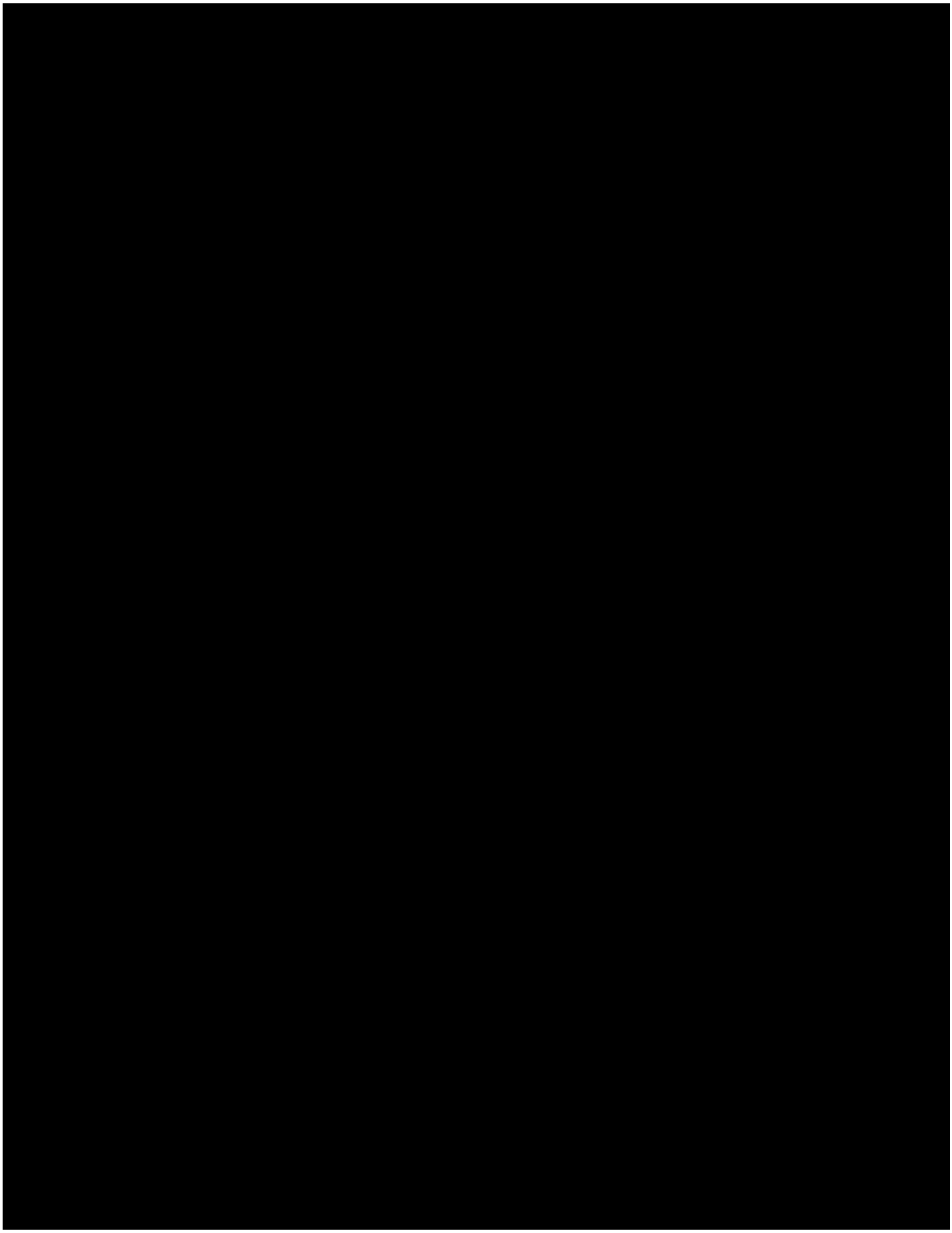

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Small and Vulnerable:

Small Firm Productivity in the Great Productivity Slowdown[1]

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Abstract

We provide broad-based evidence of a firm size premium of total factor productivity (TFP) growth in Europe after the Global Financial Crisis. The TFP growth of smaller firms was more adversely affected and diverged from their larger counterparts after the crisis. The impact was progressively larger for medium, small, and micro firms relative to large firms. It was also disproportionally larger for firms with limited credit market access. Moreover, smaller firms were less likely to have access to safer banks: those that were better capitalized banks and with a presence in the credit default swap market. Horseraces suggest that firm size may be a more important and robust vulnerability indicator than balance sheet characteristics. Our results imply that the tightening of credit market conditions during the crisis, coupled with limited credit market access especially among micro, small, and medium firms, may have contributed to the large and persistent drop in aggregate TFP.

JEL Classification Numbers: E22, G32, L11, O30, O47,

Keywords: Credit constraint, Financial crisis, Firm size, Intangibles, Producvitity, SMEs

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Contents

I. INTRODUCTION

The large and widespread productivity slowdown in Europe after the Global Financial Crisis (GFC) revitalized the empirical literature on drivers and obstacles of productivity growth. With persistently weak growth since the GFC and given the on-going adverse economic shock due to the COVID-19 pandemic, understanding the impact of crises on productivity growth has become even more urgent. With few exceptions, the literature so far has primarily focused on explaining the depth and scale of the productivity slowdown. A question that has so far received little attention is whether the productivity slowdown impacted firms unevenly and why This paper fills this gap.

We provide broad-based evidence showing that smaller firms are more adversely affected than their larger counterparts, with the impact progressively larger for medium, small, and micro firms relative to large firms, and disproportionally larger for firms with limited credit market access.[2] We further show that smaller firms were less likely to have banking relationships with stronger banks—better capitalized banks and banks with a presence in the credit default swap (CDS) market. Our results imply that smaller firms' limited credit market access, coupled with the tightening of credit market conditions during the crisis, may have contributed to the large and persistent drop in aggregate TFP after the GFC.

The credit market access explanation has an intuitive appeal because it connects two defining features of this episode of productivity slowdown. The first is the sharp and unanticipated tightening of credit supply in the aftermath of the collapse of Lehman Brothers. The second is the predominance of small and medium enterprises (SMEs) in many European countries. The link between tight credit supply conditions and limited credit market access is particularly relevant for SMEs for several reasons. These firms tend to be informationally opaque and dependent on bank financing (Gertler and Hubbard 1988; Custodio et al. 2013). SMEs are also more likely to be "marginal borrowers" who rely on small local banks (Stein 2002). They also tend to have fewer banking relationships and face higher obstables to establish new ones (Rajan 1992). To the extent that their banks cut down credit more aggressively when credit market conditions deteriorate, SMEs are more likely to lose access to credit.

