Firm Net Worth, External Finance Premia, and Monitoring Cost

Estimates Based on Firm-Level Data

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Abstract. We estimate the sensitivity of firms' external finance premium to variation in their net-worth-to-capital ratio using a comprehensive panel of balance sheet and income statement data for Swiss nonfinancial firms from 1998 to 2016. We address the endogeneity of net worth through two complementary instrumental variable strategies: one based on lagged non-operating and financial profits, and another employing a shift–share design that interacts firms' predetermined financial exposure with aggregate dividend returns. Our empirical approach is grounded in the costly state verification (CSV) framework of Townsend (1979) as implemented in Bernanke, Gertler, and Gilchrist (1999) and related macroeconomic models with financial frictions. Using the estimated elasticities, we recover the deep structural parameters, in particular the monitoring cost, which we estimate at roughly one quarter of firms' gross return on capital, with a range from 0.15 to 0.35 across specifications. Our results support the financial accelerator mechanism at the firm level and are broadly consistent with the original BGG calibration.

JEL classification: E32, E22, E44, G32.

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1. Introduction

Do firms' financing structures matter for their cost of external finance? In a setting with no financial frictions, it would be irrelevant whether firms use internal funds or external funds to finance their projects, because the costs of the two sources of financing would be the same. This is not necessarily the case in reality, for example, because of asymmetric information between lenders and borrowers in credit markets. Such information asymmetries can lead to firms having to pay a premium for external finance, making external funds more costly.

Moreover, the external finance premium increases when a firm's net-worth-to-capital ratio deteriorates. Because net worth tends to move procyclically, the premium rises during economic downturns and periods of contractionary monetary policy. This so-called "balance sheet channel," formalized in the financial accelerator framework of Bernanke, Gertler, and Gilchrist (1999), adds to the standard interest rate channel of monetary policy and amplifies business cycles.

In this paper, we estimate how sensitive a firm's external finance premium is to variation in its net-worth-to-capital ratio. We provide empirical estimates of this sensitivity based on firm-level data including detailed information on balance sheets and income statements of Swiss firms. The dataset is encompassing, containing both large and small firms in Switzerland, including many firms that are not publicly listed, for the period 1998 – 2016. We compute two alternative measures for the external finance premium. The first measure is based on a proxy of firms' marginal cost of external finance that we estimate with a production function. The second measure is the credit spread, defined as the difference between firms' average cost of external finance and the risk free rate. An instrumental variable approach is used to address the potential endogeneity issue that firms with a higher net-worth-to-capital ratio may have better investment opportunities. To isolate the variation in net worth that is exogenous to firms' business opportunities, we employ two complementary identification strategies. First, we use shocks to firms' net financial and nonoperating profits as an instrument. Second, we construct a shift–share (Bartik-type) instrument that exploits predetermined cross-sectional differences in firms' exposure to dividend income and common aggregate shocks to dividend payments. The share component is defined as firms' dividend income from third-party securities relative to earnings before interest and taxes (EBIT), measured in 2007, prior to the global financial crisis.

The shift component is given by annual aggregate dividend returns from the global equity market. This design exploits the fact that aggregate financial market fluctuations are plausibly exogenous to individual firms, while cross-sectional exposure shares are fixed prior to the crisis, ensuring that the interaction provides exogenous variation in net-worth shocks across firms.

We motivate our empirical specification within the costly state verification (CSV) model developed by Townsend (1979). In the CSV framework, owing to asymmetric information, the lender must pay an auditing cost before it can retrieve the remaining capital of a firm that has gone bankrupt. Because of this extra cost, the so-called monitoring cost, external finance becomes more expensive than internal finance. Assuming furthermore that lenders require a higher financial premium from firms with lower net-worth-to-capital ratio, because such firms are more likely to go bankrupt, results in an inverse relation between a firm's net-worth-to-capital ratio and the external finance premium.

Using our estimates of the sensitivity of the external finance premium to variation in the net-worth-to-capital ratio, we are able to pin down the deep parameters of the CSV model. In particular, we can deduce an estimate of the typical monitoring cost as a fraction of the gross return to capital. This parameter is key in many models, which include financial frictions at the macroeconomic level. In such models, an increase of the external finance premium affects negatively firm borrowing, leading to lower investment and output. Because firms' net-worth-to-capital ratio is affected by procyclical factors such as the development of profits and asset prices, it tends to develop in-sync with the economic cycle. Hence, information frictions à la Townsend (1979) are set to amplify aggregate fluctuations. Since the seminal work by Bernanke, Gertler, and Gilchrist (1999) (henceforth BGG), such a "financial accelerator channel" has been included in many widely used dynamic stochastic general equilibrium (DSGE) models, for example, in Christiano, Motto, and Rostagno (2008), Smets and Wouters (2007), and Christiano, Trabandt, and Walentin (2011).

Across our two identification strategies, we estimate an elasticity of the external finance premium with respect to the net-worth-to-capital ratio in the range of 0.04 to 0.09, and an elasticity of the credit spread in the range of 0.01 to 0.02. These estimates imply a monitoring cost of roughly one quarter of firms' gross return on capital, with a range from 0.15 to 0.35

across specifications. The range is close to the calibration originally proposed by Bernanke, Gertler, and Gilchrist (1999), who set the monitoring cost at 12 percent, and well within the range suggested by Carlstrom and Fuerst (1997). It contrasts, however, with Carlstrom, Fuerst, and Paustian (2016), who propose a modification of the original model and derive from their calibration a monitoring cost of 63 percent. Overall, both identification strategies reinforce the conclusion that the financial accelerator mechanism is quantitatively important at the firm level and broadly consistent with the original BGG calibration.

To our knowledge, Levin, Natalucci, and Zakrajsek (2004) is the only other study that employs firm-level balance sheet data to estimate the variation in firms' financing costs based on their net-worth-to-capital ratio. Using quarterly data on credit spreads, expected default probabilities, and leverage ratios for 900 publicly listed US nonfinancial firms between 1997 to 2003, they examine the cross-sectional and time-series behavior of the external finance premium through the lenses of a CSV model. According to their baseline estimates, monitoring costs vary between around 0.1 and 0.4, matching the variation in observed credit spreads over time. One contribution of our work compared to theirs is that we introduce an exogenous variation in the firms' net worth to estimate the elasticity of the external finance premium. In their study, this elasticity is not directly estimated, but inferred from the estimates of the deep parameters of the CSV model matched to firm level data on leverage ratios and credit spreads. Furthermore, our analysis incorporates many non-publicly listed firms, which were not included in their study. More recently, Altavilla, Gürkaynak, and Quaedvlieg (2024) decompose the external finance premium using loan-level data for euro-area firms and document substantial firm-level variation in borrowing costs. Our approach is complementary: rather than decomposing the premium, we estimate its structural sensitivity to net worth and recover the underlying monitoring cost.

Related work examines the impact of exogenous shocks to entrepreneurial wealth on firm-level outcomes. In particular, Ring (2023) studies how stock market fluctuations affecting entrepreneurs' personal wealth transmit to real activity in the firms they own. Using matched owner–firm data he finds that negative wealth shocks to owners lead to persistent employment declines. While his shocks operate through the owner's personal balance sheet, the identification approach is conceptually akin to our shift-share instrument, which interacts firms' predetermined financial exposure with aggregate financial market shocks. Our contribution is complementary: we focus on shocks to the firms' own net worth and trace their impact on the external finance premium and credit spreads. The finding that plausibly exogenous wealth shocks—whether to owners or to firms directly—have substantial real effects strengthens the broader relevance of balance sheet channels.

This paper proceeds as follows. In Section 2, we outline the key equations of our CSV model. In Section 3 we discuss our data and show how our measures fit into the BGG model. In Section 4, we present the estimates, and in Section 5 we discuss their implications. Section 6 concludes.

2. Theoretical motivation based on costly state verification

We use a standard costly state verification (CSV) environment (Townsend, 1979) as in BGG to motivate our empirical specification. In this setting, asymmetric information implies that external finance is more expensive than internal finance, and the external finance premium is decreasing in the borrowing firm's net worth. If net worth is cyclical, the premium is countercyclical and amplifies aggregate shocks.

There is a continuum of risk-neutral firms with survival probability γ. Each firm i chooses capital $K_{i,t}$ at price Q_{t-1} before observing an idiosyncratic shock $\omega_{i,t}$ with $\mathbb{E}[\omega_{i,t}] = 1$ and variance σ^2. Ex post returns equal $\omega_{i,t} r_t^k$, where

$$r_t^k \equiv \frac{r_t + (1+\delta)Q_t}{Q_{t-1}}$$

depends on the risk-free rental rate r_t, depreciation δ, and the price of capital. Projects are financed by net worth $N_{i,t}$ and debt $B_{i,t}$ so that $Q_{t-1}K_{i,t} = N_{i,t} + B_{i,t}$.

Monitoring the realisation of $\omega_{i,t}$ requires a proportional cost μ. If $\omega_{i,t}$ falls below a threshold $\overline{\omega}_{i,t}$ the firm defaults and the intermediary recovers the residual return net of monitoring costs; otherwise it receives $Z_{i,t}B_{i,t}$. The nondefault gross loan rate $Z_{i,t}$ satisfies $Z_{i,t}B_{i,t} = \overline{\omega}_{i,t} R_t^k Q_t K_{i,t}$ with R_t^k the gross return. With aggregate risk, $\overline{\omega}_{i,t}$ and Z_t move countercyclically in equilibrium, as in BGG.

