z}_3$, have sufficient brand value such that they can be taken over by another agent if the owner dies. Most of these larger firms have productivity $\tilde{z}_2$ (18% overall), and the remaining 2% of firms are of the largest type. I normalize $\{\tilde{z}_1, \tilde{z}_2, \tilde{z}_3\}$ such that the average level of productivity in the economy is 1. This leaves two parameters, $\tilde{z}_2/\tilde{z}_1$ and $\tilde{z}_3/\tilde{z}_1$ to be chosen. Table 2 confirms that the 80/18/2 split is a good approximation to the overall firm size distribution. All firms exit with probability η.

Worker Skill. Workers' skill level θ_t follows an AR(1) in logs: $log(\theta_t) = \rho_\theta log(\theta_{t-1}) + (1-\rho_\theta)\mu_\theta + \sqrt{(1-\rho_\theta^2)}\sigma_\theta\epsilon_t$, where $\epsilon_t \overset{\text{i.i.d}}{\sim} \mathcal{N}(0,1)$. I approximate this using a five-state Markov process. The mean of the process is normalized such that average endowment of effective units of labor is 1. I assume a high persistence of labor income, and choose σ_θ such that model-implied dispersion in log earnings matches the cross-sectional variance of the log of disposable income in Germany, as estimated by Fuchs-Schuendeln, Krueger, and Sommer (2010).[25]

Inheritance of Assets. The weight on parental bequests χ in starting assets of new-born agents is chosen as follows: in the HFCS, 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: less than 25, 30 and 35 years of age. Depending on the age cut-off, this fraction ranges from 44%-54%.[26] I therefore use $\chi = .5$ as the baseline value.

[24] Smith et al. (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 Germany since these are the most comprehensive estimates available.

[26] These numbers are computed conditional on reporting of a positive value. There is a large share of people who report zero gifts or inheritances. Without conditioning on positive transfers, the aggregate share of wealth

Inheritance of Types and Population Shares. All children of entrepreneurs are born as entrepreneurs. Moreover, heirs of owners of type 2 or type 3 firms inherit their parent's firm, and hence are entrepreneurs with productivity $\tilde{z}_2$ or $\tilde{z}_3$ themselves. The distribution of entrepreneurial productivity of all other new-born agents is chosen such that, in steady state, there are 80% small firms and 2% of the largest firms. If born as workers, agents draw an initial skill level θ_t from the unconditional distribution. The probability that a worker's offspring is an entrepreneur is chosen such that, in steady state, the share of entrepreneurs in the population is 7.6%. This corresponds to the share of entrepreneurs in France.

4.2 Quantification

The quantification strategy has two parts. First, some parameters have either been estimated by many previous studies (e.g., the depreciation rate of capital) or can be directly estimated from the data without using the structure of the model (e.g., firm exit rates). These parameters are listed in Table B.1 in Appendix B. Second, I choose the key parameters of the model – entrepreneurial productivity, the discount factor, and the three financial market frictions – to match a set of data moments for the French economy. I choose France as the baseline country since Amadeus has especially good coverage in France and its level of inequality is average within the Eurozone.[27]

This approach leverages the mapping between frictions and observable firm choices described in Section 3.4 together with the statistics I document on firm ownership and financing. It allows me to quantitatively assess the importance of frictions in debt and equity markets and is as such a complement to 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 for example taxes. In Section 7, I discuss the interpretation of the parameters in more detail and present suggestive evidence that firm ownership and financing is indeed driven by a country's legal and institutional environment and can therefore be thought of as financial frictions.

4.3 Choice of Moments

Table 1 lists each French moment and next to it the model parameter most sensitive to that moment. Of course, all moments are jointly determined by all parameters. The dispersion of firm productivity, $\tilde{z}_2/\tilde{z}_1$ and $\tilde{z}_3/\tilde{z}_1$, is chosen to match the observed dispersion in employment shares. The maximum leverage constraint λ is pinned down by the aggregate leverage of private firms in the economy. The last two parameters both relate to equity markets: the fixed cost of going public and the proportional monitoring cost paid by outside investors. They are identified by the private share (the share of total firm value that is privately held) and the insider share of public firms.

that is inherited or gifted is 16%-20%.

[27] See Kalemli-Ozcan et al. (2015).

Table 1: Matched parameters: France

Parameter	Value	Moment	Value
z_2/z_1	12.6	employment share top 25%	81.1%
z_3/z_1	53.0	employment share top 1%	18.3%
λ	0.53	aggregate leverage	48.5%
c_M	0.14	aggregate insider share	33.4%
c_{IPO}	0.04	share of private firms	37.0%
β	0.98	top 10% wealth share	52.6%

Notes: Table 1 lists the six estimated parameters and target moments. The value of the moments is identical in both the model and data. c_{IPO} is reported relative to the value of a type 2 firm. c_M is the share of output net of labor payment that is used to monitor insiders. As a share of sales, it would be 4%. Employment shares are measured as the wage bill from the Amadeus Financial Module, winsorizing the top and bottom 1%. All other moments are described in Section 2.

As discussed in Section 3.4, the fixed cost of IPO mostly affects the extensive margin, so which firms choose to go public. The monitoring cost mostly affects the intensive margin, so how much equity is sold when going public. Conditional on productivity and financial frictions, the share of wealth held by the richest 10% of households is sensitive to the discount factor β. The higher is the discount factor, the higher the desire of all agents to save. Workers' savings behavior is more sensitive to the discount factor though, because entrepreneurs face borrowing constraints. A higher β narrows the gap in savings rates between the two types of agents, translating into a lower top wealth share.[28] Figure B.1 in Appendix B shows how the moments are affected by each parameter, starting from their baseline values.

4.4 Model Fit

Table 2 compares the model to key moments from the French data that were not directly targeted. In terms of inequality, only the share of wealth held by the richest 10% of households was targeted. As Table 2 shows, the model matches the Gini coefficient for wealth well: 0.64 vs. 0.66 in the data. It should be noted that the top 10% wealth share and the Gini are sensitive to different features of the wealth distribution and therefore the fact that the former was targeted does not mechanically imply a good fit for the latter.

The model also closely fits the distribution of wealth at the very top – the richest 1% hold 24% of total wealth, compared to around 23% in the data. Interestingly, the model actually slightly over-predicts wealth concentration at the very top. Most existing quantitative models have difficulties generating levels of wealth concentration at the top that are in line with the data (see DeNardi (2015) for a comprehensive survey). The key innovation in this model is that I match the firm size distribution in more detail and explicitly take into account that even in large publicly traded firms, there are a few insiders who hold sizeable shares of the equity. Since the firm size distribution is highly skewed and fat-tailed, the wealth distribution inherits some

[28]To match France's top 10% wealth share, the model requires a discount factor of $\beta = .98$. Since all agents die with probability π_d, they effectively discount the future at $\beta(1 - \pi_d) = .96$.

of these properties once one carefully models ownership structures of firms.

Since the focus of the paper is on the role of firm ownership and financing for inequality, the distribution of wealth between entrepreneurs and workers is an important over-identifying moment. In the model, about 25% of total wealth is held by entrepreneurs, which closely fits the 24% in the French data.

The key novelty of the model is the decision of entrepreneurs to go public and sell shares of their firms. The extent to which they choose to do so is an important determinant of wealth inequality. As Table 2 shows, the model replicates, both qualitatively and quantitatively, the negative relationship between insider share and firm size I document in Section 2. The fact that in larger firms, less of the equity is held by insiders confirms that the linear formulation of the monitoring cost is able to capture important features of the trade-off entrepreneurs face when choosing how much equity to sell.