We ask two main questions. Did smaller firms experience a larger decline in post-crisis TFP growth vis-à-vis their larger counterparts and if so, can their productivity slowdown be explained by ex-ante limited credit market access? To answer these questions, a major data challenge needs to be overcome. First, we need firm-level data with comprehensive coverage over the firm size distribution, especially for SMEs. Datasets that focus on publicly listed firms or underrepresent SMEs are unsuitable for this purpose. Second, the dataset needs to have detailed information on firm-level input and output so TFP can be accurately estimated. Third, the dataset also needs to have detailed firm-level financial information in order to control for different forms of financial vulnerabilities. Finally, we need bank-firm matched information in order to examine a firm's access to credit and to evaluate the strength of its creditors.

[2] Following Eurostat definition, micro, small, and medium-size enterprises are defined as firms with employees no more than 10, 50, and 250, respectively. Large firms are those with 250 or more employees.

We put together a comprehensive cross-country firm-level dataset by merging data from Orbis, AMADEUS and Fitch Connect (formerly Bankscope) . The final dataset contains detailed information on firm-level input, output, and balance sheet information. It also includes information on each firm's mainbank along with bank balance sheet information. For a subset of firms, we also have information on their annual patent applications from the Worldwide Patent Statistical Database (PATSTAT). Our final sample covers 8 European countries in the period before and after the GFC.

We start by showing that the post-crisis decline in within-firm TFP growth was significantly larger among smaller firms than their larger counterparts. We hereafter call this fact the firm size premium of post-crisis TFP growth. This premium is estimated within narrowly defined industry-country groups and persists even after controlling for shocks at the industry-country level. The result also holds after controlling for firm-level indicators of financial vulnerability and life cycle characteristics previously identified in the literature.

We then show that smaller firms that faced more severe tightening of credit conditions during the crisis experienced a larger TFP slowdown. Following Duval et al. (2019), the tightening of credit conditions is measured by the average CDS spread of banks in the firm's home country around the collapse of Lehman Brothers on September 15, 2008, or by the average CDS spread of the firm's main creditor banks during the same period.[3] The result is also robust to measures of credit supply tightening based on bank lending surveys. These results futher indicate that the firm size premium of post-crisis TFP growth was driven by an interaction between a tigher credit market conditions and small firms' vulnerabilities in the credit market.

Running horsesraces between firm size and firm-level indicators of balance sheet vulnerability, we find that firm size is an important factor for TFP vulnerability that is distinct from balance sheet characteristics. Moreover, the firm size effect strengthens when controlling for balance sheet characteristics whereas the effects of balance sheet characteristics weaken when controlling for firm size, which suggest that firm size may be a more important and robust vulnerability indicator.

Why are smaller firms more vulnerable to adverse credit supply shocks? While we do not attempt to provide a comprehensive answer to this question, we examine the credit access channel more closely. The strength of a firm's credit market access reflects the extent to which the firm has access to high quality lenders that can weather the crisis relatively well—an important mitigating factor for adverse credit conditions for the borrowers. We hypothesize that the firm size premium of post-crisis TFP growth is smaller for firms with stronger credit market access.

We examine two alternative measures for the strength of credit market access. The first is bank capitalization. When credit conditions tighten, banks experience a deteriation in their asset quality. Less capitalized banks face higher pressure to deleverage and cut back lending

[3] We focus on the period before and after the GFC because this is when a sample break in TFP growth seemed to have occurred (Figure 1). The latter part of our sample (2010-2011) also coincides with the European sovereign debt crisis. But the data do not show a clear break after the sovereign debt crisis, in contrast to the GFC in 2008.

via the traditional bank lending channel. The second is the bank's presence in the CDS market. The use of CDS presence as a proxy for creditor strength is motivated by extant evidence that CDS trading is associated with sounder fundamentals, higher financing capacity, and lower borrowing cost.[4] Consistent with our hypothesis, we find that the firm size premium of post-crisis TFP growth was mitigated by access to better capitalized banks and banks with CDS presence. We also find evidence on the extensive margin of credit market access: Smaller firms are less likely to have a relationship with better capitalized banks and banks with CDS presence. These results imply that improving creditor market access may help mitigate the negative effect of adverse financial conditions on small firm productivity.

The causal interpretation of these results hinges on several arguments. Because firm size is typically very persistent and the GFC was unforeseen,[5] firm size captures an ex ante firm-level vulnerability that is unlikely to be correlated with unobserved firm characteristics that may correlate with post-crisis TFP slowdown conditional on our extensive set of controls (including industry×country fixed effects, firm-level balance sheet vulnerability indicators, firm age, and the pre-crisis level of TFP).[6] We also confirm that the TFP of smaller firms did not on average grow at a slower rate than larger firm before the crisis. Furthermore, in a placebo test, we do not find evidence of the credit access channel operating in the post-2000 recession. The TFP growth of smaller firms did not decline more than their larger counterparts after the 2000 recession, nor did it depend on the strength of their creditor banks. This further collarobrates our interpretaiton that the small firms' credit market vulnerability was an impediment to post-GFC TFP growth.

The connection between firm size and credit market access is discussed in a large literature. In a seminal paper, Gertler and Gilchrist (1994) show that small firms accounts for a disproportionate share of manufacturing decline that follows tightening of monetary policy, consistent with the theoretical prediction that small firms have more limited capital market access. In subsequent workhorse models of credit market frictions over business cycles (e.g. Kiyotaki and Moore 1997; Bernanke, Gertler, and Gilchrist 1999), firm size proxies for credit market access, which captures smaller firms' lower collateral values, greater reliance on bank finance, smaller likelihood to issue debt publicly, and greater idiosyncratic risk, among other factors. A large empirical literature based on publicly listed firms has shown that external financing constraints are closely related to firm size. Firm size is a strong predictor of financing constraints in various settings and is a key input to commonly used financial constraints indices, including those based on structural estimations (e.g. the White and Wu (WW) (2006) index) and qualitative information from corporate financial statements (e.g. the

[4] CDS trading can increase financing capacity of the reference entity because it mitigates problems of limited commitment and asymmetric information. In the former, it reduces strategic default by enhancing creditor's bargaining power in ex-post renegotiations and (Bolton and Oehmke, 2011). In the latter, it mitigates the proverbial "lemon problem" by reducing asymmetric information on creditworthy borrowers. For a review of the theoretical and empirical literature, see Augustin et al (2014).

[5] In our data, firm size (measured by the log number of employees) is high persistent with an autocorrelation of 0.95.