Competitive intermediaries break even in expectation at the safe rate R_t. Firms choose $K_{i,t}$ and $\overline{\omega}_{i,t}$ taking the participation constraint into account. Let the leverage (capital–to–net worth) ratio be $\kappa_{i,t} \equiv Q_t K_{i,t}/N_{i,t}$ and let $s_{i,t} \equiv \mathbb{E}_{t-1}\left[\frac{R^k_{i,t}}{R_t}\right]$ denote the external finance premium. Equilibrium implies an upward–sloping supply of funds, $\kappa_{i,t} = \psi(s_{i,t})$ with $\psi'(.) > 0$, and firms choose capital by equating expected returns to the marginal cost of external funds:

$$\mathbb{E}_{t-1}[R^k_{i,t}] = \psi^{-1}(\kappa_{i,t})R_t. \tag{1}$$

A fall in net worth increases $\kappa_{i,t}$, raises the marginal cost of external finance, and depresses investment. Hence, the slope of $\psi^{-1}(\kappa_{i,t})$ governs the strength of amplification.

For estimation we log-linearise (1) by assuming $\psi^{-1}(\kappa_{i,t}) = \kappa^{\nu}_{i,t}$, which yields

$$\mathbb{E}_{t-1}[r^k_{i,t} - r_t] = \nu \ \ln(\kappa_{i,t}), \tag{2}$$

where $r^k_{i,t}$ is the net return to capital and ν is the elasticity of the external finance premium with respect to leverage.

We also estimate a specification based on the observed contractual interest rate on debt. Let $z_{i,t}$ be the average gross loan rate. The credit spread is $z_{i,t} - r_t$, which in the CSV setting need not equal the marginal cost of funds, so its elasticity ξ may differ from ν:

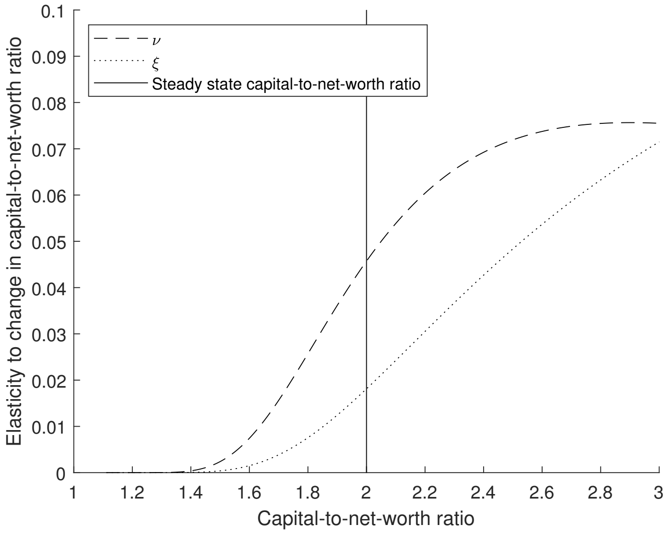
$$z_{i,t} - r_t = \xi \ \ln(\kappa_{i,t}). \tag{3}$$

Equations (2) and (3) map directly to the data on returns and leverage. Given a steady–state κ and assumptions on the idiosyncratic shock, estimates of ν and ξ imply a monitoring cost μ; conversely, μ maps into (ν, ξ) as in BGG. Figure 1 illustrates this mapping.

3. Data

We use a relatively large panel of firm-level balance sheet and income statement data ranging from 1998 to 2016, provided by the Swiss Federal Statistical Office (SFSO). The dataset is underlying official GDP data and other National Account statistics. The sample is a comprehensive draw

Figure 1: *Elasticity of the credit spread and the marginal cost of external financing, and the capital-to-net-worth ratio*



from the population of Swiss firms,[1] covering all industries in the economy, except the financial and public sectors.[2] The dataset comprises over $118,800$ observations at an annual frequency, from $25,300$ firms, in an unbalanced panel. The SFSO collects data for all large firms annually. Smaller firms are replaced more frequently in the sample, with firms from the same industry and similar characteristics.[3] The data include detailed information on firm financing structure. Among others, the dataset includes firm outstanding debt, net worth, total assets, number of employees, value-added, and interest payments. The available balance sheet and income statement variables are listed in Tables 1 and 2, respectively. Even though we do not observe the entire universe of firms, the dataset has some advantages over more broadly available datasets, such as Compustat, in that it contains both large and small firms as well as both privately held and

[1] The sample is not representative as it over-samples large firms. This is because the sample is used to project aggregate GDP, for which large firm statistics have higher information content. The sampling frame is divided by industry, respectively by sector (primary strata) based on the 2-digit NOGA classification (NOGA is the Swiss industry classification, similar to NACE) and size classes based on the number of employees (secondary strata). This stratification allows the SFSO to build the most homogeneous subpopulations possible, in terms of economic activity and size. A size limit is set for each economic sector, above which all the companies are surveyed. In the remaining strata, simple random samples are drawn. The sample size is set so total gross production and total full-time equivalents at the 2-digit NOGA can be estimated with a coefficient of variation of 2.5%. See BFS (2020) for details.

[2] The financial and public sectors are not included in our data. Therefore, the parameters, we estimate do not relate to these parts of the economy, which amount to approximately 20% of total GDP. These two sectors do, however, not reflect entrepreneurs in the BGG sense: for example, financial firms do not raise credit to invest in the classical way and the public sector in Switzerland is hardly likely to go bankrupt.

[3] Of the smallest firms, (firms with less than 10 full-time employment, FTE) 67% are three or less than three years in the sample, while 72% of the largest firms (firms with more than 250 FTE) are ten years or more in the sample. See Table A.1.

publicly listed firms. Depending on their legal form, firms do not necessarily have to publish their balance sheets or income statements; therefore, information on the financial position, in particular of smaller firms, tends to be less publicly available. It may be important to include such firms as they may have different financing structures than do larger, publicly held firms.

Table 1: *Balance sheet variables*

Assets	**Liabilities**
Working capital	Current debt
Inventories	Long-term debt
Third-party securities	Provisions
Long-term accounts receivables	Net worth
Fixed assets (tangible assets, property, plant equipment)	
Intangible assets	
Others	

Note: This table shows a generic balance sheet. "Others" includes costs for incorporation, costs for increases in capital, and unpaid share capital. "Net worth" includes treasury stock, profit carryforward, and net profits.

Table 2: *Income statement variables*

Expenses	**Income**
Cost of materials	Revenue
Decrease in inventories	Increase in inventories
Personnel expenses	Other operating revenue
Interest payments	Subsidies
Other expenses	Dividend income from third-party securities
Loss on third-party securities	Income from third-party securities
Nonoperating expenses	Nonoperating revenue
Depreciation costs on fixed and intangible assets	Net loss
Tax expenses	
Net income	

Note: This table shows a generic income statement.

We now define the variables that are used to estimate the sensitivity of the finance premium to variation in net worth. While some variables are taken directly from the dataset, others are unobserved and have to be estimated.

The key variables that describe firms' financing structures are contained in the balance sheet data. Firm net worth $N_{i,t}$ is defined as firms' capital $Q_{t-1}K_{i,t}$ less outstanding obligations $B_{i,t}$.[4]

[4] As the reference date of the balance sheet variables, such as the capital stock, is set at the end of the reporting period, these variables are taken from our dataset in $t-1$. Therefore, the quantity of capital productive in t is denoted as $K_{i,t}$ and is the capital reported at the end of the previous reporting period at the price of the previous reporting period Q_{t-1}. In contrast, the variables taken from the income statement, such as interest payments, refer to the entire year t and enter the model contemporaneously.

Capital consists not only of firms' physical capital but of all assets that are available in a given period. $Q_{t-1}K_{i,t}$ includes therefore firms' liquid assets plus the collateral value of illiquid assets. Outstanding obligations $B_{i,t}$ are the sum of all long- and short-term debt on which a firm must pay interest, i.e., total liabilities without provisions. On average, the outstanding debt amounts to 57.2% of firms' total capital (the median is at 59.4%). This suggests that external finance is an important part of firms' total capital. Defined in this way, net worth captures both the collateral value of firms' assets and the accumulation of retained earnings. This is relevant in light of Lian and Ma (2021), who document that the majority of US corporate borrowing is earnings-based rather than asset-based. Our measure encompasses both channels through which net worth can relax borrowing constraints. There is some sectoral heterogeneity. The transport sector and the restaurants and hotels sector operate with more debt per unit capital than the pharmaceutical sector, for example (see Table A.2).

A further central variable is the external finance premium, which is the difference of the return to capital and the risk-free rate, proxied by the 3-month LIBOR.[5] Gross return to capital $R^k_{i,t}$ is assumed to equate the marginal cost of external finance. Because of diminishing returns, the return to capital depends inversely on the capital level. Assuming a Cobb–Douglas production function, the rent for a unit of capital is $\frac{1}{X_{i,t}}\frac{\alpha Y_{i,t}}{K_{i,t}}$, where $\frac{1}{X_{i,t}}$ is defined as the relative price of produced goods. Adding depreciation and considering the change in the price of capital, the gross return of capital is defined as:

$$R^k_{i,t} = \frac{\frac{1}{X_{i,t}}\frac{\alpha Y_{i,t}}{K_{i,t}} + Q_{i,t}(1-\delta_{i,t})}{Q_{i,t-1}}. \tag{4}$$

We measure the relative price of the produced goods at the firm level as $P^Y_{i,t}$ divided by aggregate price CPI_t.[6]. As capital is the sum of the physical capital and liquid assets, capital

[5] The choice of the risk-free rate is not relevant in our empirical analysis as it is used only to estimate the elasticities of the external financial premium, with equation (5), and the credit spread, with equation (6). Both equations include a time dummy that absorbs all aggregate variation and a constant that absorbs any level shifts in the financial premium or the credit spread resulting from the choice of the risk-free rate.