I approximate the firm productivity distribution with three points, a choice made primarily to reduce computational complexity. Table 2 shows that the three point distribution works well and the model fits other moments of the firm size distribution (the employment share in top 10% as well as the ratio of the 99^{th} and 75^{th} percentiles to the median).

There is one moment in which model and data do not match as well. The ratio of total wealth to GDP is above 5 in the model, compared to 3.5 in the data. In Section 6, I propose an alternative quantification which directly targets wealth to GDP and show that the paper's main results are unaffected.

Table 2: Model fit: France

Moment	Data	Model
Wealth Gini	0.66	0.64
Top 1% wealth share	22.6%	24.3%
Share of Wealth held by private entrep	23.7%	25.3%
Slope of insider share wrt size	-.024	-.033
Employment $\frac{\text{p99}}{\text{median}}$	59.8	61.3
Employment $\frac{\text{p75}}{\text{median}}$	2.5	1.3
Employment share top 10%	62.7%	62.1%

Notes: Table 2 compares key moments in model and data that were not targeted in the quantification. The first three moments are based on the HFCS in combination with Amadeus Ownership and Compustat Global. All firm moments are from Amadeus. The slope of the insider share with respect to size is the coefficient from a linear regression of the insider share on log(assets) in model and data. Wealth to GDP is estimated using my measure of wealth based on HFCS, Amadeus Ownership, and Compustat Global and 2009 GDP as measured by Eurostat.

4.5 Financial Frictions, Inequality, and Output

To demonstrate how the level of frictions in debt and equity markets affect aggregate output and the distribution of wealth in the economy, I run three counterfactuals. In each of the three, I reduce financial constraints by 50%, starting from the French baseline. For the maximum leverage constraint, that implies increasing λ by 50%, for the costs associated with outside equity, that corresponds to a 50% reduction. All counterfactuals are steady-state to steady-state comparisons.

The results are summarized in Table 3. Increasing access to external finance in the form of either debt or equity always increases aggregate output and the economy's wage rate, as previously constrained entrepreneurs can now invest more in their productive firms. In the case of equity frictions, better risk-sharing also encourages business investment.

Table 3: The role of frictions in debt and equity markets

	Aggregate Output	Wealth Gini	Top 10% Wealth Share	Wealth Share Private Entrep
Baseline	-	0.64	52.6%	25.3%
$\lambda \uparrow 50\%$	+1.4%	0.66	56.4%	33.4%
$c_M \downarrow 50\%$	+1.0%	0.61	49.9%	21.3%
$c_{\text{IPO}} \downarrow 50\%$	+0.2%	0.63	52.4%	22.4%

Notes: Table 3 reports the model implied values of aggregate output, the Gini coefficient of wealth, the share of wealth held by the richest 10%, and the share of aggregate wealth held by entrepreneurs running private firms for the baseline quantification to France as well as three counterfactual. The first counterfactual increases λ from 0.53 to 0.78, the second one reduces c_M from 0.14 to 0.07, and the third one reduces the fixed cost c_{IPO} from 0.04 to 0.02. All counterfactuals are steady-state to steady-state comparisons.

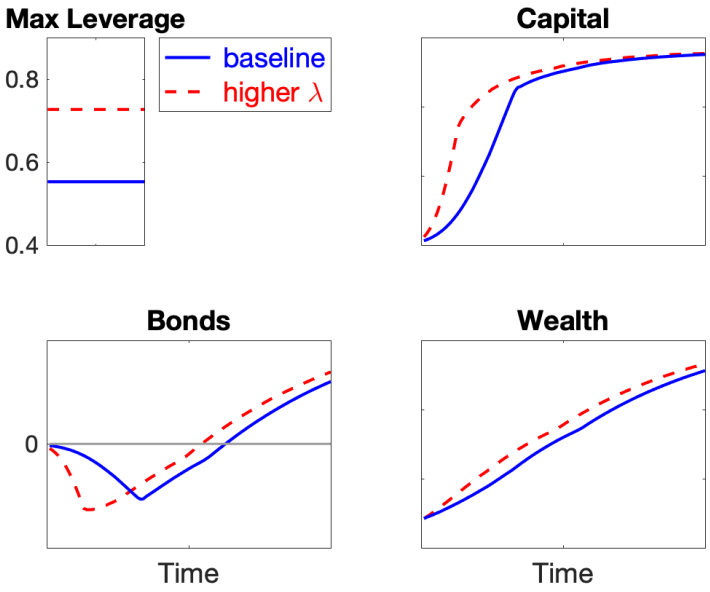
The relationship between financial frictions and inequality is more subtle. As Table 3 shows, wealth inequality increases as the access to debt improves, but decreases as outside equity becomes more cheaply available. The main mechanism driving this relationship in the model works through wealth accumulation of entrepreneurs. Since the savings behavior of workers is not directly affected by these parameters, higher wealth holdings of entrepreneurs lead to higher wealth inequality in the economy. Column 4 confirms that in an economy with more access to debt, entrepreneurs hold a larger share of wealth and inequality is higher, while the reverse is true for counterfactual improvements in access to outside equity. I now turn to describing in more detail how frictions in debt and equity markets affect entrepreneurs' savings behavior.

Leverage and Wealth Accumulation. The effect of the maximum leverage constraint λ on savings of entrepreneurs is similar to what other quantitative papers on entrepreneurship have found. In, for example, Cagetti and DeNardi (2006), loosening borrowing constraints increases steady-state inequality. Although the details of the model are different, the mechanism here is similar: the less tight the debt constraint, the more capital entrepreneurs can invest in their firms, the more profits they make, and the more they save. Figure 6 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 less tight borrowing constraint as in Table 3. Both entrepreneurs 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.

The top left panel shows the maximum share of capital that can be financed by debt, $b/k = \lambda\,(1-\delta)/R$. The bottom left panel plots the evolution of bond holdings both for the baseline entrepreneur (the solid blue line), and the one with more access to debt (the dashed red line). With a higher λ, the entrepreneur can borrow more, invests more in their firm (top right panel), and reaches 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 bottom right panel shows.

Figure 6: The role of λ for capital, savings, and wealth

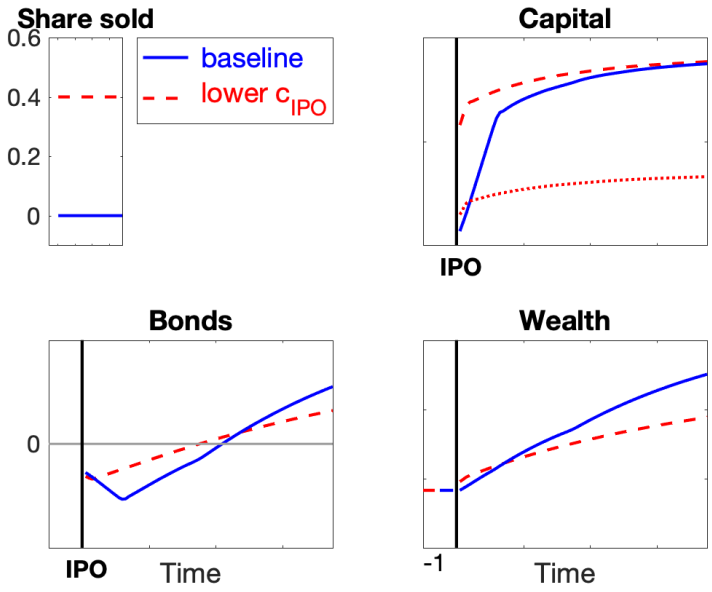


Notes: Evolution of capital, bond holdings (personal savings net of borrowing by the firm), and wealth for two entrepreneurs who face $\lambda = 0.53$ and $\lambda = 0.78$ respectively. All other parameters used for the simulation are set to the values estimated for France. Entrepreneurs start with the 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 7 compares two entrepreneurs facing different fixed costs of IPO. The solid blue 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 red line) sells 40% of his company. As depicted in the top right panel of Figure 7, the IPO allows him to rapidly increase investment in her firm. He can do that for two reasons: First, he must only finance 60% of any given amount of investment. Second, the proceeds of the IPO provide additional cash, which is the reason why *his* share of capital (dotted red line) is higher than the capital invested by the baseline entrepreneur who remained private (solid blue line). In contrast, the baseline entrepreneur only slowly saves out of the borrowing constraint and expands her firm. As illustrated in the bottom left panel, she borrows heavily for a longer period of time than the public entrepreneur. Eventually, she starts saving and does so at a higher rate.