[6] See Section III for a detailed discussion on the relationship between pre-crisis TFP level and post-crisis TFP growth.

Kaplan and Zingales (1997) (KZ) index and the Size and Age (SA) index by Hadlock and Pierce, 2010). A separate literature, using information from company registries or survey data, has shown that firm dynamics such as growth and investment are closely related to firm size. This literature has shown that smaller firms tend to grow faster and have different business cycle sensitivity from larger firms (Fort et al 2013). Combining census data on private firms with public data on listed firms, Dinlersoz et al. (2019) show that small private firms are the least leveraged, implying that their credit market access is most limited. Using a cross-country firm-level survey, Beck et al. (2005) show that the growth of small firms is more constrained than that of large firms by financial obstacles, such as the access to and cost of external financing.

These two literatures have their relative strengths and limitations. While the first literature draws on the rich information from publicly listed firms to test the direct link between a firm's size and its financial positions, it is silent on private firms that tend to be more externally financial dependent. In comparison, the second literature offers a more complete picture on firm dynamics cross the (close to) full distribution of firms. But it often lacks the necessary information to jointly examine a firm's financial positions and productivity. Futhermore, exant evidence on very small firms is very limited both due to the lack of comprehensive data on micro and small firms. Our paper complements and bridges these two strands of the literature by offering comprehensive evidence on the linkage between a firm's size, productivity, financial positions, and creditor relationship. Our results on micro and small firms also fill the gap in the empirical literature on the growth and financial positions of these very small firms.

A large literature also examines the linkage between financial frictions and producvitity. The theoretical literature shows that financial frictions—such as collateral constrains, financial market restrictions, and inefficient capital allocation—matter for aggreate productivity because they lead to distortions in entry, techonology adoption, and resource allocation (Buera and Shin, 2013, Midridian and Xu, 2014, Gopinath et al. 2017), slows down convergence to a new steady state after reforms (Moll, 2014). Our paper shares the same interest in exploring financial frictions channels of productivity growth, but our focus is on within-firm producivity growth rather than the allocation of resources across firms. Closer to our paper is the work by Aghion et al. (2010) who show theoretically how credit constraints can lead firms to cut research and development (R&D) during recessions. Using French firm-level data over the period 1993-2004, Aghion et al. (2012) finds supporting evidence that R&D investment of credit constrained firms plummets duirng recessions. Besides the sample difference, our paper differs from Aghion et al. (2012) by focusing on TFP growth rather than R&D investment.

The paper is also closely related to a growing literature since the GFC that examines how the crisis has affected firm-level outcomes. The bulk of this literature focuses on employment. Chodorow-Reich (2013) show that having a relationship with a weak bank negatively affected firm employment, with the effect concentrated on SMEs. Siemer (2019) shows that financial constraints reduced the employment of small firms more than large firms after the GFC. One paper that examines broader firm-level outcome is Huber (2018) who show that exposure to a larger bank's lending cut has large and persistent effects in firm output, capital, employment, and patenting for German firms. Most closely related to our work are Duval et al. (2019) who similarly examine drivers of productivity slowdown after the GFC. They

show that firms with high ex ante rollover risk experienced a larger decline in post-crisis TFP growth relative to firms with low ex ante rollover risk. Our results complements their findings in identifying firm size as an additional vulnerability to the crisis shock and in showing evidence on the role of credit market assess.

The rest of the paper is organized as follows. Section II describes data and measurement. Section III presents the empirical framework and results on small firm vulnerability. Section IV discusses the channels for small firm vulnerability. Section V presents additional results and robustness checks. Section VI concludes.

II. DATA AND MEASUREMENT

A. Data sources and sample

Our firm-level data source is the Orbis historical database, put together by merging historical vintages of the Orbis database from Bureau van Dijk.[7] Orbis is the largest cross-country firm-level database with rich information on the financial accounts and productive activities (e.g. output, capital stock, and employment) for both public and private firms. The data are collected from variout sources including national company registries and harmonized into an internationally comparable format.

For bank-firm relationship, we use the BANKER variable in the AMADEUS dataset. This variable lists up to five most important creditor banks for each firm.[8] This information has been used by Giannetti and Ongena (2012), Kalemli-Özcan et al. (2015), Barbiero et al. (2016) and Duval et al. (2019) to study bank-firm relationship. As these prior studies, we use this variable from one vintage of the data (2015), relying on the assumption that bank-firm relationships are sticky and do not significantly change over short periods of time (Giannetti and Ongena 2012, Kalemli-Özcan et al. 2015).

For firms in the database we match each creditor bank identified in AMADEUS, using bank name, with the corresponding bank balance sheet data from the Fitch Connect (formerly Bankscope) database using bank name. There is no standardized procedure to match banks in AMADEUS and Fitch Connect. We use a probabilistic record linkage algorithm to match banks names from the two datasets.[9] We match 74 percent of all bank names in our sample.

Our final sample includes 8 countries: Denmark, France, Germany, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. These countries are selected based on two criteria. First, there was no significant change in the coverage of firms over our sample period as

[7] See Gal (2013) and Kalemli-Özcan et al (2019) for detailed descriptions on the Orbis vintages.

[8] The original source of the information is Kompass, which provides company directory in more than 70 countries. Kompass collects data from firm registries, chambers of commers, and phone interviews with firm prepresentatives. Firms can also voluntarily register with the Kompass directory.

[9] The matching is implemented by Stata's *reclink2* package. Kalemli-Özcan et al. (2020) similarly use name matching to merge KOMPASS and BANKSCOPE databases.

compared to Eurostat SBS and summarized in Appendix Figure A1.[10] Second, data on banking relationship information is available. We do not include countries for which the BANKER variable is missing for all firms in the country. The coverage of the Orbis sample compared to official aggregate statistics is extensive. Gross output and employment covered in the sample represents on averege above 60 percent of aggregate output and employment in Eurostat Structural Business Statistics (SBS) in France, Portugal, and Spain; between 30 and 50 percent in Denmarke, Germany, and Sweden. The coverage in Netherlands is lower (between 15 and 20 percent) but stable.[11]

For this final sample, we follow Gal (2013) to construct and clean the firm-level data. Specifically, the following procedure is taken to ensure the consistency and comparability of variables across countries and over time. All nominal variables recorded in U.S. dollars in the orginal dataset are converted to local currency. They are then deflated using local currency deflators from the OECD Structural Analysis Database (STAN) and converted to 2005 U.S. dollars using country-industry purchasing power parity exchange rate from Inklaar et al (2005). We drop financial firms and government-owned firms and keep firms in all other sectors. We only keep firms that continously exist over our sample period (4 year before and after the GFC). This sample restriction ensures that pre- and post-crisis TFP growths are measured in the same time period for all firms, thus avoiding contaminating our results with sample attrition. However, by excluding firms that entered and exited during our sample period, our results may not be directly used to infer the effect of the crisis on aggregate TFP.[12]

