The Intangible Economy and the Decline of Corporate Leverage in Europe

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September 4, 2025

Abstract

Contrary to widespread concerns about rising indebtedness, corporate leverage has steadily declined over the past two decades across many western economies, and in particular in the EU. This paper documents this trend using novel microdata for the near-universe of firms across 21 European countries. Leverage fell throughout the period of loose monetary policy before 2020, at a similar rate across firms of different sizes, productivities, and dividend policies. Declining leverage has traditionally been associated with a tightening supply of external finance, but our evidence suggests an important role for falling credit demand, driven by in-house development of intangible capital. We build a dynamic model in which heterogeneous firms compete by investing into tangible and intangible assets. Firms that invest more into intangibles experience greater economies of scale, leading to higher profitability and accumulation of market power. However, intangibles face a higher external financing cost, and also a greater risk of expropriation by competitors that poach key human capital. Our model shows how firms save cash (and maintain low net leverage) due to both traditional precautionary reasons and a novel strategic motive to retain human capital. The model can be estimated to quantify the importance of each mechanism for explaining the decline in European corporate leverage.

Keywords. Corporate leverage, Technological change, intangible assets, secular trends.

JEL classifications. G32, G35, J24, J33

1. Introduction

During the post-World War II period advanced economies experienced a historic expansion of financial intermediation, with private credit to GDP rising almost uninterruptedly over a long time period. Jordà et al. (2022) document that the debt-to-GDP ratios of non-financial firms in 17 developed countries more than doubled between 1945 and 2000. Among U.S. public corporations, leverage tripled over the same period (Graham et al., 2015). Corporate debt has also risen significantly in China, and now exceeds the level in most OECD economies (Beck et al., 2023). This long-term trend has elicited concern among regulators and policymakers, since high corporate debt levels have amplified recent financial crises (e.g., Kaplan, 2019). For example, Kalemli-Özcan et al. (2022) document greater investment cuts among more highly levered European firms during the 2012 Eurozone crisis.

However, a striking and largely unnoticed fact is that for years corporate leverage has been *steadily declining* among private firms—a reversal in the long-term trend which predates the 2008 financial crisis. This paper's first contribution is to carefully document this generalized decrease, using novel data that covers the near-universe of firms in 21 European countries. We show that median net leverage across Europe fell from 36% in 2002 to 20% in 2022. The pattern has been similar across all large economies (except Poland), with only brief periods of increase during the crisis years of 2008–2012.

This structural break in leverage has likely been overshadowed by a focus on large publicly traded firms, whose balance sheets are much more readily available to researchers. Yet, unlisted firms constitute a large part of GDP and the vast majority of total employment. Moreover, corporate indebtedness may be overstated when using GDP as a denominator, since the capital income share has risen across many economies (Rognlie, 2016).[1] Nevertheless, our results are consistent with the limited research conducted on private firm leverage in the United States, where leverage declined by 10 percentage points from 2004 to 2018 (Bellon et al., 2024), and also Japan (Khoo and Durand, 2017).

[1]The debt-to-GDP ratio is an imperfect measure of corporate financial health, as it does not account for firms' repayment capacity, which depends on the value of their own assets. A more direct measure of financial strength is the leverage ratio, which links debt obligations to the productive assets backing them.

Because this decline has taken place during a period of historically loose monetary policy, it is hard to attribute to the classical explanations for falling leverage. A broad strand of literature documents how tightened credit supply can prevent firms from raising debt (e.g., Ivashina and Scharfstein, 2010; Chodorow-Reich, 2014; Corbisiero and Faccia, 2020). Other common explanations are that secular stagnation has reduced the amount of profitable investment opportunities, especially in Europe (Gordon, 2012; Eichengreen, 2015; Jones and Philippon, 2016; Eggertsson et al., 2019) and that falling interest rates have reduced the value of tax shields (e.g., Dallari et al., 2018).

While these factors certainly explain part of the leverage decline, they are at odds with additional trends we document using European microdata. First, the share of credit-constrained firms in Europe (as measured by the ECB's SAFE survey) was higher in 2001 than in almost any other year afterward, and has fallen from 14% to 3% over our sample period. Corporate dividend payouts have been higher since the crisis period than before it (3.5% of total assets in 2020, compared to 3% in 2003). Moreover, leverage has fallen at a near-identical rate across firms of different sizes (measured by number of employees), age, and productivity (measured by growth in sales/employee). It is hard to argue that firms which pay out dividends or are growing the most rapidly are also financially constrained, especially during a period of near-zero borrowing rates.

The paper's second contribution is to offer a complementary *demand-driven* explanation for the leverage decline: Firms increasingly derive value from intangible assets, which require fewer upfront cash outlays to create than physical capital (and hence less debt financing). This explanation is distinct from the traditional view that intangible capital has low debt capacity due to its limited collateral value (e.g, Falato et al., 2022), or more recent research showing that intangibles allow firms to accumulate significant market power and thus may depress investment spending (Crouzet and Eberly, 2023).

Instead, our explanation is motivated by two defining characteristics of intangible assets. The first is that they are largely created by skilled employees, who contribute their human capital via activities such as coding software, developing new product designs, collaborating on a marketing campaign, or analyzing large datasets. Unlike the purchase of physical property or equipment, such activities can be executed within significant cash spending by the firm. Skilled employees

naturally must be rewarded for their human capital contributions, but their compensation is partly deferred (e.g., via unvested equity grants) to ensure retention until project completion (Sun and Xiaolan, 2019; Eisfeldt et al., 2023).

A second unique feature of intangible capital is that it can be easily expropriated by competitor firms, which creates a strategic motive for firms to hoard cash and maintain low leverage. Intangible assets can be deployed simultaneously across multiple divisions of a firm, allowing it to scale up quickly (Crouzet et al., 2024). This non-rivalry property also makes it easier for other firms to claim or copy the assets, a threat that can be particularly disruptive to the fastest-growing firms. However, accumulated liquidity can help firms to protect their intangible capital. For example, a firm with abundant cash holdings (and thus low net leverage) can more easily deter talent poaching, by matching the competing offers that its skilled employees receive. Döttling et al. (2025) show that established firms with a sufficiently conservative financial structure can deter young firms from entering the market and competing for human capital.

We formalize this explanation by constructing a dynamic discrete-time model of firm investment and production, which nests the two defining features of intangible capital alongside costly external financing and secular productivity shocks. Calibration of this model can quantify how much of the leverage decline in Europe is due to lower demand for debt driven by rising intangible investment, relative to a tightening of credit supply or decrease in investment opportunities. Another novel feature of our model is that market power arises endogenously from firms' development of intangible assets.

The framework models an economy with heterogenous firms operating under monopolistic competition, and a representative household of overlapping generations who supply labor and consume output (with preferences characterized by love of variety, as in Dixit and Stiglitz (1977)). Each firm uses tangible and intangible capital, complemented by skilled and unskilled labor, and is the sole producer of a single distinct good. At the start of each period, the firm hires workers from the household sector and builds capital. The firm must spend cash to invest into tangible assets and (to a lessor extent) to create intangibles. This cash can come either from earnings retained from a previous period, or from costly external debt obtained from the household sector.

Firms differ in their ability to retain and enhance human capital, which is representing in the model by an investment cost parameter that varies across firms. This cost advantage allows some firms to build intangible capital more efficiently than others, and thus to scale up production more rapidly. Because each firm has some pricing power over the good that it produces, firms that can create intangible assets efficiently can also accumulate market power.

While such firms can increase profitability by investing heavily into intangible assets, the downside risk is that their capital is more prone to expropriation. In our model, an expropriation threat arises in each period following a Poisson process, and the arrival rate increases with the amount of intangible capital that the firm possesses. This feature represents that firms which create more intangible capital also signal that they have higher quality human capital, thus becoming more attractive targets of poaching. When a firm experiences expropriation, it loses all of its intangible capital and must exit the economy. However, a firm can deter expropriation by making a cash payment to the household, which can represent a cash bonus to match an employee's outside offer. In each period firms also face a risk of sudden depreciation of their tangible capital, but cash savings allow the firm to rebuild its physical assets prior to production.

Corporate cash holdings serve three distinct roles in our model. First, firms face a pecking order in which they prefer to fund investment needs with retained earnings rather than costly debt. Second, firms have a traditional precautionary motive to save cash, to rebuild physical capital that has depreciated. Third, cash holdings allow firms to prevent expropriation of intangible assets. In each period, the firm trades off investing its cash to create capital (thereby boosting current profits) versus saving it to protect existing capital or boost retained earnings (potentially increasing future profits).

We present analytical results showing that firms which can create intangible assets more efficiently also invest more overall into both types of capital. These firms charge higher markups for their good and thus accumulate a greater share of the market. We also show that the a firm's optimal cash policy is to retain earnings and build up cash savings until a buffer is reached, and then to pay out all excess cash. This buffer rises with a firm's efficiency of creating intangible assets.

Finally, we show how the model can be calibrated to decompose the leverage decline in Eu-

rope based on different possible determinants. Our demand-driven explanation can be tested by increasing in the productivity of intangible capital relative to tangible assets. The traditional credit supply mechanism can be tested by increasing the cost of external debt, which rises by a larger amount in our model for firms that invest more into intangibles. The secular stagnation explanation can be tested by reducing the productivity factor in the firm's production function. The model can quantify the relative importance of the three channels, by conducting a counterfactual exercise that varies the model parameters one at a time.

The rest of the paper proceeds as follows. In Section 2 we present a review of the literature and position our contribution in light of previous work. In Section 3 we present our data and the empirical trends we observe across EU firms. In Section 4 we discuss our model and its implications. Finally, Section 5 concludes.

2. Literature Review

Our work is not the first one documenting declining corporate leverage. According to Beck et al. (2023), aggregate EU gross leverage declined modestly during the mid-2000s, surged briefly during the financial crisis, and then fell steadily from 36% in 2009 to 29% in 2021. Net leverage follows a similar pattern, particularly since 2016. Among individual EU states, leverage peaked in the mid-2000s in Germany, France, Austria, and the Netherlands. In periphery countries leverage declined substantially after 2009, and is now lower than in 1995. The primary exception is Central Europe (Poland, Slovakia, and the Czech Republic), where leverage rose from a low base as the region integrated into the EU. This prolonged decline in average leverage is matched in data on U.S. firms. Average US firm leverage has fallen by about 10 percentage points (pp) since 2004, with most of the decrease coming after the financial crisis (Bellon et al., 2024). Leverage has fallen by 12pp among Japanese listed firms since 1999 (Khoo and Durand, 2017). Since 2008 leverage fell by 10pp in Australia and by 6pp in the United Kingdom (Beck et al., 2023). These trends suggest a structural shift in advanced economies rather than a European phenomenon.

Our study contributes to the literature via using firm level data to further document the phenomenon, linking it to other relevant trends we have observed over the same period.

We consider three structural factors as possible drivers: financial regulation, secular stagnation and rising importance of intangible capital.

Declining leverage may in part reflect a rise in financial constraints, potentially due to tighter regulation (Almeida et al., 2004; Whited and Wu, 2006). A well-established result in finance research is that a firm may reduce debt usage due to a tightening of financial constraints. This arises when a firm would like to raise debt to pursue positive-NPV investment opportunities, but creditors are unwilling to provide sufficient financing at a reasonable cost of capital. In particular, negative macroeconomic shocks can exacerbate information asymmetry between a firm and its creditors about the quality of investment opportunities or the ability to repay debt. Prior work measures financial constraints using proxies for asymmetric information such as firm size, age, a commitment to pay out dividends, or the amount of tangible assets (Fazzari et al., 1988; Whited and Wu, 2006; Almeida and Campello, 2007; Hadlock and Pierce, 2010).Another strand of literature shows that shocks to credit providers can percolate through to the real economy, by reducing corporate access to external financing for investment. Fundamentally strong firms may struggle to raise external financing, if they rely on creditors whose balance sheets have deteriorated. This is a significant concern for EU firms, which rely heavily on bank loans instead of public debt or equity issuance. Kalemli-Özcan et al. (2022) compare EU firms that had pre-existing lending relationships to banks with high versus low sovereign bond holdings during the financial crisis (a proxy for balance sheet weakness). They show that more highly levered firms cut investment by a greater amount during the crisis, an effect amplified by a pre-existing relationship to a weakened bank.These findings suggest that declining leverage across the EU could be driven by weaknesses in firms and banks that arose during the financial and Eurozone crises. Declining gross leverage since 2008 could be caused by a reluctance or inability of banks to lend to firms, and net leverage could decrease due to firms conserving cash in anticipation of becoming financially constrained. Notably, in order for this channel to explain most of the decline in leverage across our sample period, it must be that firms' available supply of credit remained depressed during the recovery period after the Eurozone crisis, despite record-low interest ratesIn the years after the crisis Kalemli-Özcan et al. (2022) show that EU firms with pre-existing relationships with hard-hit banks cut investment heavily. In addition, new EU bank capital norms under

Basel III have clearly reduced bank incentives to lend to smaller firms since 2014. Yet the decline in leverage started before the 2008 crisis, and persists even once EU credit conditions had stabilized from the Euro crisis. ECB surveys document renewed bank willingness to provide credit (Beck et al., 2023). The decline in aggregate EU leverage accelerated after 2016. Strikingly this occurred at a time of loosening of monetary policy which reduced financing costs to historic lows.

We contribute to this literature by providing evidence against this interpretation, in fact in our data the incidence of firms that are credit or liquidity constrained is falling, while dividend payouts and profitability are increasing.

The steady decline in leverage coincides with two other major structural transformations in advanced economies. The first is a well-documented decline in business dynamism (e.g., Eggertsson et al., 2019; Eichengreen, 2015; Jones and Philippon, 2016; Gordon, 2012; Akcigit and Ates, 2023), which has contributed to an era of secular stagnation, even in periods of minimal interest rates. In a low-growth environment, firms may reduce borrowing due to weaker and more uncertain future prospects, while banks may also become more cautious in extending credit. This explanation aligns with research documenting rising secular stagnation (Eggertsson et al., 2019; Eichengreen, 2015; Jones and Philippon, 2016) and declining business dynamism across advanced economies (Gordon, 2012; Akcigit and Ates, 2023, 2021). These trends may be particularly pronounced for EU firms, which experienced prolonged economic weakness following the financial and Eurozone crises.

A second driver of declining leverage is the shift toward intangible capital, a defining feature of the digital transformation that began in the 1980s. Information technology has fundamentally changed corporate production and distribution, reducing reliance on physical assets and, consequently, the need for debt financing (Corrado and Hulten, 2010).

Unlike physical assets, intangible investments—such as software, brand value, and human capital—require different financing structures. Whereas physical capital often requires large upfront expenditures that can be debt-financed, intangible investment tends to be funded through retained earnings or equity (Döttling et al., 2025; Eisfeldt et al., 2023). Furthermore, firms operating in intangible-intensive industries may experience increasing returns to scale, allowing a small set of successful firms to grow rapidly with minimal debt (Crouzet et al., 2024; Hsieh

and Rossi-Hansberg, 2023; De Ridder, 2024).