Figure 7: The role of c_{IPO} for capital, savings, and wealth



Notes: Evolution of capital, bond holdings (personal savings net of borrowing by the firm), 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 hit.

Finally, the bottom right panel shows the evolution of wealth that results from the differences in equity market frictions. 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 that is mostly driven 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, which means that he would have to absorb 100% of the losses if the firm exits, as opposed to 60% in the case of the counterfactual entrepreneur. This leads her to save more, accumulate

more wealth, and run a smaller firm.

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

5 Financial Frictions and Wealth Inequality across Euro-zone Countries

The above comparative statics suggest that frictions in financial markets could be an important driver of differences in wealth inequality across European countries. To assess this quantitatively, I re-estimate the model for three comparison countries. In the absence of direct measures of the level of frictions across countries, I follow a similar approach as for France and use the model together with the data moments I document to infer financial frictions country by country. I find large differences in financial market frictions across countries – large enough to generate a range of wealth inequality that is quantitatively close to the data.

I then use the quantified model to conduct a counterfactual harmonization of financial markets within the Eurozone. This allows me to decompose differences in wealth inequality into the contribution of debt vs. equity friction. I find that equity frictions are quantitatively almost six times as important. I also analyze what would happen to aggregate output, wealth, and its distribution if other countries were to adopt France's financial market institutions. Such a complete harmonization of financial markets would have modest effects on aggregate output, but significantly move aggregate wealth and within-country inequality.

5.1 Financial Frictions and the Firm Productivity Distribution in Germany, Austria, and the Netherlands

I quantify the model for three comparison countries – Germany, Austria, and the Netherlands – which were chosen to span the range of wealth inequality among Eurozone countries. I keep all externally set parameters constant at their values listed in Table B.1, keep the discount factor constant at the level estimated for France, and choose the TFP process as well as the three financial market parameters to match the same set of five moments (except for the top 10% wealth share) as I did for France.

5.1.1 Germany

Germany and France differ significantly when it comes to 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 33% of firm value is accounted for by privately held firms, while this number is almost twice that 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 in combination with a smaller insider share is indicative of there being a larger fixed cost of IPO in Germany, but a 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. Since entrepreneurs have less access to outside equity, a form of external finance particularly relevant for high productivity firms, productivity has to be more dispersed in Germany to rationalize the observed skewness of the firm size distribution. Table 4 reports all moments and parameters.

Table 4: Parameters and moments: Germany

Parameter	Value	Moment	Value
z_2/z_1	20.2	share of employment in top 25%	82.6%
z_3/z_1	64.5	share of employment in top 1%	16.1%
λ	0.63	aggregate leverage	58.3%
c_{IPO}	0.07	share of private firms (value)	58.9%
c_M	0.13	aggregate insider share	28.0%

Notes: Table 4 lists the five estimated parameters and target moments for Germany. The values of the moments are identical in both model and data. c_{IPO} is reported relative to the value of a type 2 firm. c_M is a share of output net of labor payment. Employment shares are measured as the wage bill from the Amadeus Financial Module, winsorizing the top and bottom 1%. All other moments are described in Section 2.

5.1.2 Austria

The main difference between France and Austria is the insider share. In Austria, nearly 60% of public equity is in the hands of 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 so high, the fixed cost of going public in Austria has to be low, in order for any firms 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. All moments and parameters are collected in Table 5.

5.1.3 The Netherlands

The Netherlands is unique among Eurozone countries in that outside equity plays a very important role. Merely 11.4% of the value of firms is privately held, and the insider share is very low at 16.1%. At the same time, aggregate leverage of firms 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. My model cannot fully match the low share of private firms, even if the fixed cost of IPO is zero, since there is always a mass of young

Table 5: Parameters and moments: Austria

Parameter	Value	Moment	Value
z_2/z_1	13.0	share of employment in top 25%	74.0%
z_3/z_1	35.0	share of employment in top 1%	13.1%
λ	0.54	aggregate leverage	49.6%
c_{IPO}	0.004	share of private firms (value)	78.6%
c_M	0.31	aggregate insider share	57.4%

Notes: Table 4 lists the five estimated parameters and target moments for Austria. The value of the moments is identical in both model and data. c_{IPO} is reported relative to the value of a type 2 firm. c_M is a share of output net of labor payment. Employment shares are measured as the wage bill from the Amadeus Financial Module, winsorizing the top and bottom 1%. All other moments are described in Section 2.

firms that have not yet matured and hence are not allowed to go public. Therefore, I set both the fixed and monitoring costs to zero and choose λ as well as the TFP process to match the other three moments.

The results are displayed in Table 6. The model comes close to matching the share of private firms and the aggregate insider share. The reason the insider share is positive despite a monitoring cost of zero is twofold: First, I set the minimum insider share to 5%.[29] Given that the monitoring cost is zero, all firms with productivity z_2 or z_3 choose this minimum value. Second, firms with the lowest productivity choose an insider share higher than 5%. For the low productivity firms, the entrepreneur's death triggers firm failure. Since entrepreneurs have zero utility if they die, they put zero weight on firm profits in that state of the world. From the point of view of outsiders, who do take into account the state of the world in which the entrepreneur dies, investment in the firm is not optimal. The effect is similar to the monitoring cost: optimal investment from the point of view of outsiders is lower, which induces a hump-shaped relationship between firm value and share sold and implies an interior solution for the choice of insider share.

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

Table 6: Parameters and moments: the Netherlands

Parameter	Value	Moment	Data	Model
z_2/z_1	5.3	share of employment in top 25%	67.1%	67.1%
z_3/z_1	19.4	share of employment in top 1%	12.7%	12.7%
λ	0.49	aggregate leverage	44.7%	44.7%
c_{IPO}	0.0	share of private firms (value)	11.4%	13.1%
c_M	0.0	aggregate insider share	16.1%	15.5%

Notes: Table 4 lists the five estimated parameters as well as the values of the corresponding moments in model and data for the Netherlands. Employment shares are measured as the wage bill from the Amadeus Financial Module, winsorizing the top and bottom 1%. All other moments are described in Section 2.

[29]This assumption has no effect on other countries, since their monitoring cost prevents any entrepreneur from selling such a high fraction of their firm.

Tables D.1 - D.3 in Appendix D assess the fit of the model for non-targeted moments in Germany, Austria, and the Netherlands.

5.2 Wealth Inequality in Germany, Austria and the Netherlands

For France, the discount factor β was chosen to match the share of wealth held by the richest 10%. For all other countries, I re-estimated only parameters related to firms: the productivity distribution and the three financial market frictions. Table 7 summarizes what the model predicts for the distribution of wealth in the three comparison countries. The first column compares the top 10% wealth share in model and data, the second column does the same for the Gini coefficient of wealth. Not only does the model correctly predict the qualitative differences in inequality - Germany and Austria have more wealth inequality than France, the Netherlands considerably less –, but it also confirms that financial frictions and firm productivity are quantitatively important drivers of differences in wealth inequality across countries. For example, top 10% wealth shares predicted by the model range from 45% in the Netherlands to 61% in Austria, which comes close to the range of 43% to 60% in the data.