B. Measuring productivity

We estimate firm-level productivity following the approach proposed by Wooldridge (2009). This is a one-step efficient generalized method of moments (GMM) procedure to estimate production functions. This approach builds on the traditional control function approach, which addresses the key challenge in production function estimation: potential simultaneity bias stemming from the fact that a firm observes productivity and chooses its input while the econometrician does not observe productivity.[13] Specifically, we estimate the following production function using all firms in each industry×country group:

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[10] The reason to restrict to countries with stable data coverage is to avoid sample attrition. If, for example, small firms are more likely to be added in the post-crisis period, then our results will be biased. For all our sample countries, the change in annual coverage does not exceed 15 percent compared to Eurostat SBS during the sample period. The only exception is a large increase in coverage in Portugal between 2005-2006. To minimize the potential effect of this sample break for our estimation, we exclude Portuguese firms in 2005 from our sample.

[11] Our sample coverage is also comparable to the sample of manufacturing firms in Kalemli-Özcan et al (2019). Compare, for example, Appendix Figure A1 Panels C and D with Kalemli-Özcan et al (2019) Table D.1.3.

[12] In results not reported, we obtain statistically significant results on the firm size premium when we loosen the sample restriction that firms continously exist over our sample period. The point estimates of firm size premium using this extended sample is larger than the baseline results, implying that smaller firms that were affected more by the crisis were more likely to exit.

[13] Compared to previous two-step approaches (e.g. Olley and Pakes, 1996; Levinsohn and Petrin, 2003), the Wooldridge (2009) approach addresses the problem in identifying the variable input (e.g. labor) coefficient as

(continued…)

$$y_{ijct} = a_{ijct} + \beta_{kj} \times k_{ijct} + \beta_{lj} \times l_{ijct-1} + \varepsilon_{ijct}, \quad (1)$$

where *i*, *j*, *c*, and *t* index firm, industry, country, and time respectively. *y*, *k*, and *l* are the natural logarithm of value-added output, physical capital stock, and the number of employees, respectively. a is TFP (in natural logarithm). Output and physical capital stock are expressed in real terms using country-industry level price deflators.[14] The industry-level elasticities β_{kj} and β_{lj} are estimated using the Wooldridge (2009) procedure. Using estimation results from (1), firm-level TFP is calculated as:

$$a_{ijct} = y_{ijct} - \hat{\beta}_{ks} \times k_{ijct} - \hat{\beta}_{ls} \times l_{ijct-1},$$

where $\hat{\beta}_{ks}$ and $\hat{\beta}_{ls}$ are the estimated coefficients. TFP growth at time *t* is calculated as $a_{ijct} - a_{ijct-1}$ (i.e. log difference in TFP).

III. SMALL FIRM VULNERABILITY AND PRODUCTIVITY GROWTH

A. Empirical framework

We use a differences-in-differences model to compare the pre- and post-crisis difference in TFP growth across firms of different sizes. We estimate the following baseline regression:

$$\Delta TFPgrowth_{ijc} = \alpha_{jc} + \beta Size_i + \gamma X_i + \varepsilon_{ijc}, \quad (2)$$

where *i*, *j*, and *c* index firm, industry, and country respectively. $\Delta TFPgrowth$ is the difference in average TFP growth between the pre- (2004-2007) and post-crisis (2008-2011) periods. The advantage of comparing the average pre- and post-crisis TFP growth is that it allows for a sluggish TFP response. A similar approach has been used to study the role of balance sheet vulnerability on employment (Chodorow-Reich 2013) and TFP growth (Duval et al. 2019), and the role of household housing wealth on employment (Mian and Sufi 2014).

Our main variable of interest is firm size ($Size_i$) measured by employment in the pre-crisis period. The choice to use employment to measure firm size is motivated by theoretical models of firm dynamics based on labor hiring and retention decisions that ultimately determine firm size (Burdett and Mortensen 1999, Moscarini and Postel-Vinay 2010). This theoretical framework is quite general because most extant theories on firm productivity predict a high correlation between employment, capital, output, and assets. Empirically, one advantage of the employment measure is that it is less prone to mismeasurement and does not depend on pricing data and valuation methods, unlike monetary variables. Using the employment measure also has the practical advantage of being aligned with firm

shown in Ackerberg et al. (2015). Robust standard errors are also easier to obtain with the one-step approach compared to previous approaches.

[14] Country-industry level price deflators has also been used Gopinath et al. (2017) and Duval et al. (2019), among others because firm-level prices are not observed. As a result, our TFP measure does not reflect within sector price variations.

classifications in many European regulations.[15] As such, our results can potentially be mapped to corresponding aggregate statistics to offer direct policy implications. In all specifications, we report estimates for two alternative measures (1) the number of employees (in natural logarithm) and (2) dummy variables for micro, small, and medium-sized firms respectively. These dummies allow us to directly compare micro, small, and medium-sized firms relative to large firms. We follow the Eurostat definition and define micro, small, and medium-size enterprises for firms with employees no more than 10, 50, and 250, respectively. Large firms are those with 250 or more employees. Estimates for the two alternative measures complement each other with the former capturing the average firm size premium over the full distribution of employment and the latter reflecting the average difference between micro (respectively small and medium) firms relative to large firms.

Our main coefficient of interest is β, which captures the firm size premium on post-crisis TFP growth decline. If smaller firms experienced a larger drop in post-crisis TFP growth relative to the pre-crisis growth vis-à-vis their larger counterpart, we expect β to be positive for the log number of employees and negative for the micro, small, and medium-sized firm dummies.

We include a vector of firm-level characteristics X_i, which controls for drivers of TFP growth identified in the literature: life-cycle characteristics (measured by firm age, including linear and quadratic terms), balance sheet vulnerabilities, including debt maturity (which captures rollover risk and is measured by the current liabilities to sales ratio), leverage (measured by total liability as a share of total assets), and liquidity (measured as cash as a share of total assets). We also control for earnings (measured by the natural logarithm of EBITDA) and the level of pre-crisis TFP. Controllig for pre-crisis TFP addresses the potential concern that post-crisis growth may be related to the pre-crisis level.[16]

We include fixed effects at the four-digit-industry×country level. These fixed effects are important because the literature has extablished systemic differences across industries in financial dependence (Rajan and Zingales 1998) and exposure to shocks in trade (Alcala and Ciccone 2004) that may potentially affect productivity. By including fixed effects at the industry×country level, we are able to rule out such channels. We cluster standard errors at the industry×country level.