[6] This calculation gives us the following definition for the gross return to capital ($P^Y_{i,t}Y_{i,t}$, the firm-level nominal value added is taken from firms' income statements):

$$R^k_{i,t} = \frac{\frac{1}{CPI_t}\frac{\alpha P^Y_{i,t}Y_{i,t}}{K_{i,t}} + Q_{i,t}(1-\delta_{i,t})}{Q_{i,t-1}}$$

price $Q_{i,t}$ is a weighted average of the capital stock deflator and the GDP deflator. The weights are equal to the firm-level shares of physical capital and liquid assets to total capital. The output elasticity of capital, α, is estimated with the methodology developed by Wooldridge (2009), which uses a proxy variable approach to control for unobserved productivity.[7] Our estimate for α is 0.37, very much in line with conventional assumptions. For example, BGG assumes a value of 0.35. Depreciation rate $\delta_{i,t}$ is derived from firms' depreciation expenditures on physical capital included in our dataset.[8][9] The return to capital minus the 3-month LIBOR is our measure for the external finance premium.

In addition to the sensitivity of the external finance premium, we estimate the sensitivity of the credit spread to changes in the net-worth-to-capital ratio. The credit spread is defined as the difference between contractual interest rate $Z_{i,t}$ and the short-term risk-free rate and is used to proxy for the unobserved external finance premium (Gilchrist, Ortiz, and Zakrajsek, 2009). The contractual interest rate paid by firms is measured by the ratio of the interest payments to the total outstanding debt. Defined in this manner, the contractual interest rate reflects the average interest rate over all debt contracts that a firm holds.[10]

Column (1) of Table 3 shows the means of the annual gross marginal product of capital (MPK, as defined in equation (4)). The overall mean estimated with our dataset is 1.19 and is in line with the estimates of Lowe, Papageorgiou, and Perez-Sebastian (2019) for the private sector in

[7] We estimate α using the GMM procedure described in Rovigatti and Mollisi (2018), which is based on firms' intermediate goods purchases.

[8] As firm-level depreciation rates are erratic, we average the rates over firms by year. It is important not to average over time to consider the fact that the overall depreciation rate tends to increase over time due to a rising share of short-lived capital goods, such as IT products. This per annum average depreciation rate, which is equal for all firms each year, is then weighted with the share of physical capital for each firm per year. As a result, $\delta_{i,t}$ varies by firm and year.

[9] The estimates of the elasticity of the financial premium are similar if the estimation is conducted using sector-level output elasticities and sector-level depreciation rates (see C.8 in the Appendix).

[10] BGG assume that the interest rate that entrepreneurs must pay on their loans is reset every period, depending on their net-worth-to-capital ratio in that given period. In the data, this precondition is clearly not fulfilled: arguably, many firms hold debt with a duration of over a year. Therefore, our measure of firms' average interest rate also includes the interest rates that were set at an earlier date, depending on firm net-worth-to-capital ratios at that time. Consequently, the estimated sensitivity using this measure of average interest rate must be interpreted as a lower bound. Table C.8 in the Appendix shows the estimates of the sensitivity of the credit spread using an interest rate that is derived from the interest rate payments on additional debt taken out in period t. As expected, the elasticity of the credit spread based on this 'marginal' interest rate is higher than the elasticity estimated with the average rate.

Table 3: *Return on capital and interest rate*

	Gross MPK $R^k_{i,t}$ per year	External finance premium in basis points per quarter	Credit spread in basis points per quarter
Aggregate	1.19	407	47
Sector			
Business Services 1	1.30	612	43
Business Services 2	1.27	571	45
Construction	1.27	558	21
Education	1.25	514	38
Energy	1.07	152	50
Entertainment	1.23	472	46
Health	1.19	392	47
IT	1.27	559	45
Manufacturing Investment Goods	1.13	286	83
Manufacturing Pharma	1.17	358	59
Manufacturing Watches	1.16	338	48
Manufacturing Other	1.20	419	56
Mining	1.10	218	36
Restaurants Hotels	1.23	454	48
Trade	1.15	333	50
Transport	1.17	360	43
Firm size (number of full time employees)			
<10	1.19	401	55
10-19	1.20	417	51
20-49	1.19	405	45
50-249	1.19	413	46
>250	1.18	383	52

Note: This table shows the estimate of the annual marginal product of capital (MPK), defined in Equation (4). Column (1) shows the resulting estimate of the MPK. Column (2) shows the external finance premium on a quarterly basis ($r^k_{i,t} - r_t$). Column (3) shows the credit spread ($z_{i,t} - r_t$).

Sector definitions: Business services 1 (real estate activities; legal; accounting; management; architecture; engineering activities; scientific research and development; and other professional, scientific and technical activities), business services 2 (administrative and support service activities), construction, education (not including public schools), energy (energy supply, water supply, and waste management), entertainment (arts, entertainment, recreation and other services), health (human health and social work activities), IT (information and communication), manufacturing of pharmaceutical goods, manufacturing of investment and intermediate goods, manufacturing of watches (watches, computer, electronic and optical products), manufacturing of other goods, mining (mining and quarrying), restaurants and hotels (accommodation and food service activities), trade (retail and wholesale trade and repair of motor vehicles and motorcycles), and transport (transportation and storage).

advanced countries.[11] Columns (2) and (3) show the means of the external finance premium

[11] Various authors, such as Mello (2009) or Caselli and Feyrer (2007), estimate a net marginal product of capital of approximately 11%-12% for high income countries. However these aggregate figures have been relativised by Lowe, Papageorgiou, and Perez-Sebastian (2019), who distinguished between the private and public marginal product of capital. They show that the overall marginal product of capital is pulled down by the low rates in the public sector. Their estimates for the private-sector net marginal product of capital in advanced countries sit at approximately 20%. Thus, our estimates for $R^k_{i,t}$ are plausible.

($r_t^k - r_t$) and the credit spread ($z_t - r_t$), respectively. As the BGG calibration is defined for a quarterly frequency, the credit spread and external finance premium shown in the table are quarterly estimations. The mean external finance premium is approximately 410 basis points,[12] while the average credit spread is 47 basis points.

There is heterogeneity across the sectors. The external finance premium tends to be high in some services sectors, such as "business services" and "IT" and low in the energy and mining sectors. For the credit spread, the manufacturing sector tends to have larger credits spreads compared to the services sector. There is also some heterogeneity between the size groups (defined by the number of full-time equivalent employees). The external finance premium tends to decrease in firm size, although not monotonically. That larger firms hold more capital is consistent with the decreasing returns assumption.[13] No such clear pattern emerges for the credit spread.

4. Identification Strategy, Estimation, and Results

In this section, we estimate ν and ξ, which are the elasticities of the external finance premium and the credit spread, respectively. We also discuss the identification strategy.

4.1. Identification Strategy and Estimating Equations

We estimate the sensitivity of the external finance premium to variation in net worth, ν, using the estimating equation (logs and rates are denoted in small letters):

$$r_{i,t}^k - r_t = \alpha_0 - \nu \left[n_{i,t} - (q_{i,t-1} + k_{i,t}) \right] + D^{time} + D^{sector} + D^{size} + \varepsilon_{i,t}, \qquad (5)$$

[12]The external finance premium can shift depending on which risk-free rate is used. Our measure of the risk-free rate is the LIBOR. Any higher measure of the risk-free rate leads to a lower external finance premium. However, as the risk-free interest rate is an aggregate variable that is the same for all firms, this level shift would have no impact on our estimate of the elasticity of the external finance premium as aggregate variation is absorbed by the time dummy in Equation (5). Furthermore, to identify monitoring cost μ in Section 5, we do not use the level of the external finance premium but only its estimated reaction to changes in the leverage ratio.

[13]This assumption relates to the literature, which documents sectoral differences in monetary policy transmission. For example, Bäurle and Steiner (2015) show substantial cross-sectoral differences in the response of output to monetary policy shocks. Dedola and Lippi (2005) relate the variation of sector responses to microeconomic data and find that the responses correlate with durability and investment intensity, which supports the credit channel view.

where $n_{i,t} - (q_{i,t-1} + k_{i,t})$ is the log of the net-worth-to-capital ratio and D^{time}, D^{sector}, and D^{size} denote time, sector, and size fixed effects, respectively.[14] Our focus is on variation in net worth across firms rather than within firms over time. Consequently, we estimate the baseline specification without firm fixed effects and instead control for sector and firm-size fixed effects. Identification therefore exploits differences in net worth across observations after controlling for sector and firm-size fixed effects.[15]

In a similar vein, using the estimating equation in (6), we estimate the sensitivity of the credit spread to variation in net worth, ξ,

$$z_{i,t} - r_t = \alpha_0 - \xi \left[n_{i,t} - (q_{i,t-1} + k_{i,t})\right] + D^{time} + D^{sector} + D^{size} + \varepsilon_{i,t}. \tag{6}$$

A key concern in estimating Equations (5) and (6) by OLS is the potential endogeneity of the net-worth-to-capital ratio. Firms with higher net worth may also have better investment opportunities, implying that correlations between financing premia and net worth could reflect unobserved heterogeneity in investment opportunities rather than the mechanism implied by the BGG framework. To address this concern, we employ instrumental variables that affect firms' net worth but are plausibly unrelated to their investment opportunities or contemporaneous credit conditions.