As is true in the data, higher wealth inequality in the model comes hand in hand with a larger fraction of wealth held by entrepreneurs. The last column of Table 7 compares model and data in this respect. In Germany and Austria, which are the most unequal countries in the sample, more wealth is in the hands of entrepreneurs. In the Netherlands, the share of aggregate wealth held by entrepreneurs is smaller, and wealth inequality is lower.

Table 7: Wealth inequality across countries: model and data

	Top 10% Wealth Share		Wealth Gini		Wealth Share of Private Entrep	
	Data	Model	Data	Model	Data	Model
France	52.6%	52.6%	0.66	0.64	23.7%	25.3%
Germany	59.1%	59.8%	0.72	0.70	31.6%	34.6%
Austria	59.5%	61.0%	0.72	0.70	30.4%	34.2%
Netherlands	42.7%	45.0%	0.55	0.58	8.2%	17.2%

Note: Table 7 compares the model predictions for inequality, measured as the share of wealth held by the richest 10% 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.

5.3 Counterfactuals: Harmonization of Financial Markets

Using the quantified model, I simulate a counterfactual harmonization of financial market frictions to the French level. The purpose of this is threefold. First, since only the financial market parameters are set to the French level, this exercise allows me to disentangle how much of the differences in wealth inequality reported in Table 7 are coming from financial frictions as opposed

to the TFP distribution. Second, I decompose the explained variation in wealth inequality into the contribution of frictions in debt vs. equity markets. Third, the counterfactuals shed light on the potential consequences – in terms of aggregate output as well as the level and distribution of wealth in each country – of a more complete integration of financial markets within the Eurozone.

More precisely, I set either the tightness of borrowing constraints, or the costs of issuing outside equity, or both sets of parameters to the value estimated for France. The dispersion of the underlying TFP process is kept at each country's baseline values . Table 8 summarizes the results. The first four columns compare the baseline top 10% wealth share in each country to the counterfactual in the stationary equilibrium with French financial market institutions. I first report the results of setting all three financial frictions – the borrowing constraint λ, the monitoring cost c_M and the cost of going public c_{IPO} – to the French level. The striking result is that all three comparison countries would have very similar levels of wealth inequality as France. This confirms that it is frictions in financial markets that are driving differences in wealth inequality, as opposed to differences in the underlying TFP process.[30]

The next two columns report the results of setting either only borrowing constraints (λ), or the costs of issuing outside equity (c_M and c_{IPO}) to the French level. In Germany, borrowing constraints are significantly less tight than in France. As would be predicted by, for example, Cagetti and DeNardi (2006), tightening λ to the French level would indeed reduce top wealth concentration. However, frictions in equity markets are quantitatively much more important. In fact, on average across the three countries, frictions in equity markets are responsible for 80% of the explained variation in top wealth inequality, compared to only 14% for debt market frictions.

Table 8: Counterfactuals: adopting French financial market institutions

	Top 10% Wealth Share				Aggregate Output
	baseline	full CF	debt	equity	full CF
France	52.6%	-	-	-	-
Germany	59.8%	53.1%	56.4%	54.7%	+0.3%
Austria	61.0%	53.0%	60.8%	53.2%	+2.7%
Netherlands	45.0%	53.0%	45.1%	52.8%	-2.7%

Note: Table 8 reports model results of setting financial market frictions in Germany, Austria, and the Netherlands to the French level. The TFP process is kept at the level estimated for each country. The comparisons are steady-state to steady-state. The first four columns list the share of wealth held by the richest 10% in the baseline and the counterfactual. The last column reports the percentage change in aggregate output.

One way to interpret the counterfactuals is as a complete harmonization of financial markets within the Eurozone.[31] I predict that such a harmonization would have moderate effects on

[30]Since the contribution of financial frictions and TFP are not additive, I confirm that moving only the TFP process to the French level has very little effect on the wealth distribution.

[31]I choose the target of this harmonization to be the current French regime since this was the baseline county in the quantification, but this could easily be applied to any common level of financial frictions.

aggregate output in each country, but sizeable effects on the levels of savings and the distribution of wealth. Since financial markets are well developed everywhere in the Eurozone, it is not surprising that the potential gains or losses from adopting another country's financial market institutions are modest, at a few percentage points of GDP. The Netherlands, where this policy mostly entails *worsening* frictions in equity markets, would lose around 3% of GDP. Germany and Austria would both see their GDP increase, albeit at a higher rate in Austria. The reason for this is that in the case of Germany, the harmonization entails both improving access to outside equity (which increases output) and reducing access to debt (which reduces output), whereas in the case of Austria, the harmonization mainly entails cheaper access to outside equity.

In both Germany and Austria, wealth inequality would be substantially lower in the new steady state. Despite the fact that aggregate output would change only modestly, the effect of a financial market harmonization on the distribution of wealth is large. This is mostly driven by a reduction in wealth holdings of entrepreneurs, which is also reflected in aggregate savings. Total wealth holdings of all Germans would decline by about 18%, driven by the fact that entrepreneurs switch from risky, debt-financed and levered investment to equity-financed investment which allows them to share risk and reduces their precautionary savings motive. In Austria, total wealth would decline by 23%, driven entirely by the cheaper access to outside equity which both provides external finance and reduces risk exposure. The same holds true for the Netherlands, albeit with opposite signs.

6 Robustness

In the baseline quantification, the model-implied values of wealth to income are higher than in the data. Since most wealth in the model is firm wealth, one might worry that if the importance of wealth is overstated, the importance of firm financing for wealth inequality could be overstated as well. In order to address this concern, I consider an alternative quantification in which I directly target the ratio of wealth to income in France. As Table 10 shows, the predictions for the effect of financial frictions on inequality remain essentially unchanged.

The alternative quantification follows a similar strategy to the baseline. All parameters that were externally set or estimated remain the same. In addition to the six parameters and moments previously used, I target the ratio of wealth to GDP by choosing the gross interest rate R, which was previously set to 2%. Intuitively, the discount factor β and the interest rate R are jointly pinned down by the level of wealth and its distribution. Both parameters affect the savings behavior of all agents, but they affect workers and entrepreneurs differently, since entrepreneurs are constrained by financial frictions.

The parameters implied by the new quantification are reported in Table 9. In terms of financial markets, there is little difference across quantifications. The maximum leverage constraint and the two costs of issuing outside equity are similar to the values in Table 1. The same holds true

for the productivity dispersion. The implied discount factor is lower, but still in the range of values typically found in this type of model (see e.g., Cagetti and DeNardi (2006)). The interest rate is 7%, which is again similar to the numbers typically found in this literature.[32]

Table 9: Matched parameters in alternative quantification: France

Parameter	Value	Moment	Value
z_2/z_1	13.7	employment share top 25%	81.1%
z_3/z_1	60.7	employment share top 1%	18.3%
λ	0.53	aggregate leverage	48.5%
c_{IPO}	0.03	share of private firms	37.0%
c_M	0.14	aggregate insider share	33.4%
β	0.92	top 10% wealth share	52.6%
R	1.07	wealth/GDP	3.4

Notes: Table 9 lists the seven estimated parameters and target moments. The value of the moments is identical in both model and data. c_{IPO} is reported relative to the value of a type 2 firm. c_M is a share of output net of labor payment; as a share of sales, it would be 4%. Employment shares are measured as the wage bill from the Amadeus Financial Module, winsorizing the top and bottom 1%. GDP comes from the 2009 measures by Eurostat. All other moments are described in Section 2.