Our identification assumption is that conditional on these controls, any remaining variation associated with the post-GFC TFP does not vary systematically with pre-crisis firm size. In other words, the supply or demand conditions of a smaller firm did not decline more than those

[15] For example, in France, the legislative burden of firms substantially increases for firms with 50 or more employees, including creating a works council (comité d'entreprise), establishing a health and safety committee, and filing employee reports to the Ministry of Labor, and so on. In Portugal, firms with 20 or more employees face more a lengthy and complex procedure to fire a worker than firms with fewer than 20 employees.

[16] The correlation between the level and growth of TFP may be due to productivity convergence when firms that were less productive before the crisis gradually catch up regardles of the crisis, which will lead to a negative correlation between post-crisis growth and pre-crisis level. It is also possible that firms that were more productive before the crisis continues to grow faster due to momentums in productivity, which leads to a possitive correlation between post-crisis growth and pre-crisis level. Andrew et al. (2016) find an expanding productivity gap between "frontier" (high productivity) and "laggard" (low productivity) firms, consistent with the momentum effect.

of its larger counterpart within the same industry and country. Similar assumptions on industry-country level conditions have been used in Duval et al (2019) and Kalemli-Özcan et al. (2020). We think this is a reasonable assumption as firms likely face similar demand shocks within our narrowly defined industries. Under this assumption, equation (1) can be interpreted as identifying the firm size premium of post-crisis TFP growth.

To sharpen the identification of the impact of tighter credit conditions on TFP growth, we exploit cross-country variations in the magnitude of the credit supply shock following the collapse of Lehman Brothers on September 15, 2008. This credit supply shock was arguably unforeseen from the firm's perspective and plausibly exogenous to pre-crisis firm size. If smaller firms are more vulnerable to the shock, we should expect the firm size premium on post-crisis TFP growth to be larger in countries where credit conditions tightened more. We test this hypothesis with the following regression:

$$\Delta TFPgrowth_{ijc} = \alpha_{jc} + \beta_1 Size_i + \beta_2 Size_i \times \Delta CDS_c + \gamma X_i + \varepsilon_{ijc}, \quad (3)$$

where ΔCDS_c is the change in the average CDS spread of domestic banks in country c between September 7 and September 28, 2008 (i.e. 7 days before and after the collapse of Lehman Brothers).[17] Changes in CDS spread during this period has been used in the literature to proxy for the degree of credit supply shock (Duval et al. 2020). It captures perceived vulnerabilities of the banks as they tried to protect themselves against the defaults of other banks following Lehman Brothers. Banks whose CDS spread rose more during this period tended to suffer a larger loss in bank capital and have more difficulty in obtaining funding in the interbank market (Afonso et al. 2011; Brunnermeier 2009). These capital and funding shocks to banks were reflected in tighter credit conditions via a traditional bank lending channel. Under the assumption that firms heavily rely on home country banks, the average changes in domestic banks' CDS spread proxy for the degree of tightening in aggregate credit condition faced by domestic firms. This seems a reasonable assumption because our sample of European countries are dominated by SMEs that typically do not have access to foreign banks or non-banking financial markets such as corporate bonds or syndicated loans. The reason for measuring changes in CDS spread in a tight 2-week window around the collapse of Lehman Brothers is that they plausibly reflect credit supply rather than credit demand conditions. Because the real effect of the Lehman Brothers collapse had not materialized over this tight window, we can also rule out effects due to a firm-bank feedback loop.

To further sharpen the identification of specification (3), we replace the change in the average CDS spread in the firm's home country with the change in the average CDS spread of the firm's main creditor banks. This specification exploits variations in bank-firm relationship and allows us to rule out confounding factors that may be correlated with average change in CDS spread at the country level. For measures at the country level and the firm level, we standardize the change in CDS spread to have mean zero and unit standard deviation. This standardization allows us to interpret the coefficient as the effect of tighter credit supply condition on the TFP growth of the average firm in the average country. As we

[17] Our data source is 5-year CDS spread from the Markit database. CDS spread is expressed in units of basis points.

will show in Section IV, we investigate the robustness of our results to alternative measures of credit conditions.

B. Results on firm size premium

Table 1 shows descriptive statistics. The average pre-crisis TFP growth rate was 3 percent for the full sample of firms. It dropped by 5 percentage points, reaching -2 percent post-crisis. The mean and median of the number of employees are 26 and 7 respectively. Thus, most firms in our sample are micro or small enterprises. The mean age of firms is 19 years. There are substantial variations in firm age as well as balance sheet variables.

Figure 1 shows the path of TFP growth for SMEs and large firms in our sample. Before the crisis, TFP growth for SMEs was as strong as that for large firms. After the crisis, their trajectories diverged. The TFP of SMEs experienced a large and persistent drop whereas the TFP of large firms had a smaller decline in 2009 and was close to the pre-crisis trend in subsequent years. The crisis generated a large TFP gap between SMEs and large firms which persisted until at least 2015.[18]

Table 2 shows our benchmark results for specification (2). Column 1 shows the result on pre-crisis firm size without controlling for firm age and balance sheet variables. Column 2 controls for the linear and quadratic terms of firm age to account for life cycle effects. Column 3 controls for balance sheet variables. Column 4 jointly controls for life cycle and balance sheet variables. All columns control for four-digit-industry×country fixed effects.

Column 1 shows a significantly positive coefficient on the log number of employees (hereafter employment), indicating that smaller firms experienced a larger drop in post-crisis TFP growth vis-à-vis their larger counterparts. This result confirms the overall impression from Figure 1 and shows that the firm size premium carries over to narrowly defined industry×country groups. The result is robust to controlling for the firm's life cycle and balance sheet characteristics. Column 3 shows that a firm's post-crisis TFP growth is on average 2.4 percentage points lower than its counterpart with about 170 percent more employees (corresponding to a one-unit increase in the log number of employees). This effect is economically large considering TFP growth drop by 5 percentage points for the average firm (Table 1). Taking into account the variations of employment and TFP growth, our result suggests that a one standard deviation decrease in employment (1.27 units of log number of employees) accounts for 18 percent of a standard deviation in the drop in post-crisis TFP growth.