Thus, the decline in leverage may not reflect a lack of investment opportunities but rather a shift in the nature of corporate investment. Advanced economies have seen a rapid increase in the share of intangibles relative to total assets (e.g., Corrado and Hulten, 2010; Falato et al., 2022). Our model contributes to this literature by providing a theoretical framework that accounts for these mechanisms and aligns with observed empirical trends.

Our work also advances the empirical literature on the relationship between debt financing and intangible capital. Prior studies argue that intangible assets' low transferability and lack of explicit property rights make them poor collateral for debt financing (Dell'Ariccia et al., 2021; Falato et al., 2022; Crouzet and Eberly, 2023). We build on this research by showing that firms with high intangible intensity do not further reduce leverage in response to tighter collateral constraints. This suggests that the decline in leverage among intangible-intensive firms is primarily driven by a lower demand for credit rather than by supply-side constraints.

3. Facts about European Leverage Trends

This section describes our two main sources of data on corporate leverage and other firm fundamental variables. It then presents stylized facts about leverage trends in Europe over the past two decades. We document trends aggregated across the vast majority of European firms, and also aggregated across different groups of firms that vary in the extent to which they are financially constrained.

3.1. Data sources

3.1.1. CompNet

Our first source is a micro-founded database compiled by the Competitiveness Research Network (CompNet). This research initiative is created through collaboration between national central banks, statistical institutes, and research institutions from 22 European countries.[2] Each partic-

[2]CompNet's primary mission is to foster collaboration between policymakers and researchers on competitiveness-related issues in Europe. Countries participating in the 9th or 10th vintages of CompNet are Belgium, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Malta,

ipating country gathers firm-level data from administrative sources such as business registries, tax records, and production surveys. These data include standard balance sheet and income statement line items. The panel of participating countries is unbalanced, but most enter the database by the mid-2000s and remain through 2020. Each country collects data from a wide range of listed and unlisted firms, such that its sample is representative of corporate activity across the entire economy. CompNet processes all firm-level data using a harmonized protocol, to ensure that variable definitions and sampling procedures are consistent across countries.

Next, CompNet aggregates each firm-level variable into a set of statistical moments, such as means, standard deviations, and various percentiles. This is done in order to preserve firm-level confidentiality and safeguard data privacy. Each variable is aggregated at several different levels, including (i) country and year; (ii) country, year, and age group (younger or older than 5 years); (iii) country, year, and size group (less than 50 employees, 50-249 employees, and 250 or more employees); and (iv) country, year, and industry (2-digit NACE Rev. 2 classification). CompNet constructs these aggregates using all sampled firms, and also using only firms with 20 or more employees. It also constructs variables that are aggregated directly from the source data, as well as variables that are aggregated after re-weighting data to to ensure that it represents the entire population of firms.[3].

We use aggregate measures that are based on the sample of firms with 20 or more employees, and constructed after weighting the underlying data. CompNet's internal analysis indicates that these data are more reliable than aggregates based on unweighted data or samples including tiny firms. Nevertheless, the sampled firms cover more than 50% of the total firm population in the participating countries, with a total count of 332,073 firms in the first year of the data coverage and 367,204 in the last. Manufacturing firms constitute approximately one-third of the sample, yet their share declines from 35% in 2006 to 30% in 2018.

The CompNet database has been updated repeatedly, and the current version is the 10th

Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and Switzerland. The United Kingdom also participates in CompNet, but data is not available for most financial variables.

[3]For each individual country, weighted data are constructed by adjusting the composition of the country's sample to be consistent with its official firm counts, at the industry and size group level. These firm counts are obtained from Eurostat. For more informatoin, see the CompNet 10th Vintage User Guide available at https://www.comp-net.org/data/10th-vintage.

vintage which extends through 2022. Some countries have not yet been included in this vintage, for example due to backlogs in processing of firm-level data by the national statistical offices. For these countries, we use data from the 9th vintage which ends in 2020. We omit observations from a few country-years in which the harmonization procedure changed significantly between the 9th and 10th vintages.[4] Table 1 1 lists the years in which data is available for each country, as well as the total size of each countries' sample and population of firms. Table **??** provides information on the aggregate industry composition of the CompNet sample and the total economies of the participating countries. Throughout the paper, when using CompNet data, we restrict the sample period to 2002–2022 to ensure that aggregates are based on data from a large number of countries.

3.1.2. Administrative data from Netherlands and France

Our second data source is two national databases that contain financial data for the entire universe of firms in the Netherlands and France. The Dutch NFO database and French FICUS-FARE database are both constructed from tax records, and contain standard balance sheet and income statement variables at the firm-year level. The NFO database starts in 2005, while FICUS-FARE starts in 1995. Both datasets protect confidentiality by anonymizing firms. Therefore, it is not possible to merge these data with information on Dutch or French firms from other databases.

One key advantage of these microdata is that we can construct aggregated statistics on our own from the firm-level data, while CompNet only provides aggregates based on a limited amount of dimensions. For example, in Section 3.3.1 we measure each individual Dutch or French firm's sales growth, and then present leverage trends for different groups of firms based on this measure. In contrast, CompNet does not report any moments (for any variable) that are aggregated based on sales, earnings, or productivity growth. However, a disadvantage is that

[4]Belgium, Finland, Italy, Latvia, Sweden are in the 9th vintage but not yet in the 10th vintage, while Estonia is in the 10th vintage but not the 9th. For Sweden, we omit leverage aggregates from all years before 2007, when its calculation method appears to have changed. In France, the harmonization method changed significantly in the 10th vintage, and data from 2008 is currently missing. We fill in values for each variable based on a linear interpolation between the values in 2007 and 2009.

these national databases are not representative of the overall European economy.[5] Throughout the paper, when using the national microdata, we restrict the sample to firms with five or more employees. This restriction ensures that we filter out inactive sole proprietorships.

3.2. Stylized facts on aggregate leverage and cash holdings

Figure **??** documents median net leverage across all 22 European countries in the CompNet database. For each country, we measure net leverage as median gross leverage minus median cash holdings/total assets, where the sample medians are from CompNet. We then construct aggregate European net leverage by weighting each country's value using the total assets across the entire population of firms in the country. (We use this weighting measure in all figures that document aggregate European trends using CompNet data.)

The figure documents a remarkable decrease in net leverage across Europe, from 0.658 in 2002 to just 0.189 in 2022 (a 72% decline from the 2002 value). Notably, net leverage fell in almost all sample years, with slight increases of less than 0.01 occurring only in 2007, 2011, and 2018. Overall, net leverage appears to be in structural decline across Europe, as the trend preceded both the 2008 financial and 2012 Eurozone crises by several years.

Figure **??** presents trends in median net leverage separately for eight large and medium-sized European countries that participate in CompNet. The figure documents a persistent decline in leverage across all eight countries. In the three countries that are in the sample since 2002, net leverage declined gradually before the financial crisis. It fell from 0.756 in 2002 to 0.7 in 2007 in Germany, from 0.666 to 0.641 in France, and from 0.691 to 0.652 in Denmark. In each of these countries, the decline accelerated after 2008. Net leverage also has fallen persistently for firms that entered the CompNet sample in the mid- to late-2000s. Only in Italy was there a gradual increase from 0.244 in 2006 to 0.263 in 2008, and in Spain from 0.2 in 2008 to 0.217 in 2011. Overall, the figure shows that decreasing net leverage is a widespread phenomenon across many European countries.

The decrease in net leverage results from both a decline in gross corporate indebtedness and

[5] We are currently in discussions with national statistical offices from four other European countries, to obtain access to their firm-level tax records.

an increase in cash balances. Figure **??**, Panel A plots median gross leverage aggregated across the same sample of European firms as in Figure **??**. It documents that gross leverage fell from 0.695 in 2002 to 0.327 in 2022, a decline of 37 percentage points (pp). Gross leverage has fallen by 16pp since 2008, but it also fell by a similar amount in the mid-2000s. Next, Panel B plots median cash holdings scaled by total assets. Cash balances across Europe rose steadily from 0.037 in 2002 to 0.095 in 2019, before jumping sharply at the start of the COVID-19 pandemic. Notably, the sharp drop in European net leverage during the pandemic is driven by both a reduction in debt issuance and an increase in cash savings.

3.3. Does decreasing credit supply fully explain European trends?

One possible explanation for the decrease in net leverage is that European banks have become progressively less willing to supply credit to firms over the past two decades. Undoubtedly, many European banks have reduced their balance sheets since 2008, and also face a wide range of new regulations that increase the cost of lending to some firms. Since most European firms rely primarily on bank loans for external financing, a reduction in supply of bank credit could lead to a decrease in gross leverage. A closely related explanation is that cash balances have risen over time because firms have anticipated increased tightening of bank credit, and engaged in precautionary cash savings to avoid becoming financially constrained. This could explain the decreasing trend in net leverage.

A reduction in credit supply likely cannot explain the persistent decreases in gross and net leverage across the entire 2002–2022 period. The European Central Bank's fixed interest rate was a constant 2% from mid-2003 through the end of 2005, and then was held at 0% from mid-2016 through mid-2022. The ECB's quantitative easing and extraordinarily loose monetary policy after the Eurozone crisis translated to historically low borrowing rates for many European firms, however aggregate gross leverage decreased by 10pp during this time period.

Figure 9 documents that the share of credit-constrained European firms has not increased since the mid-2000s, with the exception of a brief increase around the 2008 Financial crisis. Panel A reports a CompNet measure that classifies firms as constrained when they report positive investment while simultaneously reducing debt and capital, or if they reduce investment

while maintaining a positive financing gap. The figure plots the weighted average across all countries of the fraction of sample firms that are classified as constrained. With the exception of 2008, the share of constrained firms has fluctuated between 0.047 and 0.061 from 2002 through 2020. There was no clear trend in the share of constrained firms before the Financial crisis, and a marked decrease after the end of the Eurozone crisis.

Panel B plots a second measure of credit constraints, based on the ECB's Survey on Access to Finance of Enterprises (SAFE).[6] CompNet does not have access to the SAFE survey data, so it estimates credit constraints at the firm level based on loan rejections, limited credit approvals, prohibitive borrowing costs, and discouraged borrowing. It then defines a threshold for credit constraints that varies across years and countries, such that the fraction of firms above the threshold in each country matches the share reported in the SAFE survey.[7] In this plot, the share of credit-constrained firms has declined significantly over the past decade, from 0.155 in 2008 to 0.033 in 2021.

Importantly, both panels show that the fraction of credit-constrained firms was lower in the period between the Eurozone crisis and the COVID-19 pandemic 2015–2019 period than in any year before the Financial crisis. In other words, firms recently appeared to be less financially constrained than in the early to mid-2000s, yet also maintained much lower leverage. This indicates that a reduction in credit supply likely does not explain the decrease in net leverage, at least in the post-crisis period.

Further supporting this conclusion, Figure 11 documents that dividend payouts as a share of total assets have increased from 3% to 3.5% over the whole sample period. Payouts have also risen consistently since the end of the crisis period. This trend suggests that firms' financial flexibility has increased in recent years, as they have been able to distribute a greater portion of the cash holdings to shareholders rather than retaining precautionary liquidity or repaying debt. In contrast, credit-constrained firms would typically prioritize liquidity preservation over returning capital to shareholders.

[6] The SAFE is conducted by the ECB jointly with the European Commission twice per year. The survey assesses the financial conditions of firms in the euro area, and is also conducted for some non-euro area countries.

[7] See Ferrando and Ruggieri (2018) for more details on the variables included and the steps of the estimation process.

To further examine whether leverage trends can be explained by a decrease in credit supply, we plot net leverage aggregated over separate groups of firms that likely vary in exposure to credit constraints. Figure **??** reports separate plots for firms incorporated within the past 5 years and for firms incorporated more than 5 years ago. Younger firms are often considered to have more difficulty raising external financing than mature firms, in part because information asymmetry is higher between creditors and firms with a not-yet-established business model. Thus, a reduction in credit supplied by European banks should have a greater impact on the leverage of young than old firms. However, the figure documents a near-identical trend across both groups of firms until the COVID-19 pandemic. Net leverage fell by 34pp from 2002 through 2019 for older firms, and by 38pp over the same period for younger firms. (During the pandemic, net leverage fell significantly faster for young than old firms.)

Similarly, Figure **??** reports separate plots for firms in three different size classes, based on number of employees. Smaller firms are often considered to be more financially constrained than large firms. Yet as with firm age, the trend in net leverage is almost identical for firms in each size class. Net leverage fell by 35pp from 2002 through 2019 for firms with fewer than 50 employees, by 34pp for firms with 50 to 249 employees, and by 28pp for firms with 250 or more employees.

3.3.1. Firm-level evidence from Netherlands and France

We further use the national Dutch and French microdata to fully examine the credit supply explanation. As discussed in Section 3.1, a key advantage of these data is that we can aggregate net leverage across a wider range of firm types than in CompNet.

Figure **??** plots net leverage trends in the Netherlands and France, separating irms along two additional dimensions related to financial constraints. Panel A plots trends separately for dividend and non-dividend paying firms in each country. In both the Netherlands and France, dividend-paying firms consistently maintain lower net leverage than non-dividend paying firms. However, the trend in leverage across both sets of firms, in each country, is almost identical.

Panel B plots trends for firms with different growth rates, measured as the three-year average of annual sales growth divided by total employees. High-growth firms are those in the top quintile of this measure in each country, while Declining firms are those with negative values

for the measure. Remarkably, net leverage fell by almost the same amount for High-growth as Declining firms in both the Netherlands and France.

One further advantage of the national microdata is that financial data is available for France since 1995. The figures thus document that leverage has been declining consistently in this country since the mid-1990s.

4. The Model

This model has the purpose of understanding how technological trends happening at the firm level can have aggregate implications for macro-financial trends.

We start from the assumption that advanced economies are withstanding a technological long term trend characterized by increasing relevance of intangible capital in production. We conceptualize this asset as something that is developed in-house by firms and skilled workers and is a key driver of their performance. Examples of such trends are digitalization and rise of e-commerce, as well as increasing value of brand and other types of intellectual property or finally high impact of marketing on sales growth (Corrado and Hulten, 2010). We therefore lay down a framework centered around a firm level production function that can capture such features. This production function includes both types of capital and is meant to capture two basic features of intangible capital that make it distinguishable from tangible capital. The first one is internal economies of scale, that unevenly benefit firms that are able to deploy intangibles[8]. In this case, we assume it's due to their higher ability to tap into the potential of better quality human capital, hired in the form of skilled workers (**?**). The second assumption is limited appropriability: intangible capital is a co-investment between firms and skilled workers, who retain a part of the value of capital, posing a potential spillover risk for companies in case the worker is poached by a competitor (Similar to **?** and **?**). This risk affects the marginal cost of investing in intangibles and firms keep it into account when they make their optimal investment decisions.

[8]For other modeling approaches of this competitive advantage given by intangible capital see for instance **?**Hsieh and Rossi-Hansberg (2023); De Ridder (2024).