The cross-country quantification also follows the baseline version closely. For Austria, Germany, and the Netherlands, I re-estimate the productivity dispersion and the three financial market frictions to match the same set of moments as before. Both the interest rate R and the discount factor β are kept at the levels estimated for France.

Table 10 compares the results of this alternative quantification to the data and to the baseline version. Overall, the model-implied share of wealth held by the richest 10% is not sensitive to the quantification approach. In Germany and the Netherlands, predicted inequality is slightly lower in the new version, whereas inequality is predicted to be slightly higher in Austria.

Table 10: Wealth inequality in data, baseline, and alternative model

	top 10% wealth share		
	Data	Baseline Model	Alternative
France	52.6%	52.6%	52.6%
Germany	59.1%	59.7%	59.2%
Austria	59.5%	61.0%	61.3%
Netherlands	42.7%	45.0%	43.2%

Notes: Table 10 reports the share of wealth held by the richest 10% of households in the data (left column), the baseline model from Section 4 (middle column), and the alternative quantification described in this section (right column).

[32]While a 7% interest rate might seem high for this time period in Europe, this partly reflects the fact that there is no aggregate risk in the model.

This result is reassuring in that the level of wealth in the model does not seem to interact with how the distribution of wealth depends on costs of external finance, which is the main mechanism of this paper. Tables D.7-D.9 in Appendix D report the estimated parameters for all comparison countries.

7 Discussion

The counterfactuals in Section 5 highlight that frictions in debt and equity markets have differential effects on steady-state equality vs. efficiency. Both of these are useful summary statistics, but are not sufficient to evaluate welfare consequences of counterfactual changes in financial market institutions. In the first part of this section, I briefly discuss the distributional effects of a Eurozone financial market integration. I show, for the case of Austria and Germany, that while workers would gain, wealthy entrepreneurs would lose as a consequence of the reform. The second part of the section relates frictions in financial markets to institutional differences across countries.

7.1 Welfare

I analyze the welfare effects of changes in financial market institutions by groups of agents. I split agents by their labor market status – worker/entrepreneur – and by their current level of wealth. The thought experiment is: does an agent of type j with assets X prefer to live in Germany with German or French financial markets?

For workers, the welfare effect of any counterfactual is straightforward: welfare increases if and only if the economy's wage rate increases. Any reduction in financial market frictions leads to a higher wage rate. Lower frictions imply that entrepreneurs have more access to external finance and thus increase investment and labor demand, which increases wages.

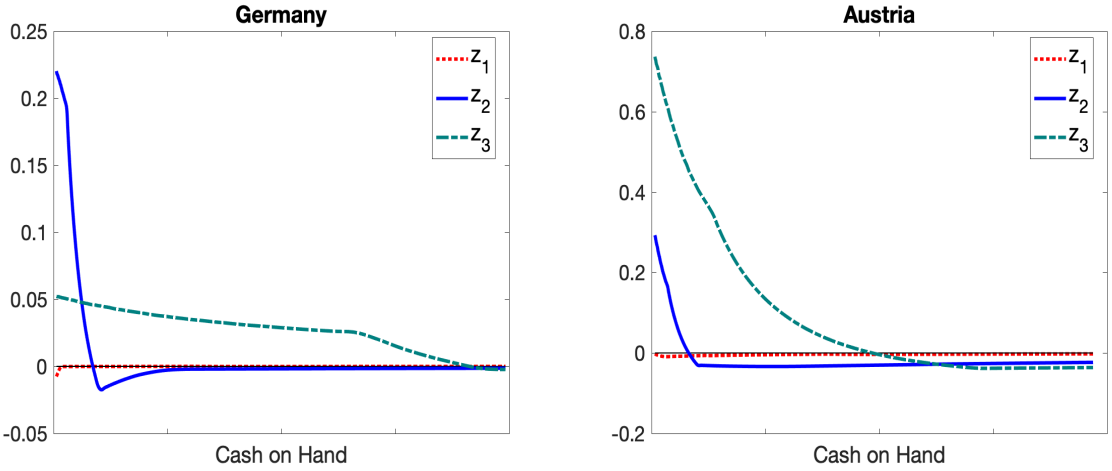
The general equilibrium effect through the wage rate has the opposite effect on entrepreneurs: higher wages reduce profits. Since exit rates are relatively low at 5.2%, the possibility that they might become workers in the future is small compared to the immediate effect on firm profits. In addition to the indirect effect via wages, entrepreneurs are directly affected by changes in financial market institutions. While the direct effect is positive for all entrepreneurs, how strongly they are affected depends on both their type and asset level.

Figure 8 plots the consumption-equivalent welfare gains for German and Austrian entrepreneurs from moving to a counterfactual equilibrium with French levels of financial market frictions. In both countries, the counterfactual wage is higher, by 2.7% in Austria and 0.3% in Germany. In both countries, entrepreneurs with the lowest productivity z_1 are worse off with French financial markets, since wages increase and borrowing constraints tighten. The welfare effect on the two high productivity types is also qualitatively similar in both countries. Poor entrepreneurs enjoy welfare gains, since for them, the positive effect of lower frictions in equity markets (c_M in the case of Austria, c_{IPO} in the case of Germany) outweighs the negative effect of higher wages and

tighter borrowing constraints. Wealthier entrepreneurs lose in this counterfactual: even with French financial markets, they do not rely much on outside equity. For them, the downward pressure on profits through higher wages and tighter borrowing constraints reduce welfare.

In summary, while most individuals would gain from a financial market reform in Germany and Austria, the wealthiest entrepreneurs would lose out from such a reform. From their point of view, the fact that poorer entrepreneurs are constrained by a lack of external finance is beneficial, as (labor market) competition is reduced and wages are kept low. To the extent that wealthier individuals have more influence on policy, the distributional consequences of financial frictions could be one important factor in explaining why financial market institutions are long lived and hard to change.

Figure 8: Consumption-equivalent welfare gains for private entrepreneurs



Notes: Both panels plot the fraction of per-period consumption entrepreneurs would be willing to give up in order to live in the stationary equilibrium with France's financial market institutions. The left panel corresponds to German entrepreneurs, the right one to Austrians. The three lines – dashed, dotted, and solid – plot the welfare gains for each productivity type.

7.2 Determinants of Firm Ownership and Financing

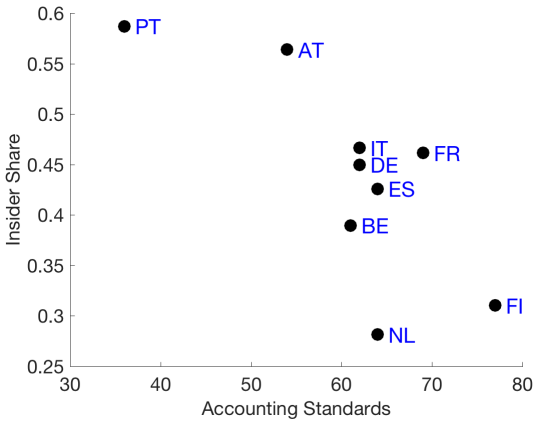
Why do German firms have access to more debt and find it harder to go public than French or Dutch firms? And what does it mean for financial markets to be harmonized within the Eurozone? This section discusses observable features of corporate governance and other institutions that differ across countries and could be responsible for the financial frictions backed out using the quantitative model. 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. I follow this tradition and point to specific laws and institutions that might be responsible for better investor protection in some countries.