Estimates for the medium-sized, small, and micro firm dummies show consistent results (columns 4-6). All three dummies are significantly negative, indicating a larger drop in post-crisis TFP growth for these firms relative to larger firms. Notably, the point estimates for medium-sized, small, and micro firm dummies gets progressively more negative (with their differences statically significant), indicating that micro firms experienced the largest TFP

[18] The magnitude of TFP growth in our sample is comparable to aggregate statistics. For example, according EU KLEMS, the average annual TFP growth was 0.5, 0.3, and -0.4 percent in 2002-2007 for EU-12 countries, France, and Spain, respectively. It is and -1, -0.9, and -0.4 percent in 2008-2011 for EU-12 countries, France, and Spain, respectively. French and Spanish firms are overrepresented in our sample.

drop, followed by small and medium-sized firm while large firms experienced the smallest decline. Column 6 suggests that the average decline in post-crisis TFP growth of medium-sized, small, and micro firms were respectively 1.4, 3,1 and 5.6 percentage points lower than that of large firms. These results therefore indicate that the firm size premium is broad-based, and the results found in columns 1-3 are unlikely to be driven by a small subset of firms in the firm size distribution.

Our control variables have the expected signs. We find that conditional on pre-crisis TFP level, firm age enters negatively, suggesting that younger firms on average have higher post-crisis TFP growth than older firms. In addition, firms with more debt maturing in 2008 and firms with higher leverage and higher liquidity have lower post-crisis TFP growth, indicating that TFP growth was negatively affected roll over risk and deb overhang (Duval et al. 2019). Liquidity enters with a negative sign, consistent with the notion that more financially vulnerable firms save more cash due to a precautionary motive (Opler et al. 1999). The cash saving can fund investment, especially intangible investment, during crisis times to support productivity (Falato and Sim 2014). We will come back to the issue of intangible investment in the next section.

Table 3 shows results for the extended specification (3). The results confirm the role of tighter credit conditions on post-crisis TPF slowdown. The coefficient for the interaction of employment and change in bank CDS spread are significantly and robustly positive, indicating that smaller firms experience a larger drop in TFP growth vis-à-vis their larger counterparts in countries where credit conditions tightened more. The results are also economically significant. Column 3 suggests that in a country that experienced an average increase in bank CDS spread in our sample (21 basis points), a one-unit decrease in the log number of employees was associated with a 0.9 percentage point drop in post-crisis TFP. In a country where the increase in CDS spread was one-standard deviation (7.9 basis points) higher than the average country, the corresponding decline associated with a one-unit decrease in the log number of employees was 2.4 percentage points. Estimates for the medium-sized, small, and micro firm dummies and their interactions with change in bank CDS spread again yield consistent results. The interaction terms are significantly negative and get progressively larger for medium-sized, small, and micro firms, indicating that the credit supply shock (measured by changes in bank CDS spread) have progressively larger effects on medium-sized, small, and micro firms. For example, in a country where the increase in CDS spread was one-standard deviation higher than the average country, the average decline in post-crisis TFP growth for medium-sized, small, and micro firms were respectively 0.9, 2.1, and 2.8 percentage points lower than that of large firms (column 6).

Table 4 reports results where we replace the change of average CDS spread of domestic banks with the change of average CDS spread of the firm's creditor banks. Compared to regressions using aggregate CDS information, using firm-level CDS information leads to a large reduction of sample. Nevertheless, we obtained quantitatively similar results. Column 3 suggests that a one-unit decrease in the log number of employees was associated with a 1.3 percentage point drop in post-crisis TFP for a firm whose creditor banks had an average exposure to Lehman Brothers (measured by average changes in the creditor bank's CDS spread). The corresponding decline associated with a one-unit decrease in the log number of employees was 3.2 percentage points for a firm whose creditor banks experienced an increase in CDS spread one standard deviation higher than the average. With the same increase in

CDS spread, column 6 suggests that the average decline in post-crisis TFP growth of medium-sized, small, and micro firms were respectively 0.3, 1.9 and 6.1 percentage points lower than that of large firms.

IV. CHANNELS FOR SMALL FIRM VULNERABILITY

A. Credit market access of small firms

Why are smaller firms more vulnerable to adverse credit supply shocks? In this section, we provide evidence consistent with the credit access channel. Having high quality lenders that can weather the crisis relatively well is an important mitigating factor for adverse credit conditions for the borrowers. The literature has shown that capital was a driver of bank performance during the crisis (Berger and Bouwman 2013, Beltratti and Stulz 2012). Banks with high capitalization before the crisis were better able to maintain credit supply during the crisis (Kapan and Minoiu 2018). We hypothesize that the firm size premium of post-crisis TFP growth is smaller for firms with better capitalized creditor banks. We estimate the following regression:

$$\Delta TFPgrowth_{ijc} = \alpha_{jc} + \beta_1 Size_i + \beta_2 Size_i \times BankCapital_b + \gamma X_i + \varepsilon_{ijc}, \qquad (4)$$

where $BankCapital_b$ is a dummy variable that takes a value of 1 if the average pre-crisis regulatory Tier 1 capital (in percentage of Risk-Weighted Assets) of a firm's credit banks is above the median. Exploring the credit strength channel comes at the cost of a reduction in sample size due to the data availability of banking relationship and bank capitalization. Nevertheless, results from this smaller sample can usefully complement those of equation (3) by showing the direct link from creditor strengthen to firms' TFP growth. They can also offer additional evidence on firm's whose creditor banks are not traded in the CDS market. We include the same set of controls as in equation (2).

Table 5 shows results for specification (4). The coefficient for the interaction of employment and bank capitalization is significantly and robustly negative. This implies that the firm size premium found in the benchmark specification (2) is smaller for firms with better capitalized credit banks. Column 3 suggests that among firms whose creditor banks' capitalization was above the median, a one-unit decrease in the log number of employees was associated with a 1-percentage-point drop in post-crisis TFP growth. Among firms with creditor banks whose capitalization was below the median, the corresponding decline associated with a one-unit decrease in the log number of employees was 2.7 percentage point. Estimates using the medium-sized, small, and micro firm dummies also indicate that having access to better capitalized banks improved post-crisis TFP growth of these firms relative to large firms. This effect seems strongest for small firms. For micro and medium-sized firms, the point estimates of the effect are consistently positive, but they are not statistically significant.