Our first instrument is constructed from net income firms generate from financial and non-operating activities. Financial income comprises dividend and other income from third-party securities net of financial expenses, while net non-operating profits is defined as business-external and extraordinary revenue minus business-external and extraordinary expenses.[16] To be more specific, the instrument is defined as the ratio of net non-operating and financial income to the total volume of non-operating and financial transactions and is lagged by one year to align with the timing of the net-worth-to-capital ratio. All variables are taken directly from firms' income statements; see Table 2. Normalizing by the gross volume of non-operating and financial flows

[14]The sector and size dummies are defined as the sectors and size groups shown in Table 3. Time dummies are defined at the annual level.

[15]Our results are robust to the inclusion of firm fixed effects, though the estimates are less precise; see Appendix C.6.

[16]Non-operating revenue or expenses are reported for approximately 90% of firm-year observations, while income or expenses related to financial market activities are observed in about 47% of cases. On average, the sum of non-operating and financial income amounts to 7.3% of a firm's net worth. See Appendix B for precise accounting definitions and variable construction.

ensures comparability across firms and limits the influence of firm size.[17]

These income components reflect realized returns on firms' financial portfolios and income from activities unrelated to core operations. After controlling for time, sector, and firm-size fixed effects, identification exploits cross-firm differences in lagged realized returns, rather than contemporaneous firm-level investment opportunities or credit conditions. Because the instrument is lagged, it is predetermined with respect to current-period shocks to the marginal product of capital or credit conditions.

A potential concern is that firms may deliberately hold financial assets, for example for hedging or liquidity management, so that financial income could reflect underlying firm characteristics. However, this should not interfere with the source of exogenous variation used for identification. Even when asset positions are chosen endogenously, realized returns contain a substantial unpredictable component. Moreover, predictable variation in financial income related to aggregate conditions, sector-wide risk exposures, or systematic size differences is absorbed by time, sector, and firm-size-bin fixed effects in the first stage. Identification therefore relies on firm-level differences in lagged financial and non-operating profits after absorbing time, sector, and firm-size fixed effects.

The second instrumental variable strategy builds on a shift–share (Bartik-type) approach (Goldsmith-Pinkham, Sorkin, and Swift, 2020) designed to address concerns that, despite the discussion above, financial and nonoperating income may still partly reflect endogenous firm behavior. In this alternative strategy, we construct exogenous firm-level variation by interacting a firm's predetermined exposure to dividend income with an aggregate measure of dividend income from global equity markets. Specifically, the share component is defined as the ratio of dividend income from third-party securities ("Dividendenertrag") to earnings before interest and taxes (EBIT), measured in the baseline year 2007, just prior to the global financial crisis.[18] This variable captures firms' pre-crisis exposure to dividend income from financial market activities. The shift component is given by annual aggregate dividend returns of the MSCI World Index.[19]

[17]We assess the robustness of the results using alternative definitions and scalings of the instrument. These exercises are discussed in Appendix C.4 and reported in Tables C.6 and C.7.

[18]For firms without data in 2007, we use the corresponding share from 2006 or, if also unavailable, from 2005.

[19]Data for the MSCI World Price Index and the MSCI World Total Return Index are obtained from Bloomberg.

Formally, the shift–share instrument is defined as

$$Z_{i,t} = \text{DividendShare}_{i,2007} \times (\Delta \log TR_t - \Delta \log PR_t)\,, \tag{7}$$

where TR_t and PR_t denote the MSCI World Total Return and Price Indices, respectively.[20]

The resulting interaction predicts firm-level variation in financial income solely based on predetermined exposure to dividend income and exogenous aggregate dividend shocks. This identification strategy is closely related to Ring (2023), who interact entrepreneurs' pre-crisis portfolio exposures with aggregate stock market returns during the global financial crisis to study the effects of wealth shocks on firm employment. In our case, the shocks operate through firms' own balance sheets rather than through owner wealth, but the exclusion restriction is analogous. Conditional on time fixed effects and other controls, the interaction of pre-crisis dividend exposure and aggregate dividend returns affects firms' net worth only through realized dividend income from financial assets. Following the recommendations in Goldsmith-Pinkham, Sorkin, and Swift (2020), we provide supporting balance checks for this identification assumption in Appendix C.2. In particular, we show that firms' pre-crisis dividend exposure is not systematically related to observable firm fundamentals and does not predict subsequent variation in the net-worth-to-capital ratio in the absence of aggregate dividend shocks.

4.2. Estimation Results

Table 4 reports the OLS and IV estimates. The parameter ν is the coefficient on $n_{i,t} - (q_{i,t-1} + k_{i,t})$ when the external finance premium, $r^k_{i,t} - r_t$, is the dependent variable. In Column (1), the OLS estimate of ν is small and negative, implying that higher net worth is associated with a slightly lower external finance premium—an effect that is both economically negligible and contrary to theoretical predictions. This pattern is consistent with the presence of endogeneity. In contrast, the IV estimate in Column (2) yields $\nu = 0.043$, which aligns closely with the calibration used in the BGG model (0.05). The instrument exhibits adequate strength, as indicated by the first-stage

[20] A common approach in the empirical finance literature to isolate dividend (or distribution) cash flows exploits the difference between aggregate returns that include dividends and returns that exclude dividends, see, e.g., Henkel, Martin, and Nardari (2011). In our context, the MSCI World Total Return and Price indices play the analogous roles. MSCI's Total Return index reinvests dividends and captures both price and cash-flow variation, whereas the Price index excludes dividends, the difference between their log returns therefore isolates the contribution of aggregate dividend cash flows. See MSCI (2024) for details on index construction.

Table 4: *Estimates for ν and ξ*

	(1) OLS	(2) IV	(3) IV	(4) OLS	(5) IV	(6) IV
Dep. variable		$r^k_{i,t} - r_t$			$z_{i,t} - r_t$	
Coefficient		ν			ξ	
$n_{i,t} - (q_{i,t-1} + k_{i,t})$	-0.009^{***}	0.043^{***}	0.087^{***}	-0.000	0.013^{***}	0.024^{*}
	(0.000)	(0.013)	(0.025)	(0.000)	(0.003)	(0.014)
First stage						
Coefficient		-0.021^{***}	-1.790^{***}		-0.021^{***}	-1.790^{***}
		(0.003)	(0.560)		(0.003)	(0.560)
Instrument		Non-oper. profits	Bartik		Non-oper. profits	Bartik
KP F-statistic		38.8	10.2		38.8	10.2
Sector FEs	Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm size control	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,903	40,903	3,300	40,903	40,903	3,300

Notes: This table reports estimates of the elasticities ν and ξ from Equations (5) and (6). Columns (1) and (4) report OLS estimates. Columns (2) and (5) instrument the net-worth-to-capital ratio with lagged non-operating and financial profits. Columns (3) and (6) use the shift–share instrument described in Section 4. Robust standard errors in parentheses. The F-statistic reports the Kleibergen–Paap rk Wald statistic. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

F-statistic reported in Column (2).

The IV estimate based on the shift–share instrument yields $\nu = 0.087$ in Column (3). This estimate is larger in magnitude but remains consistent with the Column (2) estimate once one accounts for the shorter post-crisis sample period covered by the shift-share measure, a period during which balance sheet effects may have been particularly pronounced. Table C.3 in the Appendix shows that when the Column (2) specification based on the non-operating profits instrument is re-estimated using only the post-2008 sample, the coefficient increases to $\nu = 0.059$, bringing it closer to the shift-share estimate. This suggests that the somewhat larger estimate is at least partly driven by the post-2008 sample period rather than by differences in the instrument itself.

Columns (4)-(6) report the estimates of ξ, the elasticity of the credit spread with respect to the net-worth-to-capital ratio. As in the case of the external finance premium, the IV estimates differ starkly from the OLS results. The OLS estimate of ξ is economically negligible and statistically indistinguishable from zero, whereas the baseline IV estimate of 0.013 indicates that firms with stronger balance sheets benefit from lower borrowing costs, while more highly leveraged firms face higher contractual rates. The Bartik-based IV yields an even larger point estimate, though it is estimated less precisely, and the difference relative to the baseline IV estimate is not statistically significant.

We conduct several robustness checks, discussed in detail in the Appendix. First, we extend the sample to include all available observations. The estimates in Table 4 are based on the subsample for which both the external finance premium and the credit spread can be calculated. Because the estimation of the gross return to capital involves lagged variables, the number of usable observations is smaller for ν than for ξ, while certain firms do not report all components required to construct the average interest rate. Table C.5 in the Appendix reports results using the full sample of observations. The estimated sensitivity of the external finance premium is slightly smaller when the full sample is used, whereas the corresponding estimate for the credit spread is marginally larger. The qualitative conclusions remain unchanged.