7.2.1 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 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). The authors also provide a measure of accounting standards across countries, based on examination of company reports. Figure 9a plots their measure against the average insider share in each of the nine countries. The negative relationship indicates that in countries with better accounting standards, more widespread corporate ownership is facilitated. This correlation is of course merely suggestive as countries with more dispersed ownership of public equity could have developed better accounting standards.

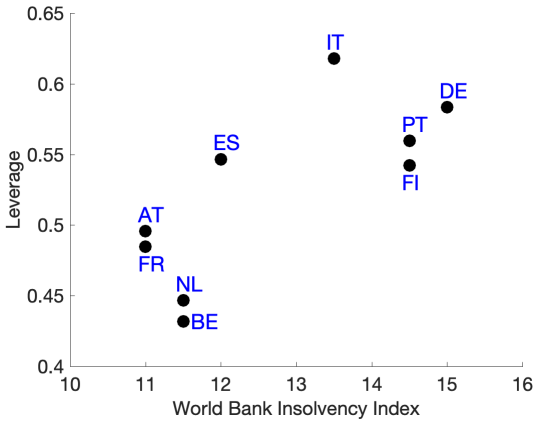
Concerning ex-post punishment, LaPorta et al. (1998) argue that legal mechanisms which can be used by minority shareholders against perceived oppression by directors are a key component of corporate governance. In the US, derivative suits give shareholders such legal recourse. In Europe, this is much 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.

Figure 9: Institutions and firm financing across countries



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

(a) Accounting standards and insider share



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

(b) Creditor protection and average leverage

7.2.2 Cost of IPO

Underwriting fees are arguably the single largest expense associated with an IPO. Abrahamson et al. (2010) 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.

7.2.3 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.

The World Bank developed an index capturing the strength of creditor rights. It includes measurements of time, 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. In the model, better creditor protection is reflected in a higher λ. Figure 9b illustrates that leverage is indeed higher in countries with stronger creditor rights.

7.2.4 Taxes

Another natural candidate for the underlying drivers of differences across countries in firm ownership and financing is taxation. While this would not alter the validity of the inference approach in the cross-country quantification, it would change the interpretation of the financial frictions backed out in this paper. 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.[33] Yet Austrian entrepreneurs are more likely to keep their firms private and not sell any shares. The rules surrounding interest

[33]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)).

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.[34] 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 wealth distribution in different countries.

8 Conclusion

Why is wealth concentration higher in some countries, and lower in others? This paper argues that who owns firms, and how firms are financed, is an important determinant of differences in top wealth shares across Eurozone countries. As such, it fits into an active literature on entrepreneurial savings and investment, and how these depend on financial markets. It focuses on a new channel – outside equity – which was previously absent from the literature, in which entrepreneurs run private companies financed with debt. The quantitative results of the paper indicate that equity market frictions are of first order importance for understanding differences in wealth inequality across countries.

Combining micro data on households and firms in nine Eurozone countries, I show that countries with greater wealth inequality have more closely held firms. This has two components: First, there are more privately held firms. Second, insiders own larger fractions of public companies. To explain how firm ownership is chosen and how this affects wealth inequality, I develop a dynamic general equilibrium model of workers and entrepreneurs with three sources of firm financing. Entrepreneurs can either stay private and finance with debt and inside equity, or go public and issue outside equity. Motivated by the facts on corporate ownership in Europe, public firms are run by a risk-averse insider, who chooses the split between inside and outside equity. Debt and equity issuance are subject to country-specific frictions that capture the strength of creditor and shareholder protection.

Qualitatively, I show that debt and equity frictions have different implications for the existence of an equality-efficiency trade-off: more access to debt simultaneously increases aggregate output and wealth inequality, while more access to outside equity also increases output but reduces inequality. I then infer the level of frictions by matching moments of the firm distribution as well as leverage ratios and the split between inside and outside equity in different countries. Quantitatively, I find that financial frictions are key drivers of differences in wealth inequality across countries. For the set of countries considered, frictions in equity markets, which are the new mechanism proposed in this paper, are significantly more important than frictions in debt

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

markets. They account for over 80% of the explained variation in wealth inequality, compared to 14% for the more standard frictions in debt markets.

The quantitative model also allows me to shed light on possible effects of a complete harmonization of financial markets within the Eurozone. For example, if Germany and Austria were to adopt France's financial market institutions, Austria would see an increase in GDP, but there would be little change to aggregate output in Germany. Wealth inequality would be significantly lower in both countries, owing to a reduction of wealth holdings by entrepreneurs. This is also reflected in aggregate savings in Austria and Germany, which would decline considerably in the event of a European financial market harmonization.

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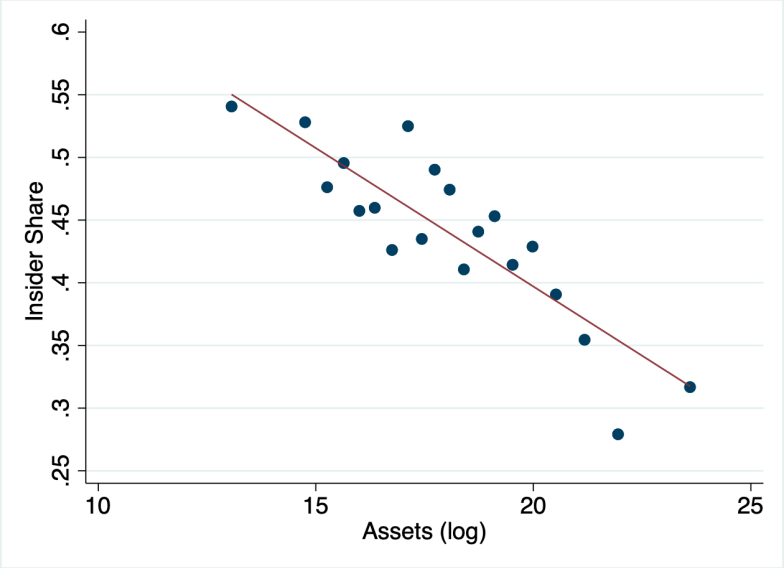
A Data

A.1 Insider Share

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.

A.2 Private Firms

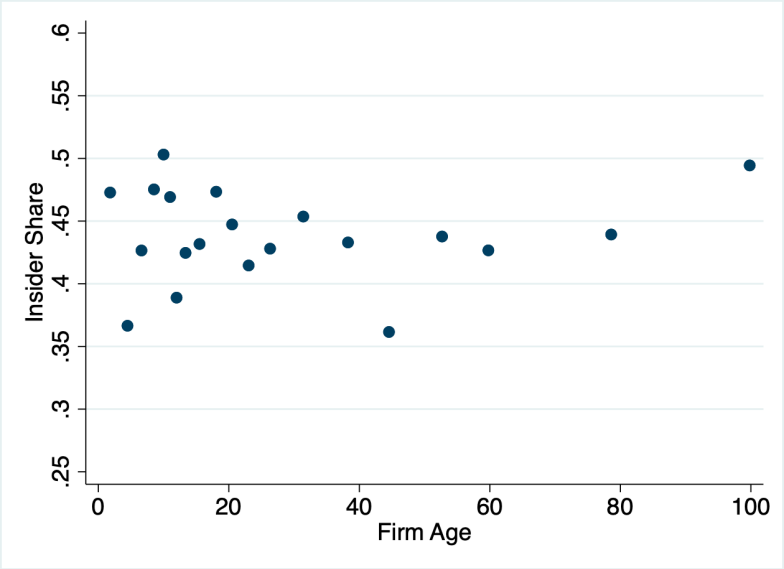
HFCS In the HFCS, surveyed households are asked to report the value of any private businesses they own. The exact wording of the question is:

> 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?