We further examine access to banks with presence in the CDS market. To the extent that banks traded on the CDS market are larger and have stronger fundamentals, a bank's presence in the CDS proxies for bank strength and (a less negative) credit supply shock. We estimate the following regression:

$$\Delta TFPgrowth_{ijc} = \alpha_{jc} + \beta_1 Size_i + \beta_2 Size_i \times CDSpresence_i + \gamma X_i + \varepsilon_{ijc}, \qquad (5)$$

where $CDSpresence_i$ is a dummy variable that takes a value of 1 if at least one of the firm's creditor banks was traded in the CDS market in the pre-crisis period—defined if it is the reference entity of a single-name CDS. As in (4), we include the same set of controls as in equation (2).

Having access to creditor banks traded in the CDS market also reduces the firm size premium of post-crisis TFP growth, similar to having access to better capitalized banks. Table 6 shows a significant and robust effect of creditor banks with CDS presence. Column 3 suggests that among firms whose creditor banks with CDS presence, a one-unit decrease in the log number of employees was associated with a 3.3-percentage-point drop in post-crisis TFP. Among firms whose creditor banks are without CDS presence, the corresponding decline associated with a one-unit decrease in the log number of employees was 2.6 percentage point. Estimates for the medium-sized, small, and micro firm dummies and their interactions with CDS presence again yield consistent results. The effect of creditor access is progressively larger for medium-sized, small, and micro firms. Column 6 shows that having access to banks with CDS presence reduces the post-crisis TFP growth decline from 1.9 to 1.3 percentage points, from 4.2 to 2.6 percentage points, and from 7 to 5 percentage point for medium-sized, small, and micro firms respectively.

To recap, our results so far use different cuts of the sample (full sample, firms whose creditor banks' balance sheet data are available, or firms whose credit banks have CDS presence). They also captures variations on different margins (the intensive margin within bank capitalization and with in CDS spread, and the extensive margin of creditor access). The consistency and robustness of these results give us confidence that the firm size premium of post-crisis TFP growth was driven by an interaction between a negative credit supply shock and small firm vulnerabilities in the credit market.

As we have discussed, having access to stronger creditor banks is a mitigating factor to adverse credit conditions. To examine this extensive margin specifically, we ask whether smaller firms are less likely to have stronger creditor banks. We estimate the following regression:

$$CreditAccess_i = \alpha_{jc} + \beta Size_i + \gamma X_i + \varepsilon_{ijc}, \quad (6)$$

where $CreditAccess_i$ is the dummy variable $BankCapital_b$ if as defined in equation (4) of the dummy variable $CDSpresence_i$ as defined in equation (5). We hypothesize that small firms are less likely to have a relationship with stronger creditor banks—proxied by banks with high capitalization or traded in the CDS market. We expect the coefficient for firm size β to be positive for the employment measure and negative for the micro, small, and medium-sized firm dummies.

We estimate equation (6) with a logistic model. Table 7 and 8 report the results for the two measures of creditor access respectively. Consistent with our hypothesis, firm size is significantly positively associated with the likelihood of a relationship with better-capitalized creditor banks and banks traded in the CDS market. Table 7 column 3 shows that a one-unit increase in the log number of employees is associated with a 29 percentage points increase in the likelihood of having access to a high-capitalized bank. This difference is economically significant and explains 110 percent of the standard deviation in the likelihood of high

capitalization. Column 6 shows that micro firms are significantly less likely to have access to better capitalized banks. The magnitude is substantial and implies an 84 percent lower likelihood. For small and medium-sized firms, the point estimates of the likelihood are also negative (at 43 and 5 percent) although they lose statistical significance.

Table 8 column 3 shows that a one-unit increase in the log number of employees is associated with a 7 percentage points increase in the likelihood of having access to a bank with CDS presence, which explains 16 percent of a standard deviation in the likelihood of CDS presence. Column 6 shows that micro, small, and medium-sized firms are also significantly likely to have access to a bank with CDS presence than larger firm. Their likelihoods are 49, 45, and 19 percentage points lower respectively.

B. Intangible capital

We futher explore the role of intangible capital in the link between small firms' credit market vulnerability and TFP growth. Following the seminar work of Corrado et al. (2005), a growing literature has argued that intangible capital is an important input to production. Investment in intangible capital—such as research and development, advertisement (e.g. to sustain brand recognition), and training (e.g. to development firm-specific human capital)—is a critical driver for TFP growth. Investment in intangible capital also has implications for TFP growth during crisis times. To the extent that firms rely on external resources to finance investment, tightening of credit conditions has a more negative effect on the intangible investment of firms that are more credit constrained (Aghion et al. 2007, 2010). Consistent with this notion, we hypothesize that smaller firms cut intangible investment more than their larger counterparts, which contributes to their lower post-crisis TFP growth. To test this hypothesis, we estimate the following regression:

$$\Delta Intangible_{ijc} = \alpha_{jc} + \beta Size_i + \gamma X_i + \varepsilon_{ijc},$$

where the dependent variable is the change and intangible investment rate or the change in the share of intangible assets. We measure intangible investment rate as the change in the stock of intangible assets divided by value added. This definition is in the spirit of investment rate expressed as a share of GDP in national accounts, capturing the flow of intangible asset relative to output. We measure the share of intangible assets as the stock of intangible assets divided by the sum of physical and intangible assets. We include the same set of controls as the baseline specification (2). We also control for the level of pre-crisis intangible investment rate in the regression with the change of intangible invstment rate as dependent variable (and similarly for the regression with the change of intangible assets share as dependent variable). This control addresses the potential concern that post-crisis change in intangible investment rate or intangible asset share may be related to pre-crisis level.

Table 9 and 10 report the results with changes in intangible investment rate and intangible asset share as dependent variable respectively. Consistent with our hypothesis, smaller firms cut intangible investment and reduce the share of intangible assets more than their larger counterparts. The estimates show that a firm's post-crisis intangible investment rate is on average 0.1 percentage points lower and its intangible share is on average 0.4 percentage points lower than its counterpart with about 170 percent more employees (corresponding to a one-unit increase in the log number of employees). The reduction in intangibles are also large

for medium-size, small, and micro firms relative to large firms, with their intangible investment rate lower by 0.3, 0.7, and 0.8 percentage points respectively.

We also examine patent applications. To the extent that intangible investment—especially research and development—results in patentable innovations, patent applications proxy for innovation output. Our primary data for patent application is the Worldwide Patent Statistical Database (PATSTAT) maintained by the European Patent Office (EPO). PATSTAT is the most comprehensive cross-country patent database, containing bibliographic data of patents from 90 patent issuing authorities, covering close to the population of all patents worldwide. We match applicant firms from PATSTA to the Orbis dataset using firm-patent match provided by Bureau van Dijk.