4.1. Setup

Agents. There are an infinite number of discrete periods, each of which can represent a full project cycle. During each period, a large set of firms interacts with a representative household. Firms produce a total of $\mathcal{J}$ goods, measured over the unit interval $[0, 1]$. Each good $j \in \mathcal{J}$ comes in n_j discrete varieties, and each firm produces a single variety i of one good j. In each period, a firm earns total profits $\pi_{it}(j)$ from selling this variety, which are fully distributed to the household via dividend payments.

The household is populated by overlapping generations which each live for two periods. When a generation is young it provides labor to firms, and also owns a bank that can provide debt financing. When each generation becomes old, it consumes goods using its labor, interest, and dividend income. There is an initial generation which is old and consumes in the first period. Thus, in each period t the representative household unit supplies labor, consumes goods, and lends to firms.

Household's Problem. The household's total consumption in each period is Y_t, and consumption of each individual good j is denoted at y_{jt}. The household is characterized by a love for variety (as in Dixit and Stiglitz, 1977) across goods. The consumption of each good j is characterized by a demand function with constant elasticity of substitution function across all of the good's varieties:

$$y_{jt} = \left(\sum_{i=1}^{n_j} y_{it}(j)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \tag{1}$$

where $y_{it}(j)$ is demand for variety i of good j.

The household's utility from total consumption $U(Y_t)$ is characterized by a constant elasticity of substitution utility function across all j goods produced in the economy:

$$U(Y_t) = \left[\int_0^1 y_{jt}^{\frac{\theta-1}{\theta}} dj \right]^{\frac{\theta}{\theta-1}} \tag{2}$$

We specify $\eta > \theta$, so that the substitution elasticity across multiple varieties of the same good j is higher than the elasticity across multiple goods.

In each period, the household provides total labor $\bar{L}_t$ to firms. A fraction ν of the household's

workers provides skilled labor h_t in exchange for a per-unit wage w_t. The remaining fraction $1-\nu$ provides unskilled labor l_t for the per-unit wage of q_t. We assume that skilled labor is relatively scarce, implying it can earn a higher salary than normal labor. This is represented by the condition:

$$\frac{1-\nu}{\nu} < \frac{1-\alpha}{\alpha} \tag{3}$$

where α represents the relative productivity of the tangible production factors vs the intangible in Eq. (9) (see below). The household also extends debt financing of D_{it} to each firm, which earns interest in the following period at a fixed rate r.Finally, the representative household also consumes the distributed profits from all firms in the economy, which we denote by $d_{it}(j)$ for firm i in industry j.

The household's problem is to choose a bundle of individual varieties of each good $y_{it}(j) \;\; \forall j \in \mathcal{J}$ to maximize utility from Eq. (2), subject to its budget constraint:

$$\max_{y_{it}(j)} \quad \left[\int_0^1 \left\{ \left(\sum_{i=1}^{n_j} y_{it}(j)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \right\}^{\frac{\theta-1}{\theta}} dj \right]^{\frac{\theta}{\theta-1}} \tag{4}$$

$$s.t. \quad \int_0^1 \sum_{i=1}^{n_j} p_{it}(j) y_{it}(j) \; dj \leq q_t h_t + w_t l_t + \int_0^1 \sum_{i=1}^{n_j} d_{it}(j) + r_t D_{it-1} \; dj \tag{5}$$

where $p_{it}(j)$ indicates the price of variety i of good j. The left-hand side of budget constraint Eq. (5) represents total per-period expenditure, which we denote R_t.

Equilibrium Demand and Pricing. The equilibrium demand for each variety $y_{it}(j)$ can be derived by solving Problem (4):

$$y_{it}(j) = \left(\frac{p_{it}(j)}{p_{jt}} \right)^{-\eta} \left(\frac{p_{jt}}{P_t} \right)^{-\theta} Y_t \tag{6}$$

where p_{jt} is a price index for each good j and P_t is a price index across the whole economy (so

$P_t Y_t = R_t$). These indexes are:[9]

$$p_{jt} = \left(\sum_{i=1}^{n_j} p_{it}^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{7}$$

$$P_t = \left(\int_0^1 p_{jt}^{1-\theta} \right)^{\frac{1}{1-\theta}} \tag{8}$$

Note from Eq. (6) that for each good j, demand for variety i is inversely proportional to its price based on the substitution elasticity across varieties.

As explained above, each variety i of good j is produced monopolistically by a single firm. The n_j firms that produce the good compete with each other á la Cournot. Each firm chooses its individual price $p_{it}(j)$ considering its impact on equilibrium demand from Eq. (6). The price of each variety is linked to the prices of other varieties and also the prices of each good p_{jt} through the price indices in Eqs. (7) and (8). Thus, firms take into account how their pricing decisions affect demand across the economy.

Firm Production. We next discuss each firm's investment and production decisions, dropping the i subscript for notational convenience. At the start of each period, a firm spends cash to build tangible capital K_t and intangible capital H_t. The firm also hires unskilled labor l_t to operate tangible assets, and skilled labor h_t which co-invests into creating intangible assets by contributing human capital. The firm's output at the end of the period is based on the production function:

$$F(H_t, K_t, h_t, l_t) = A_t \left[\alpha (K_t^{\zeta} l_t^{1-\zeta})^{\rho} + (1-\alpha)(H_t^{\gamma} h_t^{1-\gamma})^{\rho} \right]^{\frac{1}{\rho}} \tag{9}$$

where A_t reflects a productivity factor that varies over time but is common across all firms, α measures the relative productivity of tangible capital and manual labor relative to intangible capital, γ and ζ represent the output elasticity of tangible and intangible capital, and ρ is the substitution parameter between the two capital types.

[9] So far our model resembles the set-up of the model by Atkeson and Burstein (2008), where instead of a final good producer and homogeneous preferences we introduce Dixit-Stiglitz demand for multiple goods of different varieties.

The firm's upfront investment cost function for tangible capital is $c_K(K)$, with $\partial c_K(K)/\partial K \geq 0$ and $\partial^2 c_K(K)/\partial^2 K > 0$. The firm also faces a convex cost function for intangible capital $c_H(H, \phi_i)$, but the cost level varies across firms based on a random parameter ϕ_i. This parameter reflects that the ability to retain and enhance the human capital of skilled employees varies across firms, which provides some firms with a greater cost advantage than others in producing intangible assets:

$$\frac{\partial c_H(H, \phi_i)}{\partial \phi_i} \leq 0, \; \frac{\partial^2 c_H(H, \phi_i)}{\partial^2 \phi_i} > 0 \tag{10}$$

It is distributed according to the distribution function $G(\phi)$, and each firm receives a draw from the function upon entry and maintains the ϕ_i value as long as it is in operation.

In each period, the firm's gross profits from production are $\pi_{it}(j)$, which may be distributed to the household in the form of dividend payments or set aside in the form of retained earnings. We assume that both tangible and intangible capital depreciates fully at the end of each period, and hence earns no recovery value.[10]

Capital Expropriation. A key feature of our model is that intangible capital is subject to "expropriation risk". In the middle of each period, skilled workers from the household receive an opportunity to transfer the intangible assets they have helped co-create to potential new firm. When an incumbent firm experiences expropriation, it loses all of its intangible capital H_t and exits the economy. It is replaced by a new firm with an identical production technology and ϕ value (but no retained cash holdings), which has an opportunity to build capital and hire employees in period t. Expropriation risk can represent a disruptive entrant firm that attempts to poach an incumbent's human capital (Döttling et al., 2025), or more generally the "imperfect appropriability" modelled in Crouzet et al. (2024). Expropriation follows a Poisson process with arrival risk based on parameter $\lambda(H)$, such that:

$$\frac{\partial \lambda(H)}{\partial H} \geq 0, \qquad \frac{\partial^2 \lambda(H)}{\partial^2 H} > 0 \tag{11}$$

Importantly, Eq. (11) indicates that firms with a greater amount of intangible capital are

[10]The motivation is that each period in our model represents a full product cycle. Thus a single period matches the life span of machinery used to make a particular product, and the intangible capital that supports the project. Note also that each period in the model also corresponds to the working life of one generation.

more exposed to expropriation risk (consistent with Crouzet et al., 2024). One motivation is that firms which create more intangible assets signal that they have higher quality human capital, and therefore they attract more poaching offers by potential entrants. Additionally, such firms have high amounts of non-rival assets (such as software or product designs) that may be easy for competing firms to imitate.

Note that each firm's choice of H_t depends on both ϕ_i and expropriation risk. Firms with higher ϕ_i values are more efficient at creating intangible assets, and this has a positive effect on their choice of H_t. However, firms that create more intangibles than their competitors also face a greater risk of expropriation, which dampens their motive to build intangibles.

Firms can mitigate expropriation risk by maintaining strategic cash holdings. At the start of period t, the expected amount of intangible capital that a household can expropriate to a competitor firm is:

$$Q^H(H) = \left(1 - e^{-\lambda(H)}\right) H \tag{12}$$

Therefore, the firm can prevent expropriation by offering the household a payment $Q^H(H)$ at the start of the period. This payment can represent a deferred cash bonus that the firm grants to its skilled employees, which vests only when the employee remains at the firm until the end of the project cycle. Alternatively, $Q^H(H)$ can represent a payment that the firm makes to an entrant to deter it from poaching employees.

Firms also face an idiosyncratic risk of tangible capital destruction during the middle of each period. Destruction is governed by a Poisson process with arrival parameter $\delta > 0$. Thus, at the start of each period the firm expects that it needs to replace $1 - e^{-\delta}K$ of its desired tangible capital. This creates a motive for holding precautionary savings of $Q^K(K)$, which can be deployed in the middle of the period to replenish capital that is destroyed.

Cash Accumulation. Each firm starts with an initial cash endowment Q_0 upon entering the economy. This endowment can be supplemented with debt financing, so cash holdings in the initial period are $Q_0 + D_0$. The firm must use this cash to pay capital investment costs, and the rest is held as precautionary savings (to replenish destroyed physical capital) or strategic

cash (to retain skilled human capital). We label the firm's total cash needs as:

$$\begin{aligned}\mathcal{C}(H_t, K_t, \phi_i) &= c_K(K_t) + c_H(H_t, \phi_i) + Q^H(H_t) + Q^K(K_t) \\ &= c_K(K_t) + c_H(H_t, \phi_i) + Q(H_t, K_t) \end{aligned} \tag{13}$$

During each period, a firm is either hit by a shock and must spend its precautionary or strategic cash savings, or it avoids the shock and retains cash on its balance sheet. The firm then starts the next period with this retained cash Q_{t-1}, which can vary from 0 to $Q(H_t, K_t)$.

We can now present the static profit maximization problem for firm i in year t:

$$\begin{aligned} \underset{\substack{H_{it}, K_{it}, h_{it}, l_{it} \\ D_{it}, p_{it}}}{max} \quad & \pi_{it} = (1-\tau)[p_{it}y_{it} - (1+r_t)D_{it} - q_t h_{it} - w_t l_{it} - \mathcal{C}(H, K, \phi_i)] \\ \text{s.t.} \quad & A_t F(E(H_{it}), E(K_{it}), h_{it}, l_{it}) = y_{it} \\ & \mathcal{C}(H, K, \phi_i) \leq D_{it} + Q_{it-1} \\ & D_{it} \geq 0 \ , \ Q_{it-1} \geq 0, \ Q_{i0} > 0 \end{aligned} \tag{14}$$

The first line of the problem above present total firm level profits given the demand for intermediate goods derived in (6). The second line contains the production function, where the actual amount of H_t and K_t used for production depends on the expropriation risk described above. The third line presents the liquidity constraint faced by the firm. All liquidity used for investment in physical capital or precautionary allocation of liquidity can be financed only with debt or retained earnings. Finally, the last line prevents firms from being net creditors or rolling over debt over time.

Interest Rates and Credit Tightness. In our framework we include the possibility that firms may adjust their debt issuance based on interest rate deductibility, and that firms with more tangible capital provide better quality collateral, which reduces credit tightening via lower cost of borrowing. To accommodate for these potential channels, we adjust the tax rate τ_t and

interest rate r_t to be endogenous functions of debt D_t and tangible capital K_t, respectively:

$$\mathrm{r}_t = r(K_t) = \bar{r}(1 + K_t^{\psi})^{-1} \quad (15)$$

with $\kappa > 1$, $\phi > 1$. κ captures the elasticity of the tax burden to debt issuance, and therefore governs the strength of interest rate deductibility. ψ on the other hand determines the elasticity of the interest burden to the available collateral, and is therefore a measure of credit tightening.

4.2. Static Equilibrium

To solve the model, we first compute the equilibrium debt demand from the firm liquidity constraint:

$$D_{it}^{*} = \max\{0, \mathcal{C}(H, K, \phi_i) - Q_{it-1}\} \quad (16)$$

implying that the firm will demand external finance to cover its liquidity needs it cannot cover with its own cash reserves Q_{it-1}. We can then derive the optimal input bundle of the production function $X_{it}^{*} = \{H, K, h, l\}_{it}^{*}$ by solving a cost minimization problem with $F(X_{it}^{*}) = y_{it}$, given equilibrium prices $\{p_{it}(j)\}_{\forall i \in \{1,..,n_j\},\ \forall j \in \mathcal{J}}$. This allows to derive an equilibrium solution as a function of demand: $X^{*}(y_{it})$[11]. This can in turn be plugged into the profit function in (17) to solve for an unconditional profit maximization:

$$\underset{p_{it}}{max}\ \pi_{it} = (1 - \tau_t)\left[p_{it}y_{it} - (1 + r_t)D_{it}^{*} - q_t h(y_{it}) - w_t l(y_{it}) - \mathcal{C}(H(y_{it}), K(y_{it}), \phi_i)\right] \quad (17)$$

From equation (6), we know that firm level demand is also a function of price $p_{it}(j)$ and takes into account the full price distribution to compute indexes p_{jt} and P_t. Rewriting the total cost

[11] See A for the derivation of the input specific equations.

of production and investment as:

$$\hat{\mathcal{C}}(y_{it}, \phi) = (1 + r_t)D^*_{it} + q_t h(y_{it}) + w_t l(y_{it}) + \mathcal{C}(H(y_{it}), K(y_{it}), \phi_i) \tag{18}$$

we can find the equilibrium price distribution as the vector $\mathbf{p}$ such that:

$$\mathbf{p} = \left\{ p > 0 : p_{it} = \text{argmax } (1 - \tau_t) \left[p_{it} y(p_{it}) - \hat{\mathcal{C}}(p_{it}, \phi_i) \right] \ ,\forall i \in \{1, ..., n_j\}, \forall j \in \mathcal{J} \right\} \tag{19}$$

The solution is a fixed point algorithm in $\{X_{it}, p_{it}, \mathcal{C}_{it}\}_{i \in \{1, n_j\},\ j \in \mathcal{J}}$ that can be solved numerically given Y, q and w. We take w as numeraire and set it equal to 1. Given the double nested CES demand system, the final form of the equilibrium price is given by:

$$p^*_{it}(j) = \frac{\varepsilon(j)}{\varepsilon(j) - 1} MC(\phi_i, Y_t, q_t, Q_{i,t-1}) \tag{20}$$

where $MC()$ is the total marginal cost of production and $\varepsilon(j)$ is total demand elasticity facing firm i:

$$\varepsilon(j) = \left(\omega_{it}(j) \frac{1}{\theta} + (1 - \omega_{it}(j)) \frac{1}{\eta} \right)$$

and $\omega_{it}(j)$ is firm i's market share of product (industry) j:

$$\omega_{it}(j) = \frac{p_{it}(j) y_{it}(j)}{\sum_{i=1}^{n_j} p_{it}(j) y_{it}(j)} = \left(\frac{p_{it}(j)}{p_{jt}} \right)^{1-\eta}$$

When firm i manages to produce a large share of the total quantity of good j, the elasticity of demand it faces diminishes, as the outside availability of other varieties of the same good shrinks. This allows firm i to charge a larger markup on its marginal cost of production, therefore increasing its profitability.