Furthermore, Appendix C.4 reports a series of robustness exercises that modify the construction of the baseline instrument by excluding or including specific components of financial-market and nonoperating income. Including financial write-downs yields a slightly smaller estimate of ν (0.032). When the instrument is separated into its financial-market and nonoperating components, the resulting estimate of ν is somewhat larger for financial-market income (0.059) and statistically insignificant for nonoperating income, which also fails the first-stage relevance condition. This indicates that the identifying variation in the baseline instrument stems predominantly from realized returns on financial portfolios rather than from extraordinary or business-external items. The estimates of ξ exhibit a similar pattern. We also find that normalizing the instrument by value added produces estimates of ν that are close to the baseline, while the corresponding estimate of ξ is slightly lower. As an additional robustness check, Appendix C.5 reports estimates of ξ using a proxy for the "marginal" interest rate, which better aligns the timing of borrowing costs with the contemporaneous net-worth-to-capital ratio. As expected, this approach yields a larger sensitivity estimate than the baseline specification. Finally, we re-estimate our baseline including firm fixed effects. The point estimates are somewhat larger but qualitatively consistent with the baseline, and the first-stage F-statistic is lower due to the loss of cross-sectional variation, indicating that our findings are not driven by unobserved time-invariant firm heterogeneity (see Table C.9 in Appendix C.6).

Heterogeneity across firm characteristics. A distinctive feature of our dataset is that it covers firms of varying size, including many small and privately held firms that are typically absent from listed-firm datasets. To explore whether the strength of the balance sheet channel varies across firm types, we re-estimate the baseline IV specification separately for subsamples defined by firm size (full-time equivalent employees, median split), capital intensity (capital per employee, median split), and the share of long-term debt in total capital (median split). The results, reported in Table C.10 in Appendix C.7, indicate that the estimated elasticity ν is somewhat larger for large firms (0.06) than for small firms (0.03), although both estimates are statistically significant. The elasticity of the credit spread ξ is similar across size groups. Firms with a lower share of long-term debt exhibit a larger and more precisely estimated ν, consistent with the idea that firms more reliant on short-term financing are more exposed to balance sheet fluctuations. This finding is in line with Duchin, Ozbas, and Sensoy (2010), who show that investment declines during the 2007–2009 crisis were most pronounced among firms with high net short-term debt, suggesting that refinancing exposure rather than leverage per se captures vulnerability to financial shocks.

The relatively modest difference in the estimated elasticities across firm size groups is consistent with a growing body of evidence questioning whether size is a reliable proxy for financial constraints. Crouzet and Mehrotra (2020) show that differences in cyclicality between small and large firms largely reflect industry composition rather than financial frictions, Farre-Mensa and Ljungqvist (2016) find that firms classified as constrained by standard indices—which rely heavily on size and leverage—do not behave as if financially constrained, and Ottonello and Winberry (2020) show that low-leverage firms respond more to monetary policy shocks than high-leverage firms. Our results are broadly consistent with these findings: the financial accelerator mechanism operates across the firm size distribution, but the sharpest heterogeneity arises along the dimension of debt maturity structure rather than firm size or overall leverage.

4.3. External Validity

Our estimates are derived from Swiss firm-level data, and it is natural to ask how they generalize to other settings. The typical firm in our sample operates in a small, open, bank-based economy with relatively conservative leverage ratios (median debt-to-capital of approximately 59%). By comparison, U.S. nonfinancial firms—particularly publicly listed ones—tend to exhibit somewhat higher leverage, reflecting deeper capital markets and greater reliance on bond financing. Two considerations help assess the external relevance of our findings. First, the CSV framework that motivates our empirical specification is not country-specific; the structural relationship between net worth, monitoring costs, and the external finance premium applies whenever lenders face costly state verification. Second, a key advantage of our dataset is that it includes both publicly listed and privately held firms across a wide range of industries and firm sizes. Since privately held and smaller firms are arguably closer to the entrepreneurial borrowers in the BGG framework than are large publicly listed corporations, our estimates may provide a more natural empirical counterpart to the theoretical model than estimates based solely on listed firms. Nevertheless, institutional differences in financial intermediation, bankruptcy law, and accounting standards imply that the precise magnitude of the estimated elasticities may not transfer one-to-one across countries. We therefore emphasize the structural interpretation through the lens of μ rather than the reduced-form coefficients alone, as discussed in the next section.

5. Implications of our estimates within the costly state verification framework

As described in more detail in Section 2, the CSV framework as outlined in BGG is characterised by different deep parameters, namely the exogenous death rate of firms γ, the standard deviation of the idiosyncratic productivity shock σ and monitoring cost μ as a fraction of realised payoffs. However, directly estimating these parameters in practice may be difficult. This is particularly true for the death rate of firms[21] and the monitoring cost (see also the discussion in Carlstrom and Fuerst (1997) (CF), who suggest a monitoring cost in the range of 0.2-0.3). Because the deep parameters are difficult to estimate directly, they are usually set to match the empirical estimates of implied (steady state) magnitudes, such as the bankruptcy rate, the capital ratio or the spread

[21] Note that this is not the same as the bankruptcy rate; whether a firm “dies" is unrelated to the realisation of the idiosyncratic productivity shock in a specific period.

between the loan rate and the safe interest rate.

As an example, both BGG and CFP set the standard deviation of the productivity shock to $\sigma = 0.28$ and the capital ratio to roughly $\kappa = 2$.BGG set the steady state value of $R^K - R$ to 200 basis points, referring to the historical average spread between the prime lending rate and the six-month Treasury bill rate. CFP, in contrast, define the model's risk premium as the credit spread, i.e. $Z - R$, and set its steady state value to 200 basis points (both annualised quarterly values). This difference implies a substantially different monitoring cost: BGG obtain $\mu = 0.12$ (i.e. somewhat lower than CF) and CFP obtain $\mu = 0.63$ (substantially higher than CF). As a result, CFP obtain a nearly four times higher elasticity of the external finance premium to the leverage ratio of $\nu = 0.188$ compared with BGG's $\nu = 0.05$. Similarly, the elasticity of the loan rate to the leverage ratio is $\xi = 0.045$ in CFP, while BGG obtain only $\xi = 0.018$.[22]

Table 5 reports the BGG and CFP model calibrations together with our results. Column (1) is based on our estimate of $\nu = 0.043$ (non-operating profits as instrument) and $\nu = 0.087$ (shift share instrument). Column (2) is based on our estimate of $\xi = 0.013$ (non-operating profits as instrument) and $\xi = 0.024$ (Bartik instrument). The estimates are close to those of the BGG model and diverge quite strongly from the CFP model calibration. An exception is the estimate of ξ based on the shift share instrument. The point estimate is in fact closer to the CFP calibration. However, as discussed in Section 4, estimation uncertainty is substantial in this case.

The mapping between μ and elasticities ν and ξ is influenced by the calibration of σ and κ. We derive the capital ratio κ directly from our dataset and obtain a value of 2.46, see Table A.2, which is somewhat higher than BGG model's calibrated value of 2. The standard deviation of the productivity shock σ is obtained from the residuals of our estimated production function, see Section 3. As result, we obtain estimates for μ of 0.15 (non-operating profits as instrument) and 0.35 (Bartik instrument) based on $\hat{\nu}$. Based on $\hat{\xi}$, we obtain 0.20 (non-operating profits as

[22]Elasticity ν is key in determining the size of the financial accelerator. Deep parameters σ and μ do not play any further role in the linearised BGG model other than determining the elasticities ν (and ξ). However, CFP argue that the optimal lending contract in the BGG financial accelerator model allows for indexation to various aggregate quantities. As this indexation reduces fluctuations in leverage, the financial accelerator channel is much less important than it is in the BGG model despite the higher elasticity.

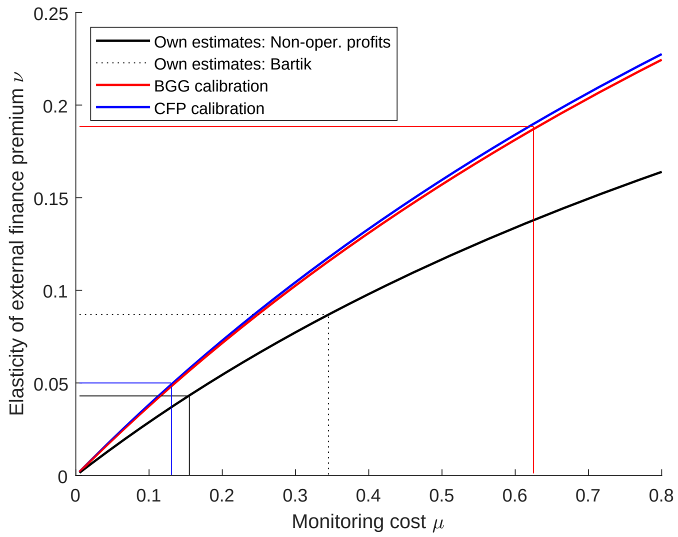
instrument) and 0.55 (shift share instrument) for μ.[23]

Table 5: *Parameter calibrations*

	$\hat{\nu}$ Non-oper.profits/Bartik	$\hat{\xi}$ Non-oper.profits/Bartik	BGG	CFP
σ	0.20	0.20	0.28	0.28
κ	2.46	2.46	2.0	1.99
μ	0.15/0.35	0.20/0.55	0.12	0.63
ν	0.043/0.087	0.055/0.130	0.050	0.188
ξ	0.010/0.018	0.013/0.024	(0.018)	(0.045)

Note: In Column (1), ν is our estimate and μ and ξ are implied by the model given $\hat{\nu}$; in Column (2), ξ is our estimate and μ and ν are implied by the model given $\hat{\xi}$. BGG: Bernanke, Gertler, Gilchrist (1998); CFP: Carlstrom, Fuerst, Paustian (2016). Values in parentheses are not stated explicitly by the authors.