A.3 Estimating Aggregate Wealth.

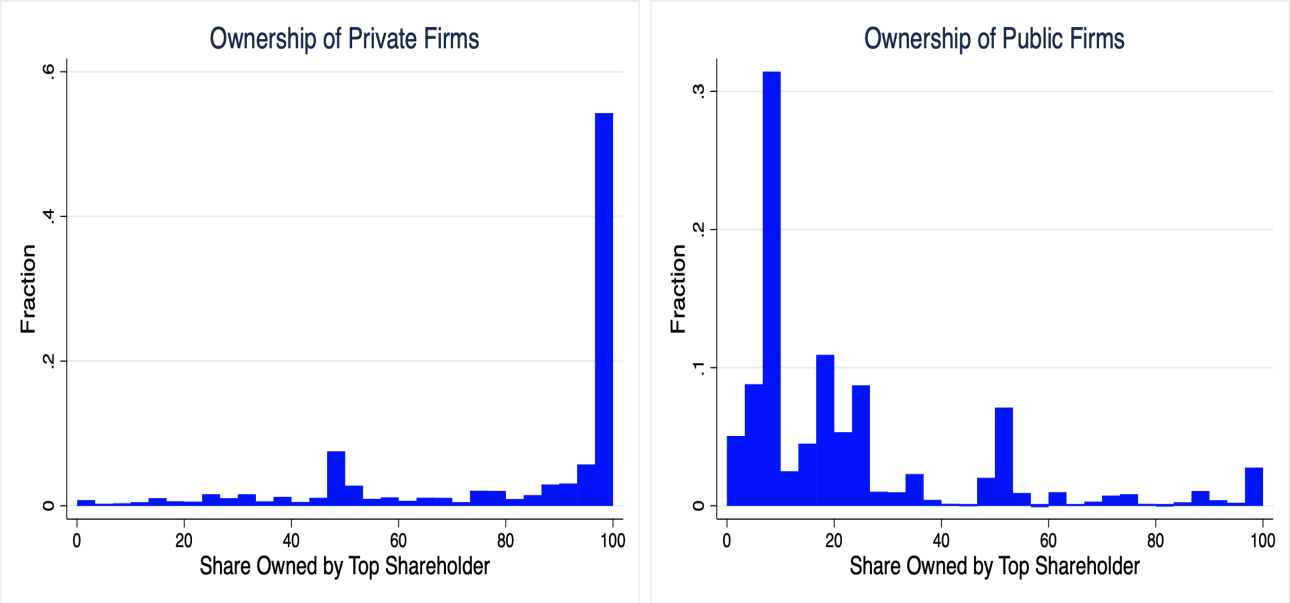
In the baseline version, I assume that the HFCS does not survey any public firm insider. Alternatively, I can classify equity holdings in the household data into two categories: small ones and

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.

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



Notes: Scatterplot 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.

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 indi-

vidual 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 computer 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.1 compares these two procedures and confirms that the two polar ways of dealing with inside equity have very similar results.

Table A.1: 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	.595	.594	.032	.034	.812	.878
BE	.986	.451	.443	.032	.046	.311	.711
DE	.992	.591	.588	.033	.04	.611	.764
ES	.999	.435	.434	.024	.025	.569	.603
FI	.974	.473	.458	.062	.087	.472	.677
FR	.984	.526	.518	.056	.071	.663	.854
IT	.999	.455	.454	.016	.018	.734	.787
NL	.995	.427	.424	.048	.053	.753	.833
PT	.997	.534	.533	.024	.027	.658	.745

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.

B Model

B.1 Parametrization

Table B.1: Externally set or estimated parameters

	Value	Description	Comment
R	1.02	risk-free rate	
σ	2	risk aversion	
π_d	.02	death probability	average working life of 50 years
δ	.06	depreciation	Stokey and Rebelo (1995)
η	.0514	exit probability	average firm age 14 years (Amadeus)
p_{yo}	.1	probability firm matures	age at IPO
ν	.9	returns to scale	
α	1/3	exponent on capital	capital share
ρ_θ	.9	persistence of worker prod	
σ_θ	.65	st.dev. of worker prod	Fuchs-Schuendeln et al. (2010)
S_{w}	.924	share of workers	share of workers in (HFCS)
χ	.5	parent wealth in starting assets	share of wealth inherited (HFCS)
$\bar{c}$	$2w\theta_1$	non-pecuniary benefits	

Notes: Table B.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 the 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.

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)).

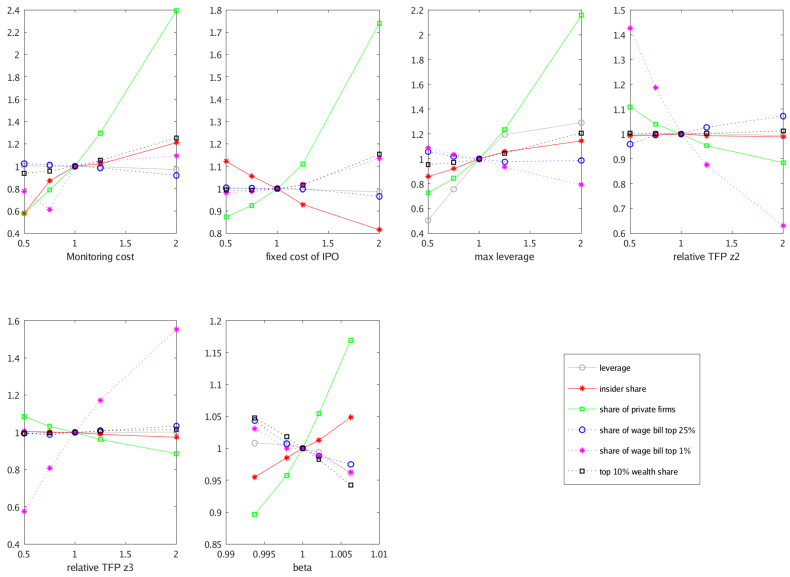
With probability p, insiders are caught, at which point they receive none of the output and pay a fine C. In this simple set-up, entrepreneurs will truthfully report the realization of η iff $(1 - \varphi) \geq (1 - p)zk^\nu - pC$.

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 $C = (1-p)/p\, zk^\nu\varphi$. Again, this is increasing in output and the share of the company financed with inside equity.

B.3 Identification

Figure B.1: Effect of each parameter on all moments.



Notes: Each panel shows changes in one target moment as a function of changing one parameter at a time. Starting point is the French baseline calibration, figure shows effect of reducing and increasing parameters by factors of 1.5 and 2.

C Additional Data Results: For Online Publication Only

C.1 Insider Share

Table C.1: Insider share, country, and firm size

	(1)	(2)	(3)
VARIABLES	insider_share	insider_share	insider_share
AT	0.282		0.272
	(0.0473)		(0.0518)
BE	0.108		0.104
	(0.0363)		(0.0421)
DE	0.168		0.129
	(0.0283)		(0.0349)
ES	0.144		0.0828
	(0.0296)		(0.0367)
FI	0.0287		0.0296
	(0.0371)		(0.0432)
FR	0.180		0.154
	(0.0280)		(0.0347)
IT	0.185		0.164
	(0.0317)		(0.0381)
PT	0.306		0.306
	(0.0491)		(0.0578)
log_assets		-0.0221	-0.0230
		(0.00251)	(0.00255)
Constant	0.281	0.839	0.728
	(0.0257)	(0.0459)	(0.0589)
Observations	2,679	2,208	2,208
R-squared	0.034	0.034	0.064

Notes: An observation is a firm. The omitted category is the Netherlands.