We finally pin down Y_t and q_t from market clearing condition on the goods market and skilled labour markets:

$$
\begin{aligned}
Y_t &= \int_0^1 \sum_{i=1}^{n_j} y_{it}(j)(q_t, Y_t)dj \\
\nu\bar{L} &= \int_0^1 \sum_{i=1}^{n_j} h_{it}(q_t, Y_t)dj
\end{aligned}
\tag{21}
$$

as both $p_{it}(j)$ and $y_{it}(j)$ are functions of Y_t and q_t. From the static equilibrium we can therefore derive an equilibrium vector $\Theta(\phi_i, Q_{it-1}) = \{X^*_{it}, D^*_{it}, p^*_{it}\}_{i\in\{1,..,n_j\},\ j\in\mathcal{J}}$, including the equilibrium production and investment choices of all firms. Based on their liquidity, we also retrieve equilibrium debt issuance and the liquidity needed for retention of human capital and for precautionary savings. We can then move on to lay down the dynamic firm problem.

4.3. Dynamic Equilibrium

The solution $\Theta(\phi_i, Q_{it-1})$ depends on the firm available liquidity in each period. In this section we therefore setup the dynamic liquidity allocation problem of each firm, which allows to close the model. Each period the firm faces a trade-off between using Q_{t-1} to finance investment (and therefore demand less debt), storing it for precautionary reasons and reduce the probability of bankruptcy, or distribute it in the form of dividends. The probability of exiting the economy is defined by the risk of capital destruction before production can take place and is therefore given by $\varphi(Q) = e^{-\delta-\lambda(Q)}$. If we define each period net flow profits as $\Pi(Q)$, we can therefore characterize the recurring firm problem as:

$$
rV_i(Q) = \max_{0\leq Q'\leq \Pi(Q)} \left\{\Pi(Q) - Q' + \beta\varphi(Q)V_i(Q')\right\} \tag{22}
$$

where $\beta = (1+r)^{-1}$ is the discount factor.

From the first order condition on Q we can derive the Euler equation:

$$
V'(Q) = \frac{1}{\beta\varphi(Q)}\ ,\ 0 \leq Q \leq \Pi(Q) \tag{23}
$$

which defines a unique solution of (22) $\forall Q \in [0, \Pi(Q)]$, as V is positive and increasing in Q.

In other words, there exist a corner solution Q^* s.t.:

- $\Pi(Q) \leq Q^*$: the firm is cash constrained and it will retain all the available cash for the next period: $Q' = \Pi(Q)$.
- $\Pi(Q) > Q^*$: the firm has excess cash and it will save exactly $Q' = Q^*$, while the rest can be either retained or distributed as dividends.

The optimal policy is therefore a 'buffer stock' policy:

$$Q' = \min\{\Pi(Q), Q^*\} \tag{24}$$

Solving the value function jointly with the static firm problem allows to derive equilibrium input and pricing decisions, as well as debt issuance and cash available for the firm in steady state.

5. Conclusions

This paper documents a steady and prolonged decline in corporate leverage in the near-universe of firms from two major EU economies, broadly consistent with aggregate leverage patterns in advanced economies. Granular data on a large sample of firms across EU countries offers perspective beyond evidence on large listed firms. We find that debt usage has been decreasing at a similar rate in good and bad times, among multiple types of firms, industries and countries. Such common trends seem hard to reconcile with rising financial constraints, and points to structural changes in the real economy.

Credit demand may fall under secular stagnation, with declining tangible investment despite interest rates at historical lows. Declining economic prospects reduces credit demand and its supply. Emerging sectors focus on intangible capital creation, which is created over time with significant human capital investment rather than acquired upfront. Innovative firms tend to have much lower or even negative leverage.

The evidence points to a strong secular decline in investment funding needs, and rising usage of internally created intangibles in growing firms. In fact, the decline in leverage appears

more rapid for technologically advanced industries. A persistent challenge to assess the relative contribution of these structural changes is lack of good measures of intangibles, under- or unreported on balance sheets under current accounting rules. We will explore how to assess credit demand is changing in the new economic environment.

We present a modeling framework focused on the rising relative productivity of intangible capital. This theoretical setup can account for multiple trends we observe in the data, such as declining leverage, increasing cash holdings and profitability. Our model also matches the empirical evidence on increasing market power and dispersion in firm growth and size, phenomena that have already been highlighted by the literature on declining business dynamism.

Our paper also sheds light on the mechanism behind the association between intangible intensity and corporate leverage at the firm level. It does so with a shift share econometric design aimed at identifying the causal impact of credit shocks driven by changing collateral requirements on firm leverage growth, assessing the differential impact this has on intangible intensive firms. We show that these firms have lower susceptibility to this kind of shock than average. This suggests that the poor collateral nature of intangibles might not be the dominant determinant behind these firms' lower reliance on debt. Theories that focus on different financial needs behind investment in intangible capital (such as lower cash in advance, for instance) might be better suited for understanding the general corporate finance trends we observe in modern companies.

The impact on financial stability of declining leverage is mixed as it depends on the drivers of the trend. The secular stagnation view suggests lower leverage may not imply a decline in corporate credit risk. The general equilibrium effect of falling credit demand include a steady reallocation of credit towards financing existing assets, such as housing. As mortgage credit funds a more cyclical asset class, this may increase correlated risk in the future (Beck et al., 2023). Future research on a larger set of countries is necessary to address long-term stability concerns.

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Table 1: Country Coverage

	Years	Number of Firms (CompNet)		Number of Firms (Population)	
Country		First Year	Last Year	First Year	Last Year
Belgium	2000-2020	6915	11197	15200	16054
Croatia	2002-2023	3872	6070	6462	6834
Czech Republic	2005-2022	15375	9808	21216	21586
Denmark	2001-2022	10288	9755	15198	12670
Estonia	2004-2023	1432	1324	-	-
Finland	1999-2020	6044	9471	8473	10611
France	1995-2021	79801	86442	107491	97193
Germany	2001-2020	-	-	36607	186987
Hungary	2003-2022	11957	11936	16267	15347
Italy	2006-2020	53001	51432	94578	75769
Latvia	2007-2019	4155	4271	5765	4466
Lithuania	2000-2022	4409	6183	5788	7067
Netherlands	2007-2022	19506	23399	28977	27022
Poland	2002-2022	27733	31747	38656	48972
Portugal	2004-2022	18231	19261	18598	20982
Romania	2005-2023	23654	21788	25172	25447
Slovakia	2000-2022	3987	13160	5521	14877
Slovenia	2002-2023	2717	3380	3209	4418
Spain	2008-2021	20187	23846	77145	70137
Sweden	2003-2020	12635	15669	16999	19370
Switzerland	2009-2022	5214	5088	-	-

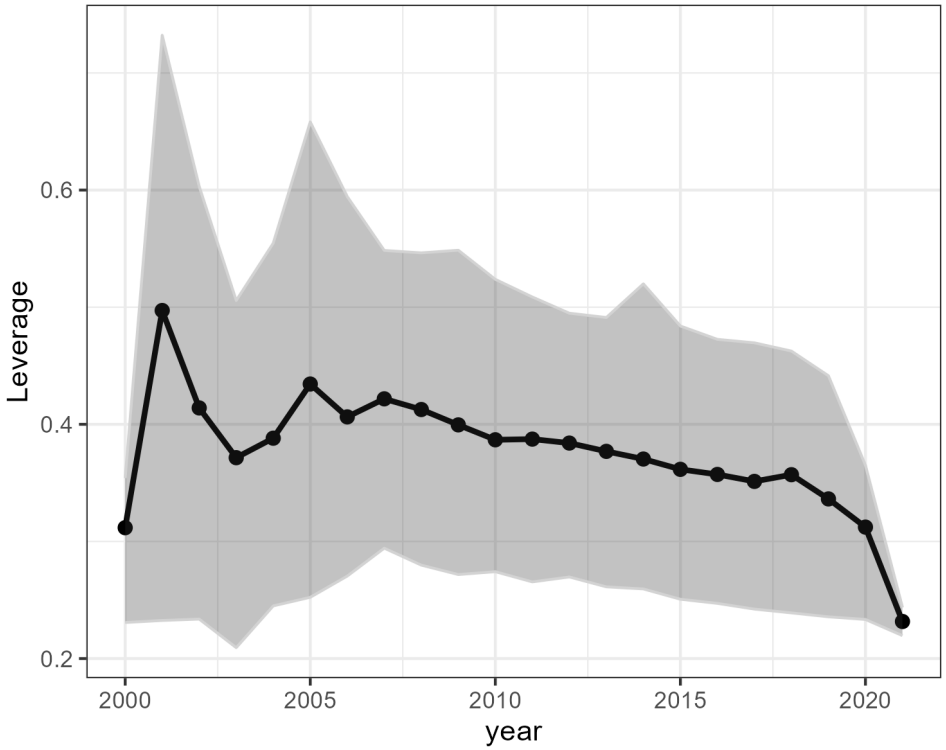
Note: The table presents the number of firms in the sample by country and year. The "CompNet" columns represent firms from the Competitiveness Network dataset, while "Population" columns refer to the full population of firms in the country. Missing values in Germany are indicated by a dash (-) and are due to confidentiality requirements.

Table 2: Macro-Sector Coverage

	Number of Firms (CompNet)		Number of Firms (Population)	
Macrosector	First Year	Last Year	First Year	Last Year
Manufacturing	92618	110545	197383	175831
Construction	33890	41176	53560	71740
Wholesale & Retail Trade	60685	84292	95686	144618
Transportation	18147	29701	32974	52765
Accommodation & Food Serv.	12619	28290	25958	66096
ICT	10096	17844	17763	29820
Real Estate	3933	4708	6488	8530
Professional Services	14060	26133	41614	50530
Admin & Support Services	15125	30847	32595	60398

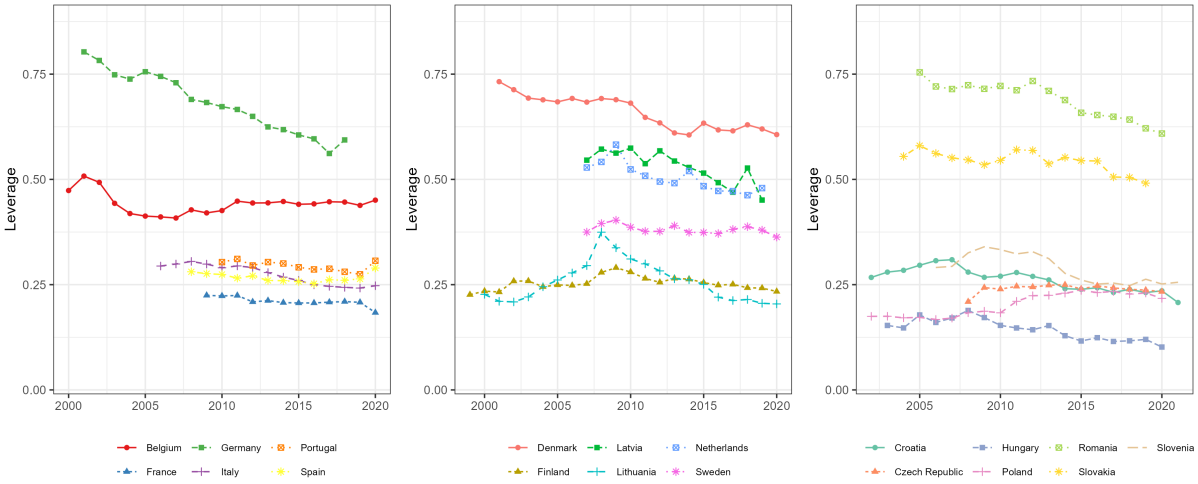
Note: The table presents the number of firms in the sample by macrosector (1 digit level of NACE REv.2 classification) and year. The "CompNet" columns represent firms from the Competitiveness Network dataset, while "Population" columns refer to the full population of firms in the country.

Figure 1: Time-Series Evolution of Corporate Leverage



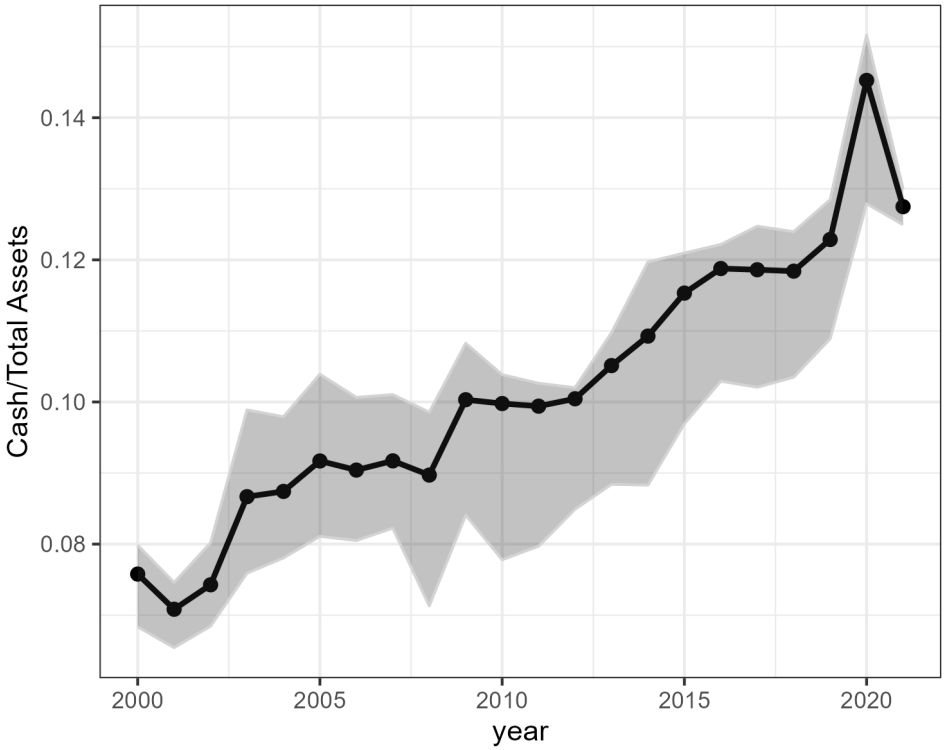
Weighted average of gross corporate leverage in the solid line, while the shaded area include leverage values between the 25th and 75th quantiles. Total Assets are used as weights. Gross leverage is defined as total debt over total assets at book values.