Figure 2: *Elasticity of the external finance premium with respect to leverage ratio ν for varying levels of monitoring cost μ*



Note: The figure illustrates the interplay between the σ and κ calibrations and the mapping of μ to ν. The blue and the red lines show the mapping of μ to ν for the BGG and CFP model calibrations, respectively. The black line represents the mapping using our σ and κ calibrations.

Figure 2 illustrates the interplay between the σ and κ calibrations and the mapping of μ to ν. The blue and the red lines show the mapping between μ and ν for the BGG and CFP model

[23]Our values for μ remain quite stable if we combine our estimated elasticities ν and ξ with the BGG and CFP model calibrations for σ and κ: Based on our estimate of ν, we obtain $\mu = 0.115$, using either the BGG or CFP calibrations for σ and κ. Based on our estimate of ξ, we obtain $\mu = 0.050$ using the BGG model calibration and $\mu = 0.057$ using the CFP model calibration. Again, an exception is the estimate based on ξ using the shift share instrument. With this estimate, but BGG or CFP model calibrations, the implied value for μ is substantially smaller, slightly above 0.2, than the implications of the same estimate but using our own calibration.

calibrations, respectively. The black line represents the mapping using our σ and κ calibrations.[24] The horizontal lines mark the implied values of ν (BGG and CFP models) and our estimated values of ν. The vertical lines mark the resulting values for μ. As the black curve is less steep than the blue/red curves, we obtain a monitoring cost $\mu = 0.15$ based on non-operating profits as an instrument, which is only slightly higher than the BGG model calibration. With the shift share instrument, the difference to BGG is somewhat larger. Still, it is closer to BGG than to the CFP model calibration.

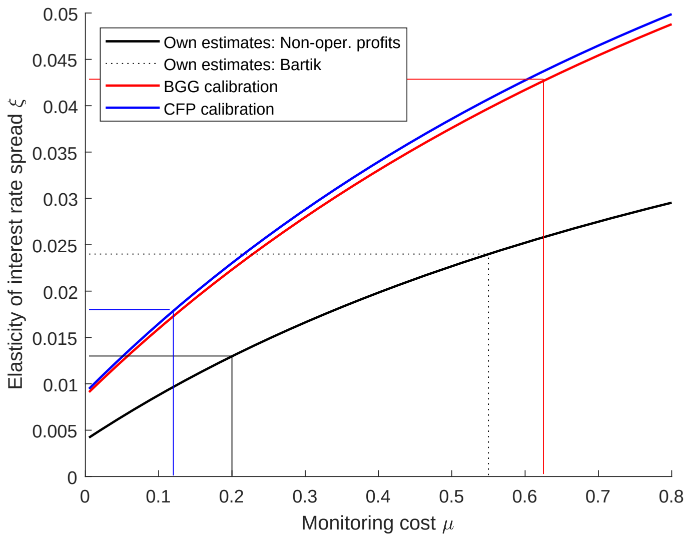
The same exercise can be done for ξ, the elasticity of the credit spread with respect to the leverage ratio. Figure 3 plots ξ as a function of μ. Again, the black line refers to our κ and σ calibrations, and the red and the blue lines, to the CFP and BGG model calibrations, respectively. We see that our estimate based on non-operating profits as an instrument can be achieved by setting $\mu = 0.20$. The dotted lines in Figure 3 mark the implications of ξ estimated with the shift share instrument. In order to achieve $\xi = 0.024$, μ has to be set to 0.55 given our calibration. As the estimate is uncertain, and furthermore, the implication sensitive to the calibration of σ and κ, we still conclude that overall, our estimates of ν and of ξ imply monitoring costs that are somewhat higher than they are in the BGG model, within the range suggested by Carlstrom and Fuerst (1997), but considerably lower than they are in the CFP model.

Using Swiss data, we conclude that, a monitoring cost in the range of roughly one fifth to one third of the return on capital is consistent with our estimated elasticities. The comparison with the BGG and CFP models shows that there is some sensitivity with respect to the calibration of κ and σ. However, under the assumptions that the monitoring cost in the US and Switzerland are of the same magnitude, our results suggest that BGG's calibration for μ and its implied value for ν are somewhat low, while CFP's calibration for μ and the implied value for ν are at the very high end.[25]

[24] As described in detail in Levin, Natalucci, and Zakrajsek (2004), for any given combination of μ, σ^2 and the external finance premium level, there is an optimal default threshold $\bar{\omega}$ and an optimal leverage ratio κ. We use these relationships to calculate, in a first step, the implied external finance premium and the implied credit spread over a fine grid of μ and ω given our estimate of σ^2 obtained from the data. In a second step, we identify for each μ the value for ω matching the leverage ratio obtained from the dataset. Finally, we derive for each μ the implied external finance premium and the implied credit spread consistent with empirical estimates of σ^2 and κ. It is straight forward to numerically calculate for each μ the magnitudes of η and ν, i.e. the effect of a small log-change in the value of κ on the external finance premium and the credit spread as shown in Figures 2 and 3

[25] The primary goal of CFP is to show that the financial accelerator is not important if indexing of financial contracts is allowed for. This conclusion holds also when $\mu = 0.12$.

Figure 3: *Elasticity of the credit spread with respect to leverage ratio ξ for varying levels of monitoring cost μ*



Note: The figure illustrates the interplay between the σ and κ calibrations and the mapping of μ to ξ. The blue and the red lines show the mapping of μ to ξ for the BGG and CFP model calibrations, respectively. The black line represents the mapping using our σ and κ calibrations.

6. Conclusion

Structural models with financial frictions are widely used in macroeconomic research and policy analysis to study how firms' balance sheets shape real activity. A central element of these models is the costly state verification friction introduced by Townsend (1979) and embedded in the financial accelerator framework of Bernanke, Gertler, and Gilchrist (1999). In this class of models, the sensitivity of the external finance premium to firms' net-worth-to-capital ratio is linked to the underlying monitoring cost faced by lenders. Despite its importance, this sensitivity and the implied monitoring cost have remained difficult to estimate empirically.

In this paper, we provide firm-level evidence on the strength of the financial accelerator mechanism using a comprehensive panel of balance sheet and income statement data for Swiss nonfinancial firms. We estimate the elasticity of both the external finance premium and the credit spread with respect to firms' net-worth-to-capital ratio, addressing endogeneity concerns through two complementary instrumental variable strategies. Our baseline instrument exploits lagged variation in firms' net financial and non-operating profits, while an alternative shift-share design interacts predetermined firm-level financial exposure with aggregate dividend returns. Both approaches aim to isolate plausibly exogenous shocks to firms' net worth that are orthogonal to contemporaneous investment opportunities and credit conditions.

Across specifications, we find a statistically and economically significant negative relationship between firms' net worth and their cost of external finance. The estimated elasticities imply monitoring costs of roughly one quarter of firms' gross return on capital, with a range from 0.15 to 0.35 across specifications. These values are close to the calibration originally proposed by Bernanke, Gertler, and Gilchrist (1999) and substantially below those implied by the alternative calibration in Carlstrom, Fuerst, and Paustian (2016). Estimates based on the shift-share instrument are somewhat larger but less precisely measured, reinforcing the conclusion that balance sheet effects at the firm level are quantitatively important.

Our findings have two broader implications. First, they provide direct empirical support for the financial accelerator mechanism at the microeconomic level, using data that include both publicly listed and privately held firms. Second, they suggest that commonly used DSGE models with financial frictions calibrated along the lines of BGG capture a realistic magnitude of monitoring costs and amplification effects. By contrast, calibrations implying very large monitoring costs appear less consistent with firm-level evidence.

More generally, the results underscore the importance of firms' balance sheets as a transmission channel for financial and macroeconomic shocks. Shocks that affect firms' net worth, whether through profits, asset prices, or financial income, translate into meaningful changes in external financing conditions and thus investment incentives.

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Appendix

A. Additional information on the data

Table A.1: *Share of firms per number of years in sample by FTE group, in%*

	FTE groups (number of full time employees) < 10	10 – 19	20 – 49	50 – 249	> 250
Number of years in sample	Share of firms per number of years in the sample by FTE group				
1	30.0	11.4	4.5	1.4	0.6
2	21.4	13.9	6.7	2.5	1.1
3	16.0	17.0	9.3	4.2	1.4
4	17.0	20.9	15.5	8.1	2.4
5	6.4	12.1	9.7	4.5	2.2
6	2.6	6.5	9.2	5.5	3.0
7	2.5	7.2	12.7	7.9	4.0
8	1.3	4.3	8.8	15.7	11.3
9	0.3	0.8	1.9	1.4	2.0
10	0.2	0.6	2.6	2.1	1.7
11	0.6	1.7	3.6	2.4	2.7
12	0.1	0.3	2.4	2.0	1.4
13	0.2	0.4	1.6	2.7	1.7
14	0.1	1.0	3.3	4.3	2.3
15	0.5	0.8	3.2	7.4	8.3
16	0.1	0.3	0.9	3.1	3.6
17	0.1	0.2	1.0	4.5	6.2
18	0.2	0.4	1.4	6.9	12.0
19	0.5	0.4	1.6	13.5	32.1
	Total number of observations per FTE group				
	9320	11730	34826	61906	14437

B. Construction of the non-operating profits instrument

This appendix describes the construction of the firm-level instrument based on non-operating and financial income components reported in firms' income statements.