C.2 Public Firms

Table C.2 compares the effect on firm value of two ways of assigning publicly traded firms to countries, by headquarter or incorporation. The first one is the baseline version used in the

paper: firms are assigned to the country in which they are headquartered. Column two counts firms as belonging to the country where they are incorporated. In all but two countries, the difference in firm value between the two is negligible. In the Netherlands, the value of firms with headquarters in the country is 25% larger than the value of firms incorporated there. In Belgium, firm value is 11% higher for firms incorporated in Belgium than for those headquartered there.

Table C.2: The value of public firms

	Headquartered	Incorporated	Difference
AT	40	40.05	.001
BE	71.06	78.9	.11
DE	686.79	685.97	-.001
ES	322.89	326.15	.01
FI	72.77	72.77	0
FR	920.84	916.95	-.004
IT	262.25	262.25	0
NL	322.87	239.41	-.259
PT	32.21	32.21	0

Notes: Value are in bn EUR. Column 1 is the total value of public firms headquartered in each country. Column 2 is the total value of public firms incorporatred in each country. Column 3 is the value of incorporated relative to headquartered firms.

D Additional Model Results: For Online Publication Only

D.1 Model Fit

Table D.1: Model fit: Germany

Moment	Data	Model
Wealth Gini	0.72	0.70
Top 1% wealth share	26.2%	31.5%
Share of wealth held by private entrep	31.6%	34.6%
Slope of insider share wrt size	-.01	-.01
Employment $\frac{\text{p99}}{\text{median}}$	60.3	59.9
Employment $\frac{\text{p75}}{\text{median}}$	3.2	1.0
Employment share top 10%	62.2%	64.0%

Notes: Tables D.1 through D.3 compare key moments in model and data that were not targeted in the estimation. The first five, as well as the ninth, moments (on the wealth distribution) are based on the HFCS in combination with Amadeus Ownership and Compustat Global. All firm moments are from Amadeus. The slope of the insider share with respect to size is the coefficient from a linear regression of the insider share on log(assets) in model and data. Wealth to GDP is estimated using my measure of wealth based on HFCS, Amadeus Ownership, and Compustat Global with 2009 GDP as measured by Eurostat.

Table D.2: Model fit: Austria

Moment	Data	Model
Wealth Gini	0.72	0.70
Top 1% wealth share	26.4%	30.5%
Share of wealth held by private entrep	30.4%	34.2%
Slope of insider share wrt size	-.02	-.003
Employment $\frac{\text{p99}}{\text{median}}$	30.2	18.25
Employment $\frac{\text{p75}}{\text{median}}$	2.3	1.3
Employment share top 10%	52.2%	58.0%

Table D.3: Model fit: the Netherlands

Moment	Data	Model
Wealth Gini	0.55	0.58
Top 1% wealth share	12.0%	16.0 %
Share of wealth held by private entrep	8.2%	17.2%
Slope of insider share wrt size	-.02	-.16
Employment $\frac{\text{p99}}{\text{median}}$	21.2	19.9
Employment $\frac{\text{p75}}{\text{median}}$	1.8	1.0
Employment share top 10%	46.1%	47.4 %

D.2 Decomposition of Counterfactuals

Table D.4: Decomposition: French financial markets in Germany

	Baseline	λ	c_{IPO}	c_M	all
Top 10% NW	59.8%	56.4%	54.4%	60.3%	53.1%
Output		-0.45%	+1.12%	+0.09%	+0.35%
Share of priv firms	58.9%	46.9%	38.1%	60.6%	33.6%
Leverage	58.3%	48.5%	58.3%	58.3%	48.5%
Insider share	28.0%	26.4%	33.4%	28.0%	33.0%

Notes: Tables D.4 - D.6 report the values of five key moments (the share of wealth held by the richest 10% of households, aggregate output, the share of private firms, aggregate leverage, and the aggregate insider share in public firms) in the stationary equilibrium for the Austrian and Dutch economies under five scenarios. Column 1 is the equilibrium, and columns 2, 3, and 4 change only the values of λ, c_{IPO}, and c_M respectively to the French level. Column 5 changes all three financial market frictions simultaneously to the French level.

Table D.5: Decomposition: French financial markets in Austria

	Baseline	λ	c_{IPO}	c_M	all
Top 10% NW share	61.0 %	60.8%	66.2%	52.5%	54.3%
Output		-0.25%	-0.56%	+3.56%	+2.7%
Share of priv firms	78.5 %	77.4%	97.3%	33.4%	40.7%
Leverage	49.6%	48.5%	49.6%	49.6%	48.5%
Insider share	57.4%	57.1%	40.1%	41.9%	40.3%

Table D.6: Decomposition: French financial markets in the Netherlands

	Baseline	λ	c_{IPO}	c_M	all
Top 10% NW share	45.0 %	45.1%	50.2%	50.5%	53.0%
Output		+0.04%	-1.2%	-2.3%	-2.7
Share of priv firms	13.2%	13.7%	31.1%	26.4%	51.2%
Leverage	44.7%	48.5%	44.7%	44.7%	48.5%
Insider share	15.5%	15.7%	0.05%	48.2%	35.0%

D.3 Alternative Quantification

Table D.7: Parameters and moments: Germany

Parameter	Value	Moment	Value
z_2/z_1	19.7	share of employment in top 25%	82.6%
z_3/z_1	67.9	share of employment in top 1%	16.1%
λ	0.63	average leverage	51.9%
c_{IPO}	0.07	share of private firms (value)	58.9%
c_M	0.14	aggregate insider share	28.0%

Moment	Data	Model
Top 10% wealth share	59.1%	59.2%
Share of wealth held by private entrepreneurs	31.6%	34.5%
Wealth/ GDP	3.2	4.1

Notes: Tables D.7 through D.9 list the five estimated parameters and target moments. c_{IPO} is reported relative to the value of a type 2 firm. c_M is a share of output net of labor payment. Employment shares are measured as the wage bill from the Amadeus Financial Module, winsorizing the top and bottom 1%. GDP comes from the 2009 measures by Eurostat. All other moments are described in Section 2. The second part of the table compares the model and data values for three moments that were not targeted in the quantification: the share of wealth held by the richest 10%, the share of wealth held by owners of private firms, and the ration of wealth to GDP. The data moments are computed as described in Section 2; GDP is a 2009 estimate from Eurostat.

Table D.8: Parameters and moments: Austria

Parameter	Value	Moment	Value
z_2/z_1	12.2	share of employment in top 25%	74.0%
z_3/z_1	34.7	share of employment in top 1%	13.1%
λ	0.54	average leverage	43.8%
c_{IPO}	0.003	share of private firms (value)	78.6%
c_M	0.33	aggregate insider share	57.4%

Moment	Data	Model
Top 10% wealth share	59.5%	61.3%
Share of wealth held by private entrepreneurs	30.4%	37.4%
Wealth/ GDP	2.9	4.7

Table D.9: Parameters and moments: the Netherlands

Parameter	Value	Moment	Data	Model
z_2/z_1	5.7	share of employment in top 25%	67.1%	67.1%
z_3/z_1	19.4	share of employment in top 1%	12.7%	12.7%
λ	0.48	average leverage	44.7%	44.7%
c_{IPO}	0.0	share of private firms (value)	11.4%	14.0%
c_M	0.0	aggregate insider share	16.1%	9.7%

Moment	Data	Model
Top 10% wealth share	42.7%	43.2%
Share of wealth held by private entrepreneurs	8.2%	17.9%
Wealth/ GDP	2.3	2.7