Figure 2: Time-Series Evolution of Corporate Leverage - Country detail



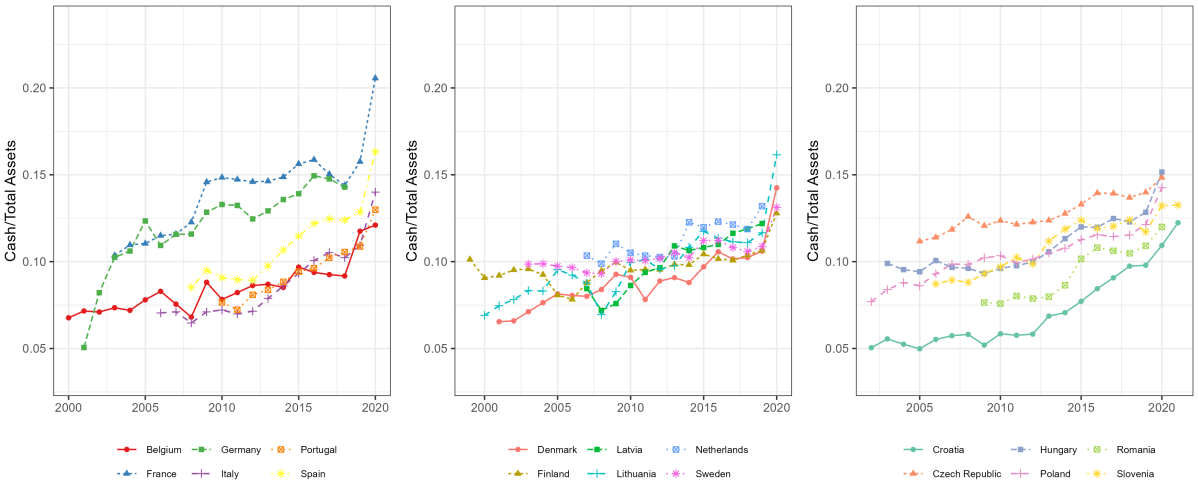
Weighted average of gross corporate leverage by country. Total Assets are used as weights. Gross leverage is defined as total debt over total assets at book values.

Figure 3: Time-Series Evolution of Cash Holdings



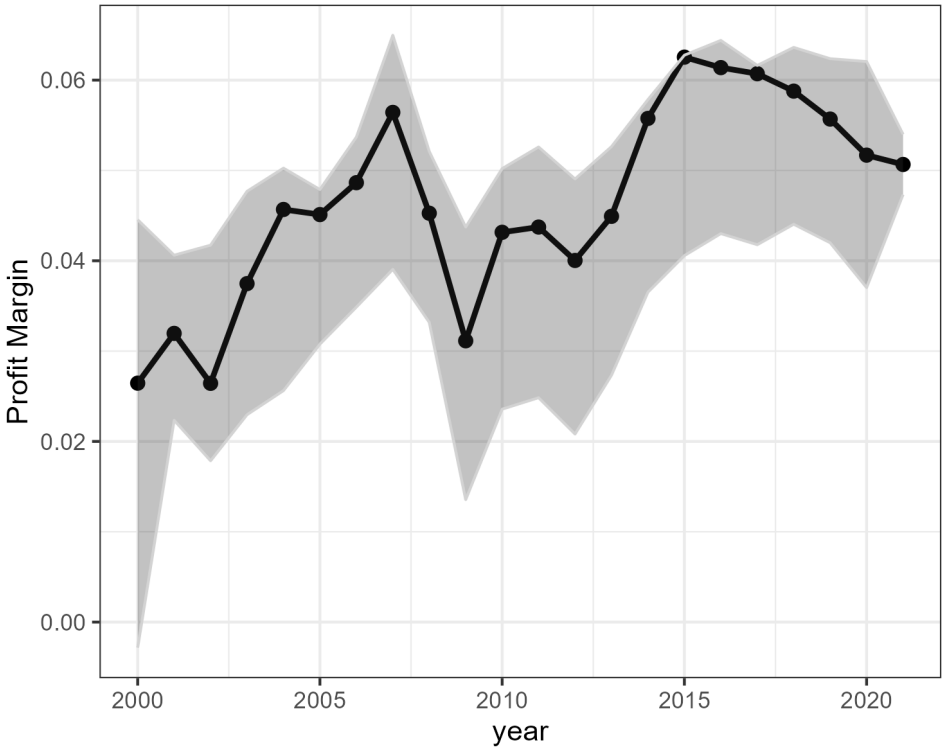
Weighted average of cash holdings as a share of total assets in the solid line, while the shaded area include values between the 25th and 75th quantiles. Total Assets are used as weights.

Figure 4: Time-Series Evolution of Cash Holdings - Country detail



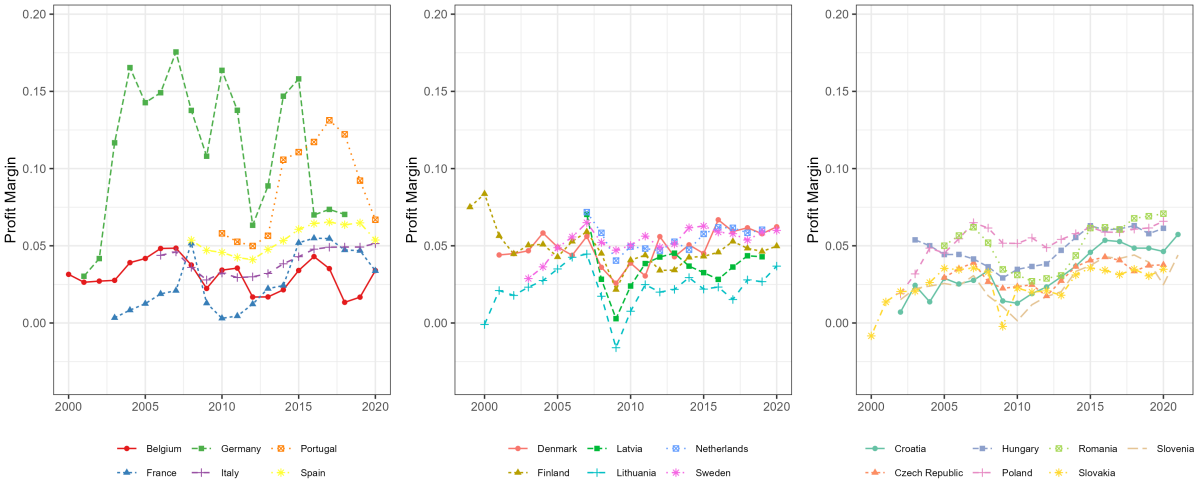
Weighted average of gross corporate leverage by country. Total Assets are used as weights.

Figure 5: Time-Series Evolution of Profit Margin



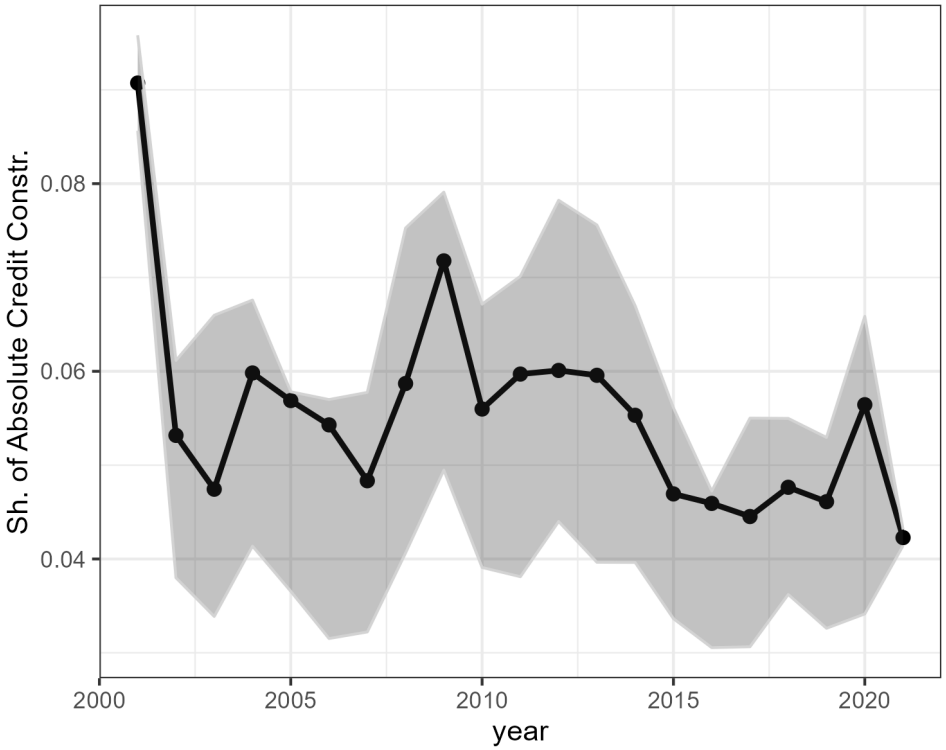
Weighted average of operating profits (EBIT) as a share of sales in the solid line, while the shaded area include values between the 25th and 75th quantiles. Total Assets are used as weights.

Figure 6: Time-Series Evolution of Profit Margin - Country detail



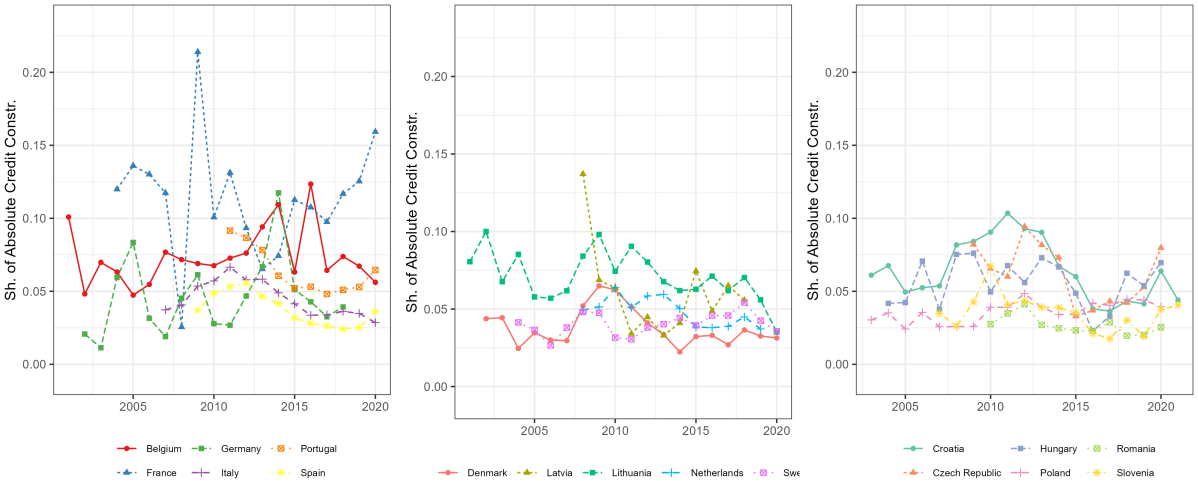
Weighted average of operating profits (EBIT) as a share of sales by country. Total Assets are used as weights.

Figure 7: Time-Series Evolution of Share of Constrained Firms



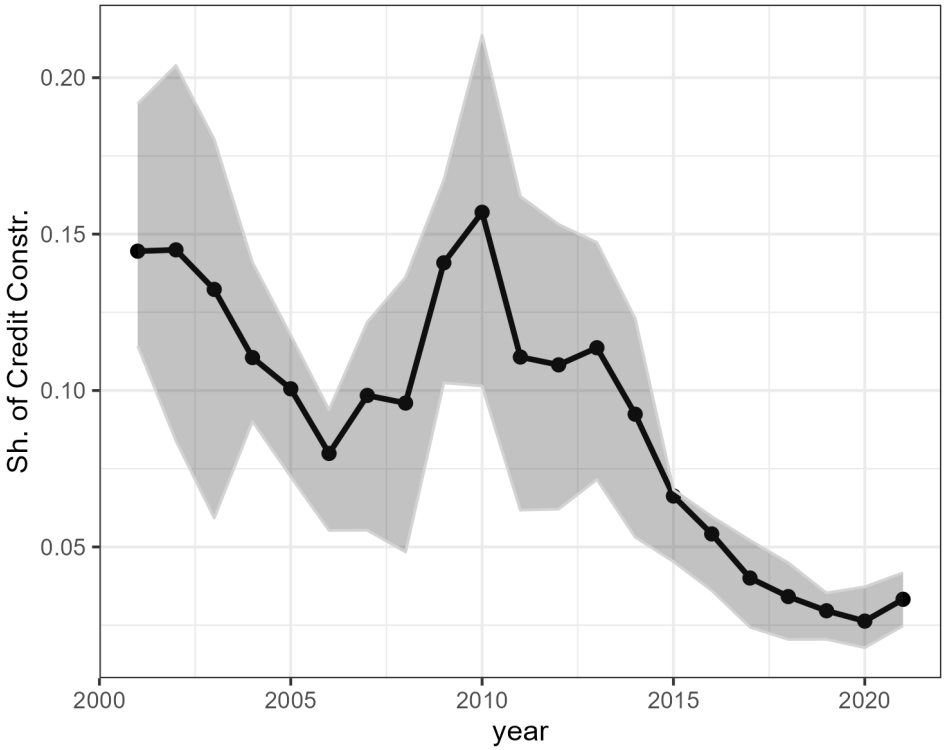
Weighted average of industry level share of credit constrained firms, while the shaded area include values between the 25th and 75th quantiles. Total Assets are used as weights. A firm is considered credit constrained if it has positive investment and total investment higher than the current cash flow as well as a concurrent reduction of debt and capital. Alternatively, a firm is considered constrained if, although disinvesting, has a positive financing gap.