Let DivInc_{it} denote dividend income, FinInc_{it} other financial income, and NonOpInc_{it} non-operating or extraordinary income of firm i in year t. Let FinExp_{it} denote other financial expenses

Table A.2: *Sample Statistics*

	Observations		*Debt/Capital in%*		*Interest paym. per 100 CHF value added*	
	Total	Firms	Mean	Median	Mean	Median
Aggregate	118837	25324	57.2	59.4	3.3	1.2
Sectors						
Business Services 1	9699	2780	57.6	59.5	3.8	0.6
Business Services 2	5208	1530	59.4	61.4	1.3	0.3
Construction	10754	2241	61.8	64.6	1.6	0.8
Education	2078	531	60.2	62.9	1.4	0.4
Energy	4556	873	51.6	52.2	6.5	3.1
Entertainment	3633	1055	55.4	56.2	2.2	0.6
Health	4884	1179	55.1	56.6	1.5	0.6
IT	5697	1372	55.2	56.0	2.2	0.5
Manufacturing Pharma	929	142	48.2	46.1	4.4	1.8
Manufacturing Investment Goods	20226	3401	54.6	56.2	3.2	1.8
Manufacturing Watches	4721	815	51.7	51.5	3.0	1.3
Manufacturing Other	12898	2420	57.6	60.8	3.3	1.8
Mining	933	168	45.6	43.9	2.6	1.6
Restaurants Hotels	4725	1058	64.9	69.5	4.5	2.1
Trade	21909	4600	57.2	59.1	4.8	1.7
Transport	5987	1159	63.1	66.6	3.1	1.5

Note: business services 1 (real estate activities; legal; accounting; management; architecture; engineering activities; scientific research and development; and other professional, scientific and technical activities), business services 2 (administrative and support service activities), construction, education (not including public schools), energy (energy supply, water supply, and waste management), entertainment (arts, entertainment, recreation and other services), health (human health and social work activities), IT (information and communication), manufacturing of pharmaceutical goods, manufacturing of investment and intermediate goods, manufacturing of watches (watches, computer, electronic and optical products), manufacturing of other goods, mining (mining and quarrying), restaurants and hotels (accommodation and food service activities), trade (retail and wholesale trade and repair of motor vehicles and motorcycles), and transport (transportation and storage).

and NonOpExp_{it} non-operating or extraordinary expenses. All variables follow the official accounting definitions of the Swiss Federal Statistical Office. Net non-operating and financial income is defined as

$$\text{NetNFI}_{it} = \text{DivInc}_{it} + \text{FinInc}_{it} + \text{NonOpInc}_{it} - \text{FinExp}_{it} - \text{NonOpExp}_{it}.$$

To account for differences in scale across firms, this net component is normalised by the total volume of non-operating and financial flows. The instrument is therefore defined as

$$\text{Instr}_{it} = \frac{\text{NetNFI}_{it}}{\text{DivInc}_{it} + \text{FinInc}_{it} + \text{NonOpInc}_{it} + \text{FinExp}_{it} + \text{NonOpExp}_{it}}.$$

The instrument is set to missing whenever the denominator equals zero, that is, when a firm reports no non-operating or financial income or expenses in a given year. This restriction ensures that the instrument is defined only for firm-year observations with observable exposure to non-operating and financial activities.

By construction, the instrument captures variation in realized income arising outside firms' core operating activity.

C. Robustness tests

C.1. Sample starting in 2008

In this first robustness check, we re-estimate the baseline specification using data starting in 2008, so that the time dimension of the sample is comparable to that of the shift–share IV. In this setting, the number of observations is higher because the unbalanced panel is not restricted to firms already present in 2007, as is required for the shift–share IV.

Table C.3: *IV-Estimates for ν and ξ for the sample starting in 2008*

Dependent variable	(1) $r^k_{i,t} - r_t$	(2) $z_{i,t} - r_t$
Estimated coefficient	ν	ξ
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.059**	0.026***
	(0.026)	(0.008)
First stage		
Instrument	-0.014***	-0.014***
	(0.004)	(0.004)
F test	12.6	12.6
Sector fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Firm size control	Yes	Yes
Observations	29952	29952

Note: This table shows the estimates of the coefficients ν and ξ using the non-operating profits instrument, but starting the sample 2008. Robust standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. The F statistic of the first-stage regression reports the Kleibergen-Paap F statistic.

C.2. Balance Checks for the Bartik Instrument

We conduct two complementary balance regressions to assess the validity of the Bartik exposure share. First, we test whether firm fundamentals predict the exposure share (FinancialShareInitialEBIT). Second, we test whether the exposure share predicts the (change in) net-worth-to-capital ratio in 2006–2007. If the exposure share is predetermined and orthogonal to firm fundamentals, both sets of coefficients should be small and insignificant.

Table C.4: *Balance Regressions for the Bartik Instrument (year = 2007)*

	(1) FinancialShareInitialEBIT	(2) $\Delta \ln(NW/K)_{2006 \to 2007}$
$\ln(\text{FTE})_{2006}$	0.043	
	(0.081)	
$\ln(\text{Sales})_{2006}$	-0.088	
	(0.067)	
FinancialShareInitialEBIT		-0.0099
		(0.0256)
Sector fixed effects	Yes	Yes
Observations	427	427
R^2	0.038	0.113
F-statistic	0.94	3.27

Notes: Column (1) regresses the Bartik exposure share (FinancialShareInitialEBIT, defined as dividend income from third-party securities relative to EBIT, measured in 2007) on lagged log employment and lagged log sales with 2-digit sector fixed effects (dsec_1–dsec_{16}; dsec_4 omitted due to collinearity). Column (2) regresses the 2006–2007 change in the log net-worth-to-capital ratio on the exposure share with the same sector fixed effects. Robust standard errors in parentheses. Neither lagged firm characteristics nor the exposure share significantly predict each other, supporting the assumption that the Bartik instrument is predetermined and orthogonal to firm fundamentals.

C.3. Whole sample

In the baseline specification, observations are considered only for which both the external finance premium and the credit spread are available. As lagged variables are employed in the estimation of the gross return of capital, the number of observations for which ν can be estimated is smaller than that for ξ. On the other hand, certain observations do not contain the full information needed to calculate the average interest rate. Table C.5 shows the estimated coefficients using all the available observations. For the estimation of ν, 6% more observations enter the regression than in the baseline specification shown in Table 4. The estimation of ξ contains 42% more observations. The estimated sensitivity using the whole sample is for the external finance premium slightly weaker than it is for the baseline estimate. For the credit spread, the sensitivity is practically the same.

Table C.5: *IV-Estimates for ν and ξ using all the available observations*

	(1)	(2)
Dependent variable	$r^k_{i,t} - r_t$	$z_{i,t} - r_t$
Estimated coefficient	ν	ξ
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.037***	0.014***
	(0.011)	(0.003)
First stage		
Instrument	−0.022***	−0.019***
	(0.003)	(0.003)
F test	48.87	47.56
Sector fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Firm size control	Yes	Yes
Observations	43352	58034

Note: This table shows the estimates of the coefficients ν and ξ using all the available observations. Robust standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. The F statistic of the first-stage regression reports the Kleibergen-Paap F statistic.

C.4. Alternative instruments

In the following we test variations of the baseline instrument. In the baseline specification, the instrument consists of financial market income, which includes the income from third-party securities plus dividend income from third-party securities minus the loss on third-party securities, and net nonoperating profits, which is the difference between nonoperating revenue and nonoperating expenses. The instrument is normalised with the total of all financial market and nonoperating transactions.

We test four instrument modifications. In Specification (1), financial write-downs are included in the instrument. Financial write-downs occur when the market value of an asset falls below its book value and it is evident that the market value will not recover the book value in the future. The write-down is the difference between the book value and the value a firm would receive from selling the asset. Thus, as for the other financial market variables contained in the baseline instrument, financial write-downs are determined by movements in financial markets and they can be assumed to affect the net worth of the single firm exogenously. However, this variable is omitted from the baseline specification because the firm has some scope to influence the level of the write-down and its timing. Therefore, this component may, in some cases, not be completely exogenous to firms' operating business.

Further, we estimate the sensitivity of the external finance premium when the instrument is split in two components. In Specification (2), the counter includes only financial market income, and in Specification (3), only net nonoperating profits. A further modification is tested with Specification (4), in which the instrument is normalized with firms' value added in the denominator.

The results are shown in Table C.6 for ν and in Table C.7 for ξ. The first-stage estimates show that the instrumental variable was robust to variations in its composition or to the normalisation method in all cases except for Specification (3), in which the counter included only nonoperating income. Apart from this specification, the instrument has the correct sign and is significantly correlated with the regressor and therefore relevant.

The results in Table C.6 show that the elasticity of the external finance premium to changes in the net-worth-to-capital ratio is relatively stable if the write-downs are added to the instrument or if the instrument variable is normalised differently. The splitting of the instrument shows that financial income has a stronger impact on the sensitivity of the finance premium than when it combined with non-operating profits.