Figure 8: Time-Series Evolution of Share of Constrained Firms - Country detail



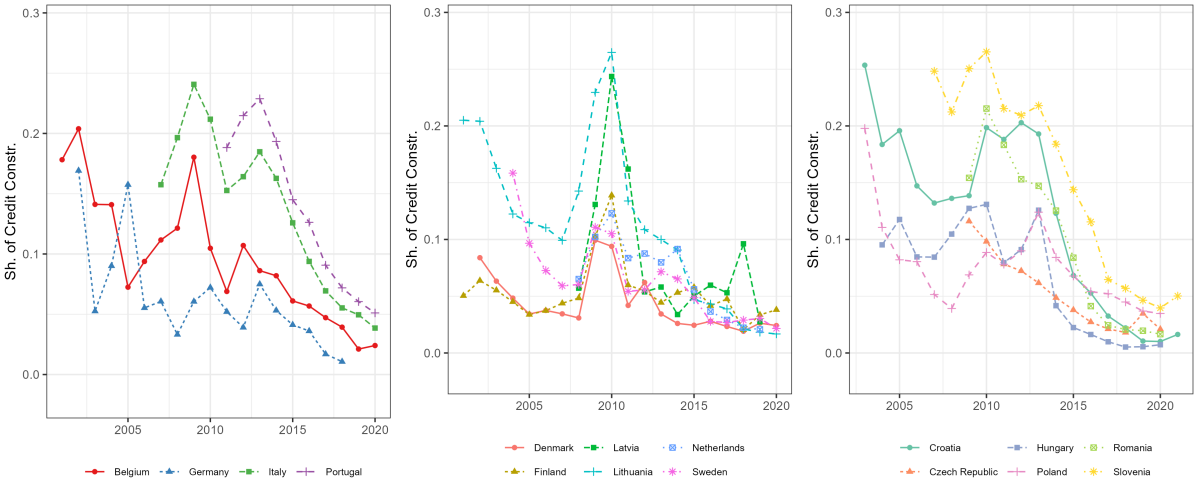
Weighted average of industry level share of credit constrained firms, by country. Total Assets are used as weights. A firm is considered credit constrained if it has positive investment and total investment higher than the current cash flow as well as a concurrent reduction of debt and capital. Alternatively, a firm is considered constrained if, although disinvesting, has a positive financing gap.

Figure 9: Time-Series Evolution of Share of Constrained Firms, SAFE definition



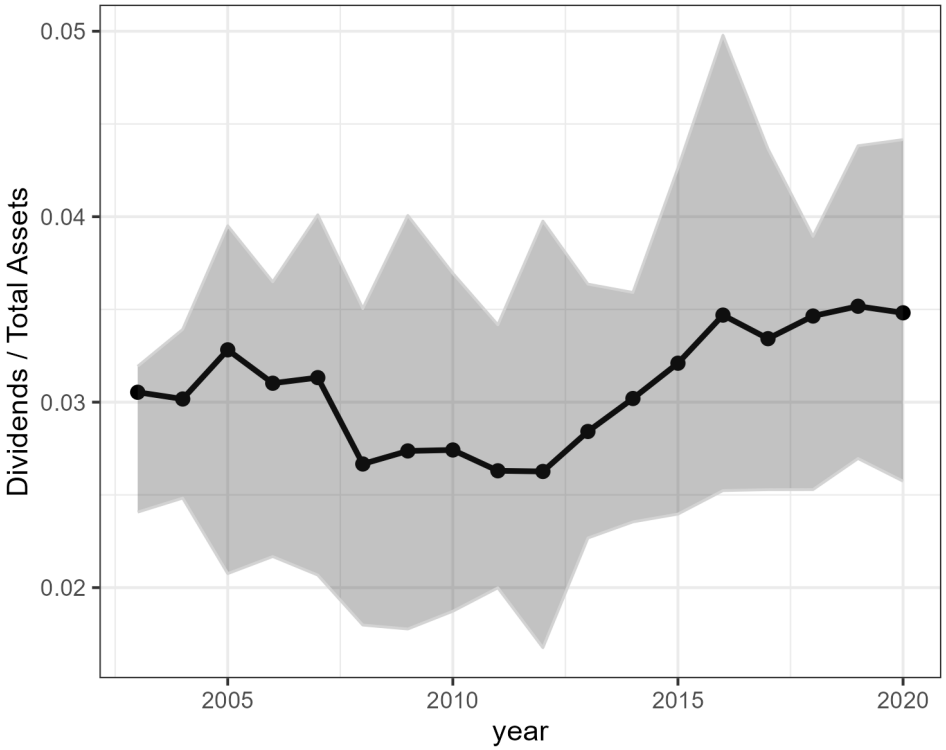
Weighted average of industry level share of credit constrained firms, while the shaded area include values between the 25th and 75th quantiles. Total Assets are used as weights. A firm is considered credit constrained based on the methodology described in Ferrando and Ruggieri (2018).

Figure 10: Time-Series Evolution of Share of Constrained Firms, SAFE definition - Country detail



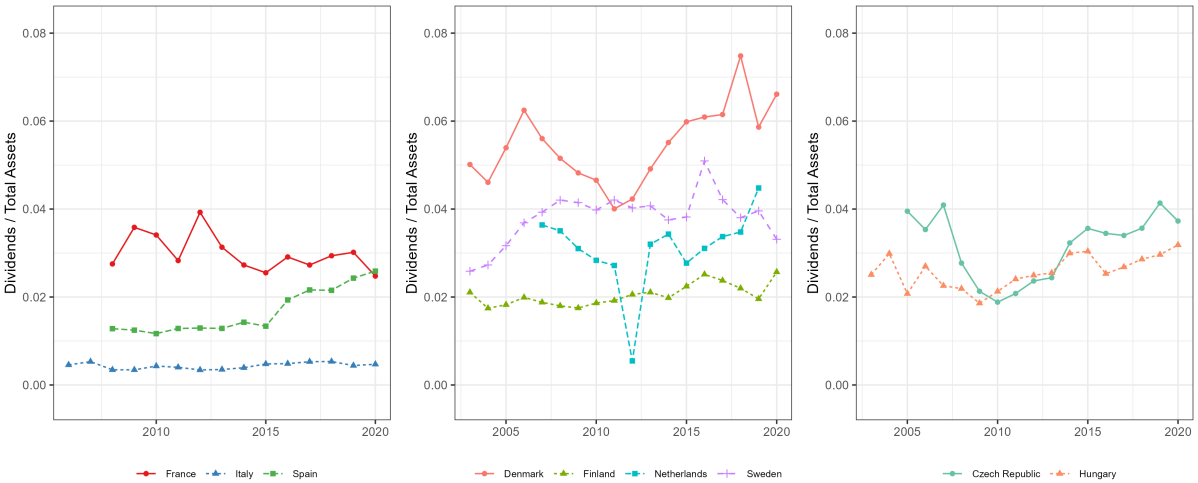
Weighted average of industry level share of credit constrained firms, by country. Total Assets are used as weights. A firm is considered credit constrained based on the methodology described in Ferrando and Ruggieri (2018).

Figure 11: Time-Series Evolution of Dividends



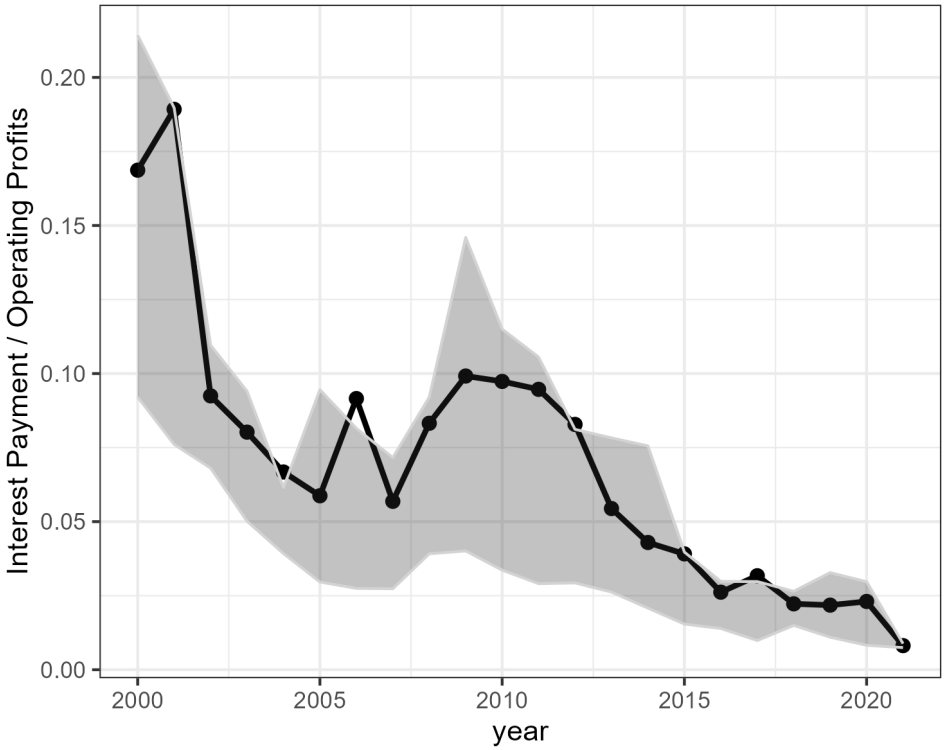
Weighted average of dividends over total assets, while the shaded area include values between the 25th and 75th quantiles. Total Assets are used as weights.

Figure 12: Time-Series Evolution of Dividends - Country detail



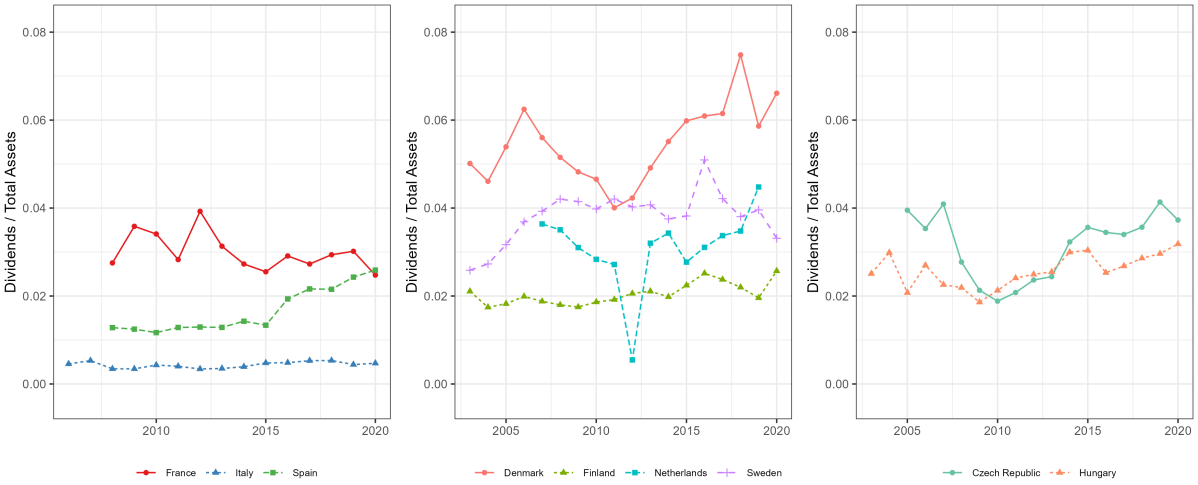
Weighted average of dividends over total assets by country. Total Assets are used as weights.

Figure 13: Time-Series Evolution of Interest Burden



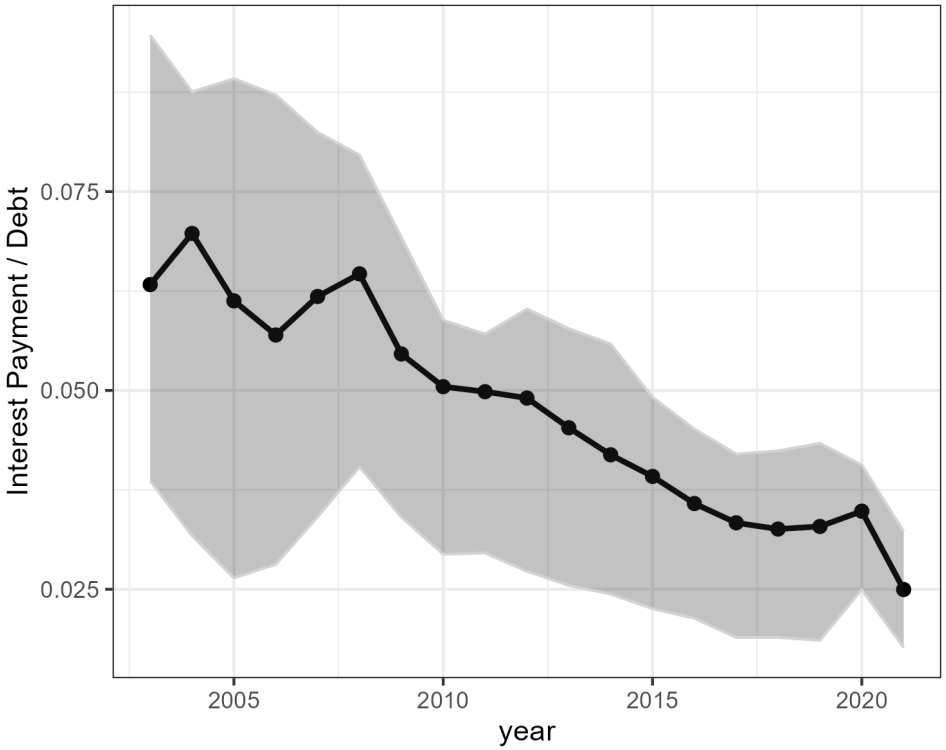
Weighted average of interest burden, while the shaded area include values between the 25th and 75th quantiles. Total Assets are used as weights. Interest Burden is defined as interest payments over operating profits

Figure 14: Time-Series Evolution of Interest Burden - Country detail



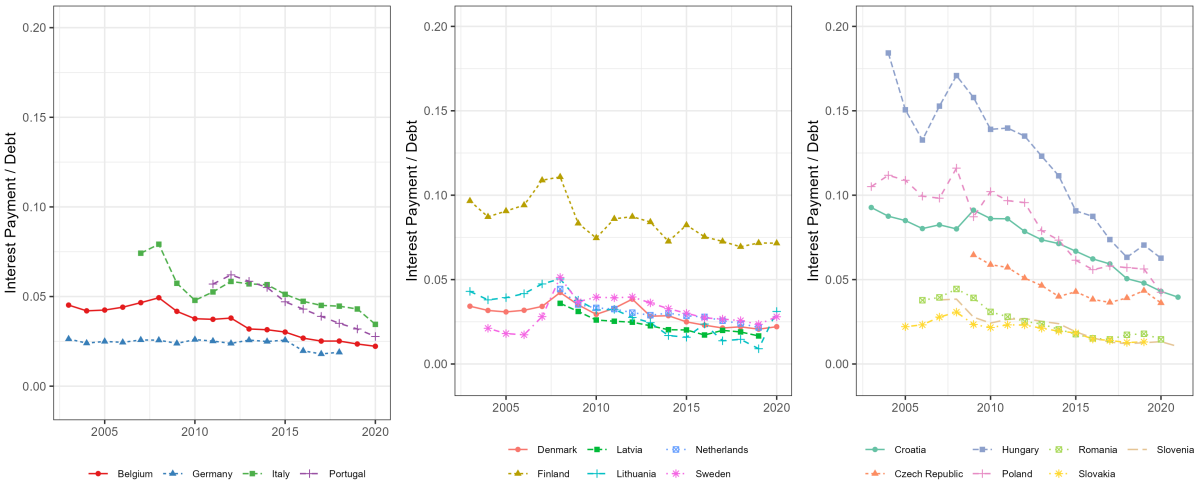
Weighted average of interest burden by country. Total Assets are used as weights. Interest Burden is defined as interest payments over operating profits

Figure 15: Time-Series Evolution of Interest over Debt



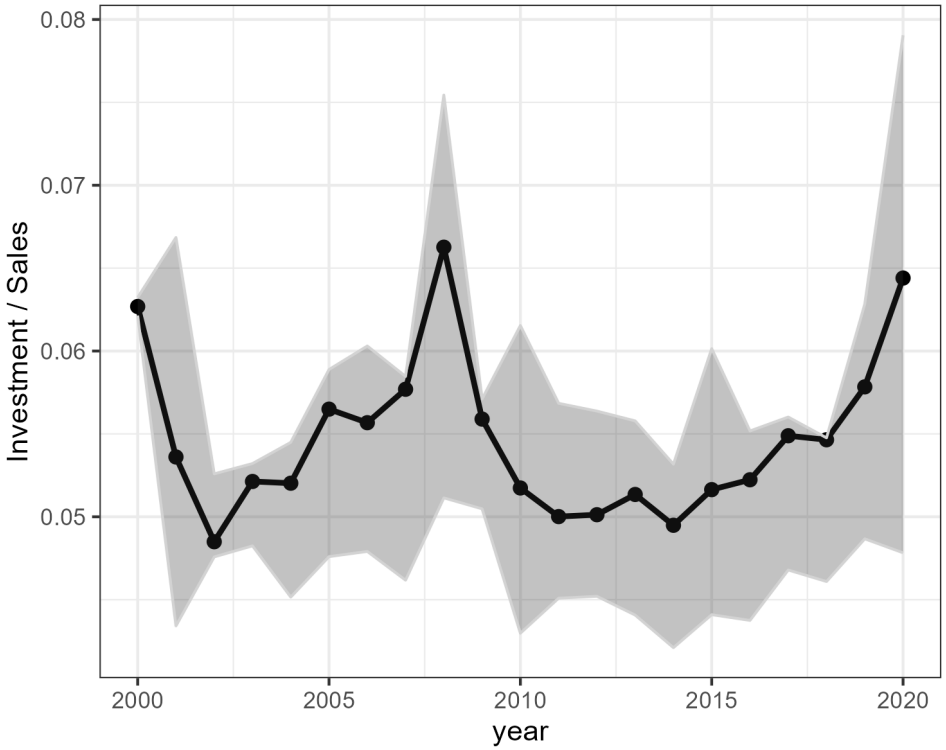
Weighted average of interest payments as a share of total debt, while the shaded area include values between the 25th and 75th quantiles. Total Assets are used as weights.

Figure 16: Time-Series Evolution of Interest over Debt - Country detail



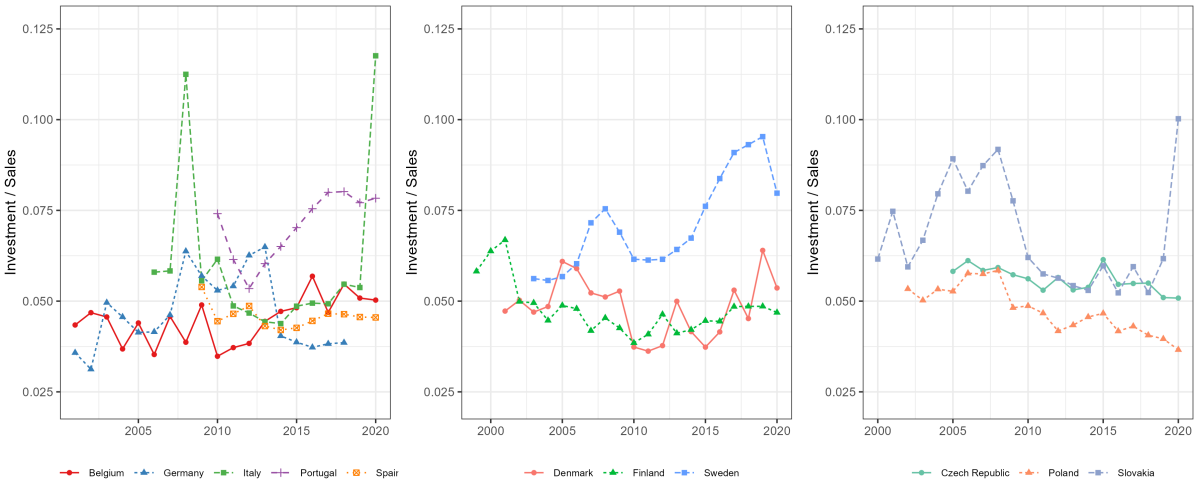
Weighted average of interest payments as a share of total debt by country. Total Assets are used as weights.

Figure 17: Time-Series Evolution of Investment Share



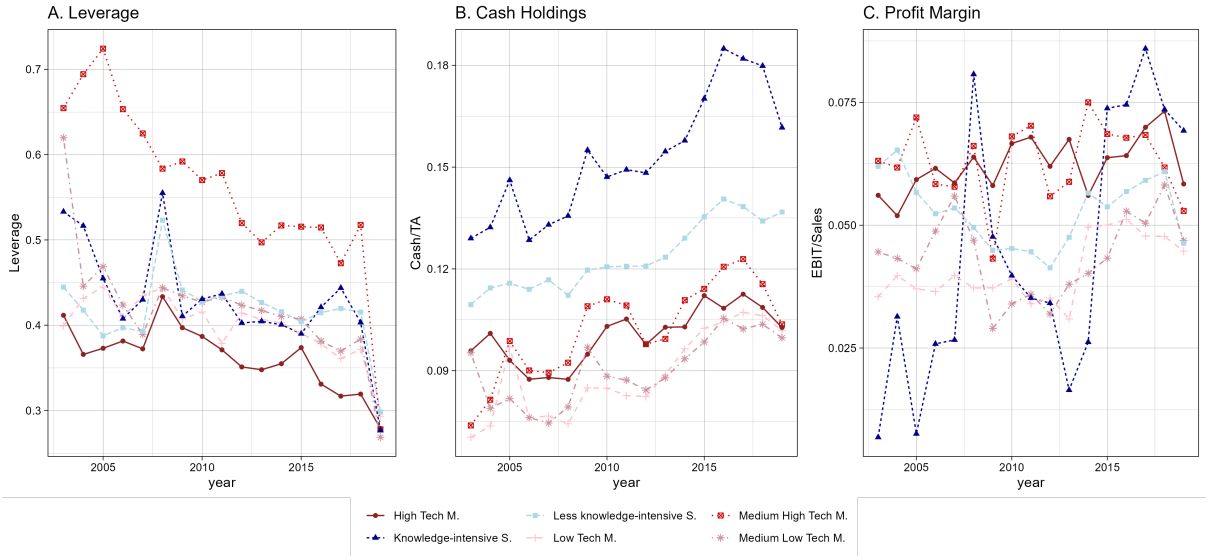
Weighted average of total investment as a share of total sales, while the shaded area include values between the 25th and 75th quantiles. Total Assets are used as weights. Data on investment in CompNet include the total value of acquired or self-constructed land, machinery, equipment, buildings and other durables (including assets under construction, but not long-term financial assets), plus the acquisitions of intangible fixed assets (acquired - not developed in-house - intellectual property such as copyrights, patents, licenses, software etc.).

Figure 18: Time-Series Evolution of Investment Share - Country detail



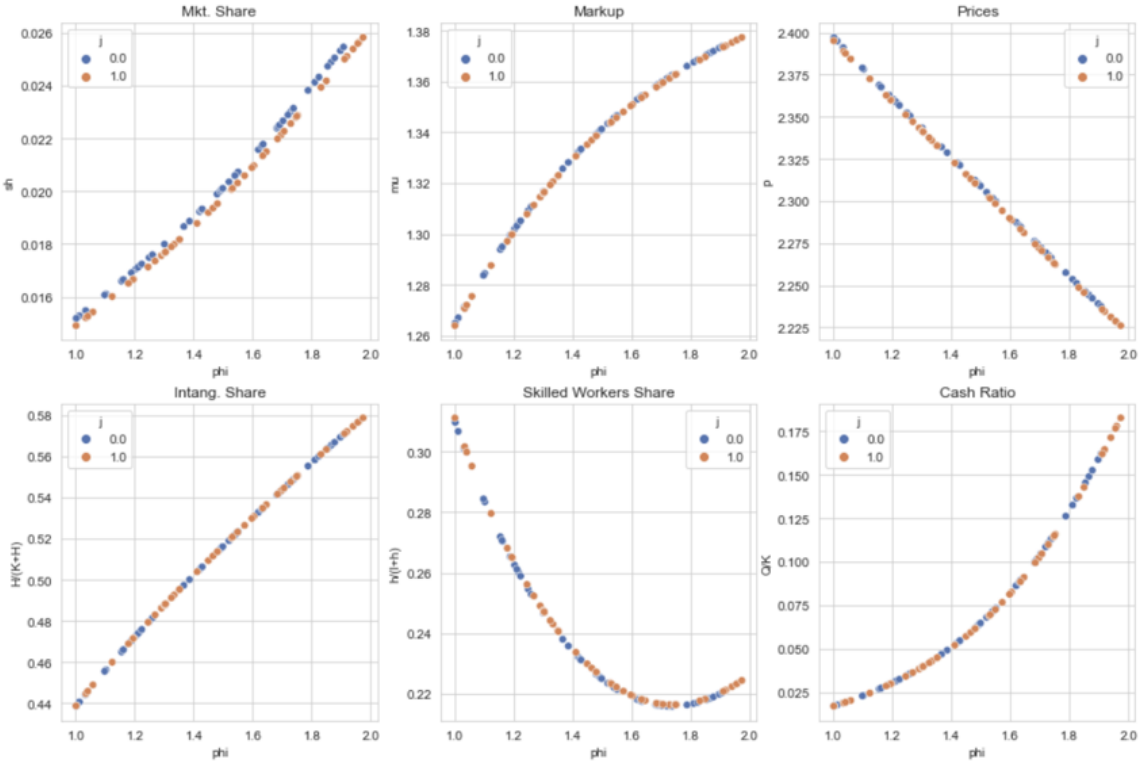
Weighted average of total investment as a share of total sales by country. Total Assets are used as weights. Data on investment in CompNet include the total value of acquired or self-constructed land, machinery, equipment, buildings and other durables (including assets under construction, but not long-term financial assets), plus the acquisitions of intangible fixed assets (acquired - not developed in-house - intellectual property such as copyrights, patents, licenses, software etc.)

Figure 19: Leverage, Cash and Profitability by Industry Level Knowledge Intensity



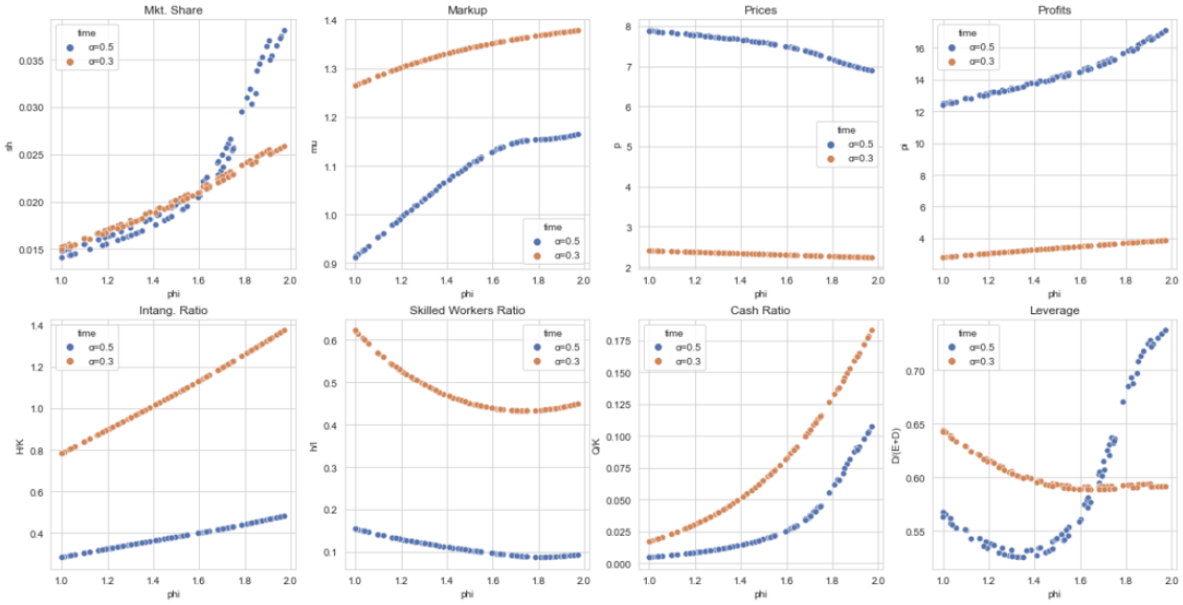
Panel A. Weighted average of leverage as total debt over total assets by industry level knowledge intensity. panel B. Weighted average of cash holdings as share of total assets by industry level knowledge intensity. Panel C. weighted average of EBIT over total sales by industry level knowledge intensity. Breakdown of Manufacturing and Services in different classes based on knowledge intensity is available at Eurostat (2025). Total Assets are used as weights.

Figure 20: Static Equilibrium



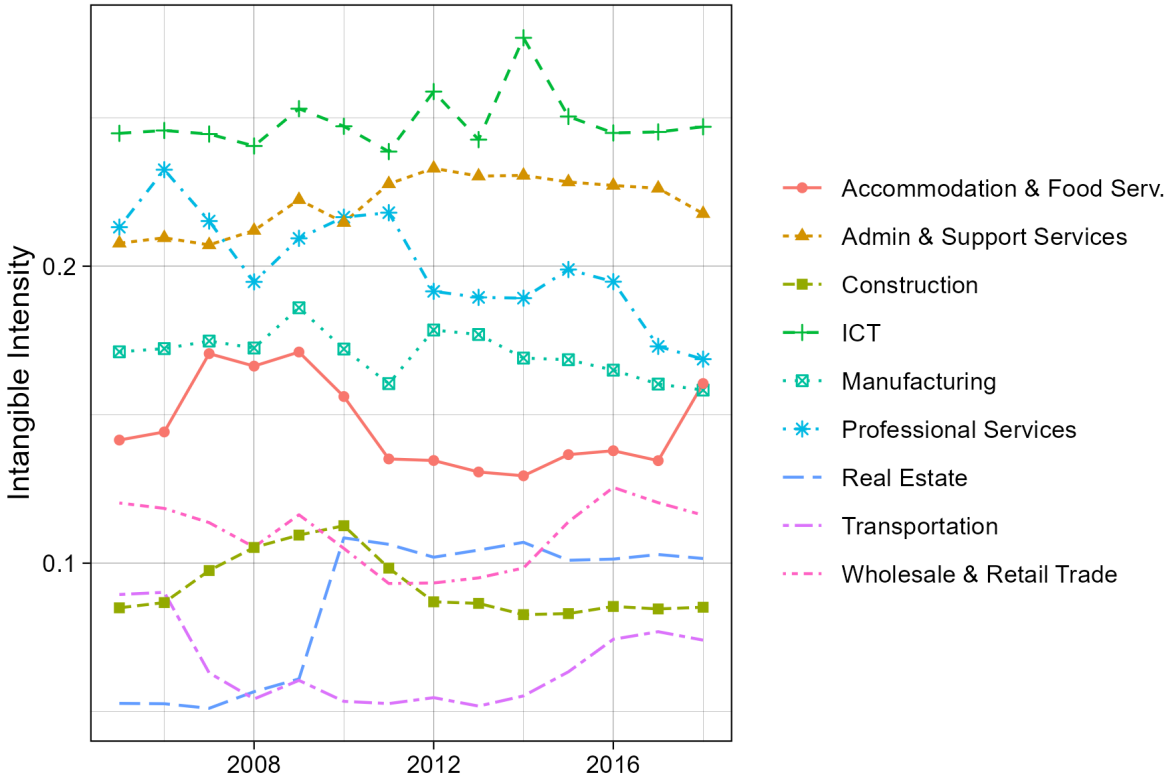
Simulation results of Static Equilibrium key variables by ϕ over a two industries economy.