The estimates of the elasticity of the credit spread listed in Table C.7 show that the estimates of ξ are robust to the inclusion of the write-downs and to the exclusion of the nonoperating income. However, ξ is not robust to the other modifications.

Table C.6: *IV-Estimates for ν using alternative instrument specifications*

Dependent variable	$r^k_{i,t} - r_t$			
	(1)	(2)	(3)	(4)
Instrument	Including write-downs	Including only financial income	Including only nonoper. income	Normalized with value added
Estimated coefficient	ν			
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.032**	0.059***	0.150	0.062***
	(0.013)	(0.007)	(0.313)	(0.019)
First stage				
Instrument	0.018***	0.087***	0.002	0.106***
	(0.003)	(0.007)	(0.004)	(0.027)
F test	29.27	155.29	0.24	15.25
Sector fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Firm size control	Yes	Yes	Yes	Yes
Observations	40,903	40,903	40,903	40,903

Note: This table lists the elasticity of the external finance premium to changes in the net-worth-to-capital ratio, ν, for the different instrument specifications. Robust standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The F statistic of the first-stage regression reports the Kleibergen–Paap F statistic.

Table C.7: *IV-Estimates for ξ using alternative instrument specifications*

Dependent variable	$z^k_{i,t} - r_t$			
	(1)	(2)	(3)	(4)
Instrument	Including write-downs	Including only financial income	Including only non-oper. income	Normalized with value added
Estimated coefficient	ξ			
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.015***	0.013***	0.018	0.006*
	(0.003)	(0.002)	(0.043)	(0.003)
First stage				
Instrument	0.018***	0.087***	0.002	0.106***
	(0.003)	(0.007)	(0.004)	(0.027)
F test	29.27	155.29	0.24	15.25
Sector fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Firm size control	Yes	Yes	Yes	Yes
Observations	40,903	40,903	40,903	40,903

Note: This table lists the elasticity of the credit spread to changes in the net-worth-to-capital ratio, ξ, for the different instrument specifications. Robust standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The F statistic of the first-stage regression reports the Kleibergen–Paap F statistic.

C.5. Marginal interest rate

We assume that interest rates that entrepreneurs pay on their loans in a given period depends on their net-worth-to-capital ratio in that same period. To analyse this, one should ideally use firm interest rates that are temporally congruent with their net worth ratio, meaning that one has data on firms' interest payments classified by the years in which the contracts were concluded. This information is, however, not available in our dataset. In the baseline specification, contractual interest rate $Z_{i,t}$ is measured by the ratio of firms' interest payments to their total outstanding debt. The average interest rate in period t therefore also includes the interest rates that are set at an earlier date, depending on the firm net-worth-to-capital ratio at that time. Thus, the average interest rate is not fully temporally congruent with the net worth ratio. Therefore, the estimated sensitivity using the average interest rate in the baseline specification must be seen as a lower bound.

We construct an alternative interest measure to better consider the temporal congruency. This 'marginal' interest rate proxies the interest rate on the additional debt taken out in period t and is defined as the change in interest payments over the change in debt. This measure has two caveats: First, this method excludes the new debt contracts that a firm concludes when it rolls over maturing loans. Second, only observations for which the change in debt and the interest payments are positive are considered. Doing so reduces greatly the number of observations and may cause a selection bias towards expanding firms. Nonetheless, this measure reveals insights into how high the sensitivity of the interest spread may be, when the temporal congruency is considered.

Specification (1) in Table C.8 shows the baseline estimates. Specification (2) lists the estimated sensitivity of the credit spread using the 'marginal' interest rate measure. As expected, the estimated sensitivity using spreads based on the 'marginal' interest rate is higher than that based on the average rate.

Table C.8: *IV-Estimates for ξ using the average and the marginal interest rates*

Dependent variable	Spread $z_{i,t} - r_t$ based on the	
	(1) Average interest rate	(2) Marginal interest rate
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.013^{***}	0.019^{***}
	(0.003)	(0.006)
First stage		
Instrument	0.021^{***}	0.034^{***}
	(0.003)	(0.006)
F test	38.83	33.95
Sector fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Firm size control	Yes	Yes
Observations	40903	12718

Note: This table shows the estimates of the coefficient ξ in Equation (6). Specification (1) is the baseline regression, which is estimated with a spread based on the average interest rate (total interest payments divided by outstanding debt). Specification (2) is estimated with a spread based on the 'marginal' interest rate (change in interest payments over the change in debt). Robust standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. The F statistic of the first-stage regression reports the Kleibergen–Paap F statistic.

C.6. Firm fixed effects

ν and ξ are structural parameters. Our interest focuses therefore on the variation of net worth across firms, in contrast to the variation within firms over time. Consequently, we estimate the baseline model controlling for sectoral and size differences that may influence the estimates. To test if our estimates are biased by any omitted time-invariant firm characteristics, we estimate equations 5 and 6 with firm fixed effects. The results are shown in Table C.9. The point estimates are somewhat larger than the baseline but qualitatively consistent: $\hat{\nu} = 0.068$ ($p = 0.083$) and $\hat{\xi} = 0.043$ ($p = 0.037$). The first-stage F-statistic is lower (5.44), reflecting the loss of cross-sectional variation when firm fixed effects are absorbed. Overall, the results indicate that the baseline estimates are not driven by unobserved time-invariant firm heterogeneity.

Table C.9: *IV–Estimates of ν and ξ, including firm fixed effects*

Dependent variable	$r^k_{i,t} - r_t$	$z_{i,t} - r_t$
Estimated coefficient	ν	ξ
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.068*	0.043**
	(0.039)	(0.021)
First stage		
Instrument	−0.005**	−0.005**
	(0.002)	(0.002)
F test	5.44	5.44
Firm fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Observations	37924	37924

Note: Robust standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The F statistic of the first-stage regression reports the Kleibergen–Paap rk Wald F statistic.

C.7. Heterogeneity across firm characteristics

To explore whether the strength of the balance sheet channel varies across firm types, we re-estimate the baseline IV specification separately for subsamples defined by firm size, the share of long-term debt in total capital, and capital intensity. Each split is at the sample median. Table C.10 reports the results.

Table C.10: *Heterogeneity of IV estimates across firm characteristics*

	Firm size (FTE)		Long-term debt share		Capital intensity (K/FTE)	
	Large	Small	High	Low	High	Low
	Panel A: External finance premium (ν)					
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.058^{***}	0.029^{*}	0.022	0.049^{***}	0.029^{***}	0.039^{*}
	(0.019)	(0.017)	(0.015)	(0.016)	(0.010)	(0.020)
	Panel B: Credit spread (ξ)					
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.014^{***}	0.012^{***}	0.007^{**}	0.017^{***}	0.013^{***}	0.014^{***}
	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.005)
Instrument	Non-operating profits (baseline)					
Sector FEs	Yes	Yes	Yes	Yes	Yes	Yes
Time FEs	Yes	Yes	Yes	Yes	Yes	Yes
Firm size control	Yes	Yes	Yes	Yes	Yes	Yes
KP F-statistic	20.1	18.0	16.0	25.3	26.5	14.2
Observations	20,451	20,452	17,602	23,301	20,451	20,452

Note: This table reports IV estimates of ν (Panel A) and ξ (Panel B) for subsamples defined by median splits on firm size (full-time equivalent employees), the share of long-term debt in total capital, and capital intensity (capital per employee). The instrument is lagged net non-operating and financial profits (baseline instrument). Robust standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

The estimated elasticity ν is somewhat larger for large firms (0.06) than for small firms (0.03), although both are statistically significant. The credit spread elasticity ξ is similar across size groups. Firms with a lower share of long-term debt exhibit a larger and more precisely estimated ν (0.05 versus 0.02), consistent with the idea that firms more reliant on short-term financing are more exposed to balance sheet fluctuations. Capital intensity does not generate a pronounced differential.

C.8. Alternative estimate of the financial premium

As the firm-level depreciation rates are quite erratic, we average the depreciation rate in the baseline specification over all the firms per year. We compute an alternative measure of $R^k_{i,t}$, in which the firm-level depreciation rates are aggregated at the sector level and the output elasticity of capital is estimated at sector level α_s.

The elasticity of ν estimated with the external finance premium, which is computed with this alternative estimate of the external finance premium, is listed in Table C.11, Specification (2) together with the baseline estimate. Both of the elasticities are very similar.

Table C.11: *IV–Estimates for ν using alternative measures of the external finance premium*

Dependent variable	$r^k_{i,t} - r_t$	
	(1)	(2)
	Baseline	$R^k_{i,t}$ computed with sectoral depreciation rates and α_s
Estimated coefficient	ν	
$[n_{i,t} - (q_{i,t-1} + k_{i,t})]$	0.043***	0.039***
	(0.013)	(0.010)
First stage		
Instrument	−0.021***	−0.022***
	(0.003)	(0.003)
F test	38.83	43.63
Sector fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Firm size control	Yes	Yes
Observations	40903	39177

Note: This table shows the estimates of coefficients ν from Equation (5) for the baseline specification and for an alternative measure of the external finance premium computed with the sector-level depreciation rates and the output elasticities of capital. Robust standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. The F statistic of the first-stage regression reports the Kleibergen–Paap F statistic.