Figure 21: Transition to Higher Relative Productivity of Intangible Capital



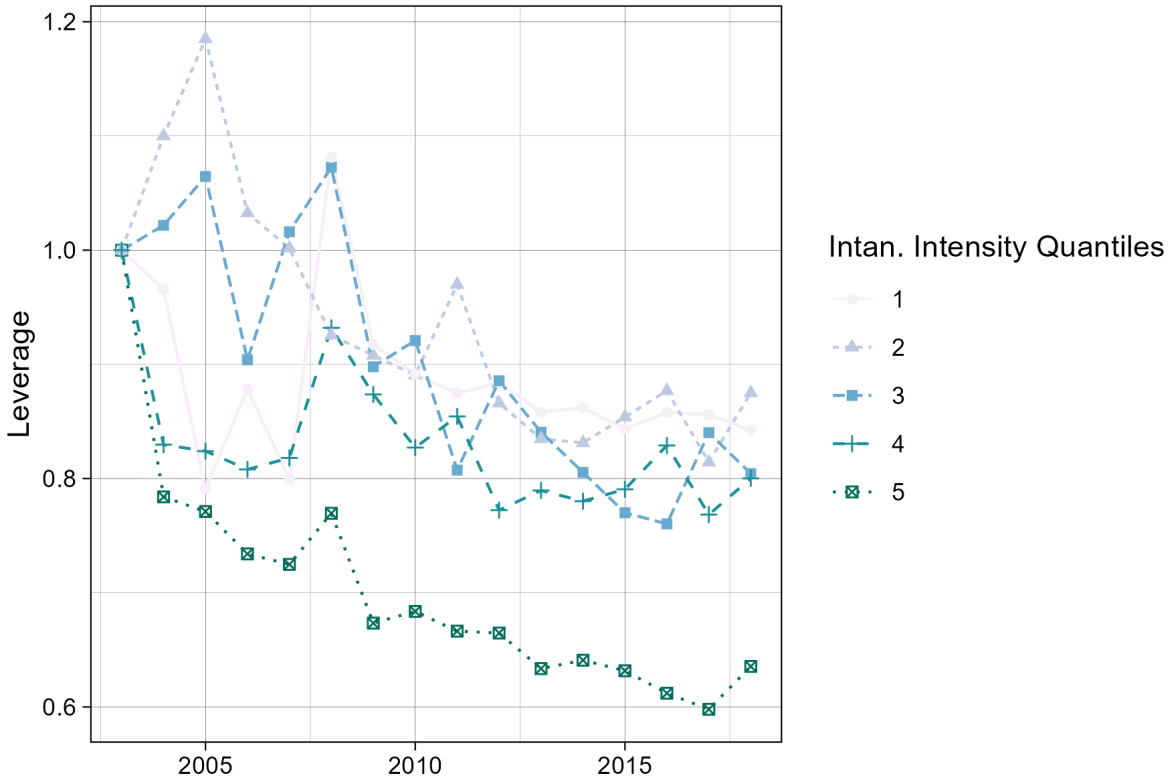
Simulation results of two periods model, after a change in the value of α from 0.5 to 0.3. Key variables by ϕ over a two industries economy.

Figure 22: Intangible Intensity over Time



Intangible Intensity is defined as SG&A over sales. Average SG&A over sales are plotted over time by macro industry. Real SG&A average exoenditure per industry is sourced from the Compustat data, while sales come from the CompNet dataset. Values at the industry level are aggregated at the macro sector level via weighted average, using total assets as weights.

Figure 23: Leverage Change by Intangible Intensity



Intangible Intensity is defined as SG&A over sales. Real SG&A average expenditure per industry is sourced from the Compustat data, while sales come from the CompNet dataset. We rank industries and split them into 5 quantiles based on intangible intensity, where the 5th quantile is made of the industries with the highest ratio of SG&A over sales. We then compute average leverage by quantile year and plot the level over time. Mean values use total assets as weights.

Internet Appendix for "A Structural Break in EU Corporate Leverage Trends"

A. Derivations for Equilibrium

Static equilibrium to the firm level problem (17) is solved in the following way.

First, we assume that cost functions take the explicit form:

$$c_H(H,\phi) = \frac{\omega_H H^{c_H}}{\phi c_H},\ c_K(K,\phi) = \frac{\omega_K K^{c_K}}{c_K} \tag{25}$$

with $\omega_m > 1, c_m > 1, \phi > 1$ for $m \in \{K, H\}$.

Moreover, the spillover function $\lambda(H)$ takes the form:

$$\lambda(H) = \frac{\lambda_0 H^{1+\lambda_1}}{1+\lambda_1} \tag{26}$$

with $\lambda_0 > 0, \lambda_1 > 0$.

Given these functions forms, we start by retrieving equilibrium $X^*_{it} = \{H, K, h, l\}^*_{it}$ by solving a cost minimization problem with $F(X^*_{it}) = y_{it}$. This varies depending on whether the firm has enough cash to cover its investment needs, and therefore $D^*_{it} = 0$ or not. In the first case, we can write the cost minimization problem as:

$$\begin{aligned} \underset{H_{it}, K_{it}, h_{it}, l_{it}}{min} \quad & q_t h_{it} + w_t l_{it} + \mathcal{C}(H_{it}, K_{it}, \phi_i) \\ \text{s.t.} \quad & A_t F(E(H_{it}), E(K_{it}), h_{it}, l_{it}) = y_{it} \end{aligned} \tag{27}$$

Firms internalize the expected risk of capital depletion so take into account the marginal cash accumulation required for each additional unit of capital they build.

Taking first order conditions with respect to K_{it} and l_{it} and then dividing the first with the second leads to finding equilibrium l_{it} as a function of K_{it}, $l_{it} = l(K_{it})$:

$$l = \frac{1-\zeta}{\zeta w}\left[\omega_K K^{c_K} + (1 - e^{-\delta})K\right] \tag{28}$$

Taking first order conditions with respect to H_{it} and h_{it} and then dividing the first with the second leads to finding equilibrium h_{it} as a function of H_{it}, $h_{it} = h(H_{it}, \phi_i)$:

$$h = \frac{1-\gamma}{q\gamma}\left[\frac{\omega_H H^{c_H}}{\phi_i} + HQ'(H)\right] \tag{29}$$

We can then plug in the solutions for h and l into the cost minimization problem and take first order conditions with respect to K and H. Taking their ratio we can find an implicit solution for K_{it} as a function of H_{it}, $K_{it} = K(H_{it}, \phi_i)$:

$$\frac{\alpha}{1-\alpha} \cdot \frac{\left[K^{\zeta} l(K)^{1-\zeta}\right]^{\rho-1} \cdot \frac{\partial}{\partial K}\left\{K^{\zeta} l(K)^{1-\zeta}\right\}}{\left[H^{\gamma} h(H,\phi)^{1-\gamma}\right]^{\rho-1} \cdot \frac{\partial}{\partial H}\left\{H^{\gamma} h(H,\phi)^{1-\gamma}\right\}} = \frac{\omega_K K^{c_K-1} + (1-e^{-\delta})}{\phi_i^{-1}\omega_H H^{c_H-1} + Q'(H)} \tag{30}$$

This solution is then plugged back in the first order condition for H, to derive an equilibrium solution for H as a function of y and ϕ, $H_{it} = H(y, \phi)$:

$$\frac{y}{\mathcal{Y}}(1-\alpha)\left[H^{\gamma} h(H,\phi)^{1-\gamma}\right]^{\rho-1} \cdot \frac{\partial}{\partial H}\left\{H^{\gamma} h(H,\phi)^{1-\gamma}\right\} = \phi_i^{-1}\omega_H H^{c_H-1} + Q'(H) \tag{31}$$

where:

$$\mathcal{Y} = \left[\alpha\left(K(H,\phi)^{\zeta} l(K)^{1-\zeta}\right)^{\rho} + (1-\alpha)\left(H^{\gamma} h(H,\phi)^{1-\gamma}\right)^{\rho}\right]^{\frac{1}{\rho}} \tag{32}$$

This implicitly defines all inputs of the production function as well as equilibrium cash as a function of y and can be solved for numerically given y, ϕ and the other parameters of the production function and the cost function.

If equilibrium investment needs exceed cash availability, then $D_{it}^{*} = \mathcal{C}(H, K, \phi_i) - Q_{it-1}$ and the cost minimization becomes quickly non tractable analytically. In this case we lay down a different total cost function, subject to the same constraint:

$$\begin{aligned} \underset{H_{it}, K_{it}, h_{it}, l_{it}}{min} \quad & (1-\tau(D_{it}^{*}))\left(q_t h_{it} + w_t l_{it} + (1+r(K_{it}))\mathcal{C}(H_{it}, K_{it}, \phi_i) - r(K_{it}) Q_{it-1}\right) \\ \text{s.t.} \quad & A_t F(E(H_{it}), E(K_{it}), h_{it}, l_{it}) = y_{it} \end{aligned} \tag{33}$$

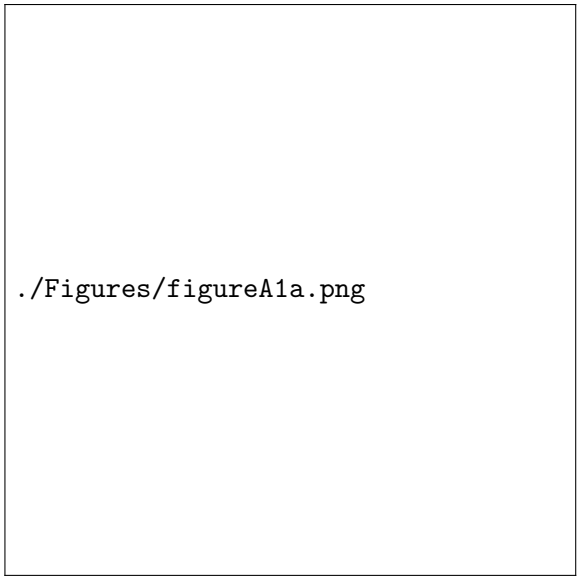
and solve numerically. If the solver does not find an interior solution due to unfeasible financing conditions we assume the firm exits and is replaced by a firm with the same ϕ_i parameter and just enough cash to sustain the investment and achieve the optimal input demand, due to free entry.

B. Supplemental Figures

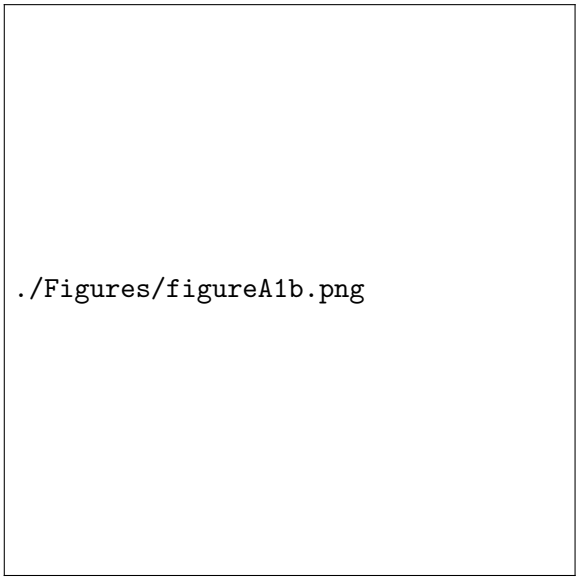
Figure B.1: Net Leverage Trends Across EU Countries

Net leverage is defined as Debt Securities plus Loans minus Currency and Deposits, divided by the sum of Financial Assets and Fixed Assets. Data for each country is from the OECD's Financial Balance Sheets and Balance Sheets for Non-Financial Assets. All data is measured on a consolidated basis. Fixed Assets are not available for some countries for the entire period of 1995 through 2020.

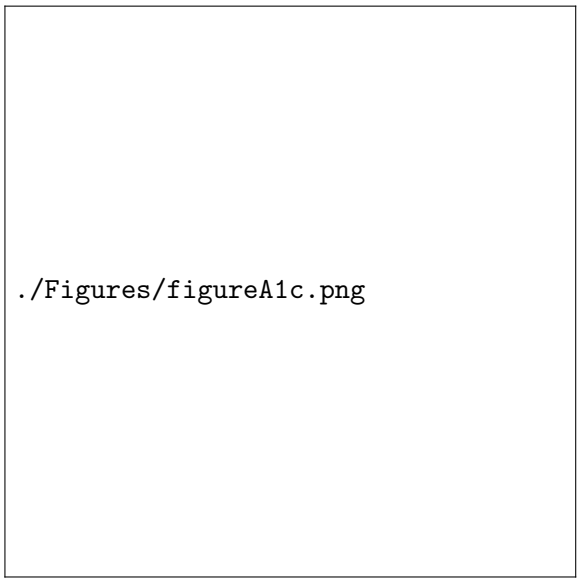
Medium-Sized Economies



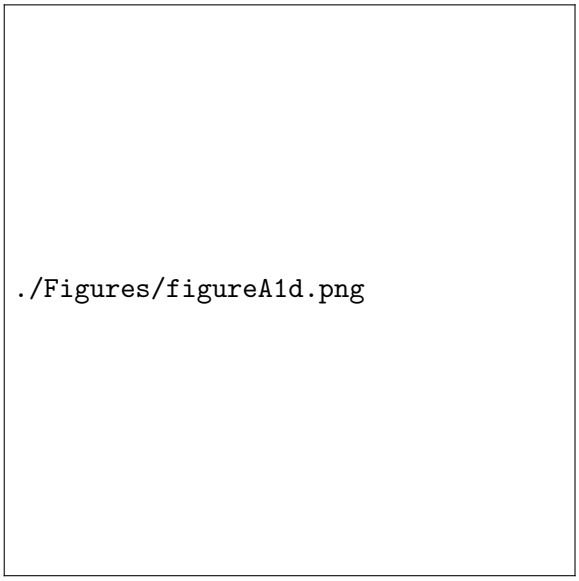
Baltic and Nordic Republics



Southeastern Europe



Central Europe



s