We report the results in Table 11. We find that smaller firms reduce patent applications more than their larger counterparts. The coefficient on employment is significantly positive in all specifications. Column 3 suggests that a one unit decrease in the log of employees is associated with a reduction of one patent application in the post-crisis period. Column 6 suggest that in the post-crisis period, micro, small, and medium-size firms on average reduce 2.2, 1.9, and 1.8 patent applications per year respectively relative to large firms. These differences are economically substantial considering the number of patent applications in our sample of firms is 2 per year.

V. DISCUSSION AND ROBUSTNESS

A. Placebo tests

To confirm that our results reflect the effects of credit supply shock following the GFC, we run a placebo test in which we estimate TFP growth differentials between smaller and larger firms during the recession following the bust of the dot-com bubble in 2000. Because the recession in 2000 was not associated with a negative credit supply shock, we should not find the TFP growth differentials between smaller and larger firms over this period to vary with creditor strength. Specifically, we rerun regression (4) but replace the years pre- and post-2009 years pre- and post-2000. We focus on bank capitalization because CDS data was limited for this period.[19] Table 12 confirms that TFP growth following the 2000 recession was not associated with firm size and its interaction with the capitalization of the firm's creditor banks.

B. Size versus balance sheet vulnerabilities

We have shown that the post-crisis TFP growth of smaller firms was lower vis-à-vis their larger counter parts. Smaller firms also tend to be younger and have weaker balance sheets—factors also relevant for credit market access. Can firm age and balance sheet characteristics explain the firm size effect, and vice versa? To answer this question, we first note that all our results so far control for age and balance sheet characteristics, so the firm size premium we found exists after these controls. We further run horseraces of these factors to compare their relative importance.

[19] We are also only able to include firms in five countries in this test: France, Germany, Netherlands, Spain, and the United Kingdom due to data availability.

Table 13 reports the results. We find that the firm size effect strengthens when controlling for balance sheet characteristics whereas the effects of balance sheet characteristics weaken when controlling for firm size. For example, a one unit decrease in the log number of employees is associated with a higher post-crisis TFP growth of 0.8 percentage point without the controls (column 1) and 2.4 percentage points with the controls (column 3). In contrast, the effects of balance sheet vulnerability all weaken. For leverage, the point estimate diminishes by 32 percent. For debt maturity and liquidity, the point estimates drop by about 90 percent and lose statistical significance once we control for firm size. We obtain similar results with the horserace between medium, small, and micro firm dummies and the controls (columns 4-6). Including the controls increases the absolute values of the point estimates for medium, small, and micro firm dummies, whereas controlling for firm size decreases the point estimates of leverage, debt maturity, and liquidity by 12, 30, and 49 percent respectively. For firm age, the effect remains significant in all specifications. It is slightly stronger with the firm size control than without the control.

We obtain similar horserace results using the extended specification incorporating exposure to the collapse of Lehman Brothers (Table 14). As before, the interaction of change in CDS spread and firm size (or balance sheet indicators) captures the TFP growth differential between more vulnerable and less vulnerable firms in countries where credit conditions tightened more. Comparing interaction terms across the specifications again shows that the firm size effect strengthens when controlling for balance sheet characteristics whereas the effects of balance sheet characteristics weaken when controlling for firm size.[20] Overall, the results in Table 13 and 14 imply that firm size is an important factor for TFP vulnerability that is distinct from balance sheet characteristics. The firm size effect can partially explain the unconditional result that firms with weaker balance sheets are more vulnerable.

C. Robustness

We now preceed with robustness checks to our baseline results. We first explore robustness to measures of creditor strength. We only use the top bank (the first bank in AMADEUS's Banker variable) instead of taking averages of the firm's main creditor banks. Our obtain very similar results as before (Appendix Tables A1-A2).

We explore the robustness to measures of credit conditions. We use the euro area bank lending survey (BLS) by the European Central Bank to measure credit supply conditions. The BLS is addressed to senior loan officers of a representative sample of banks. We use the survey response on changes on credit standards as a measure for credit conditions. Credit standards are the internal guidelines or loan approval criteria of a bank and are applied before a loan application is approved and loan terms are negotiated. Higher credit standards thus reflect a tighter credit supply. Compared to the CDS spread measure, one advantage of the BLS measure is that it separates loan supply factors from loan demand factors. Thus we can reasonably rule out demand-side counfounding factors and the bank-firm feedback loop. Furthermore, the BLS distinguishes corporate credit from household credit, allowing us to focus on credit conditions for firms. Since the BLS is available at the quarterly frequency, we use changes in the the loan supply conditions in the last quarter of 2008 to measure the crisis

[20] The only exception is that the leverage effect remains unchanged when controlling for the log of employment.

shock.[21] In comparison, the CDS spread data are available daily. As we discussed earlier, this allows us to measure changes in credit condition over a very tight window as a way to rule out demand factors and bank-firm feedback loop. Because of these relative advantages of the BLS and CDS data, we view these two measures as complementary to each other.

The results with BLS measure confirm the role of tighter credit conditions (Appendix Table A3).[22] The coefficient for the interaction of employment and credit tightening are significantly and robustly positive. The results are also economically significant. Column 3 suggests that in a country that experienced an average tightening of credit conditions in our sample (with credit conditions tightened in 72 percent of the banks), a one-unit decrease in the log number of employees was associated with a 2.5 percentage point drop in post-crisis TFP. In a country where the tightening was one-standard deviation higher than the average country (with credit conditions tightened in 84 percent of the banks), the corresponding decline associated with a one-unit decrease in the log number of employees was 3.0 percentage points. Estimates using the medium-sized, small, and micro firm dummies again yield consistent results. Small and medium firms experienced a larger drop in TFP growth vis-à-vis their larger counterparts in countries where credit conditions tightened more. One exception is micro firms, for which the effect is not significantly from zero.

Next, we explore robustness to firm size measure. We measure firm size by total assets (in natural logarithm. As discussed before, most extant theory predicts a high correlation between employment and other firm-level input and output. We confirm this in our data. For example, the correlation between employee and total assets (respectively sales) is 0.73 (respectively 0.82). Using total assets as an alternative measure for firm size, we find similar positive size premium in post-crisis TFP growth after controlling for firm balance sheet and life cycle characteristics, consistent with the baseline (Appendix Tables A4-A5).

Finally, we explore robustess to the TFP level control. In the baseline, we control for the level of pre-crisis TFP to address the potential concern that post-crisis growth may be related to the pre-crisis level. In our final robustness tests, we show that unconditonal on pre-crisis level, the firm size premium of post-crisis growth we find in the baseline continues to hold. Results on our extended specifications using interactions with changes in CDS spread and creditor strength are also not sesntive to this control (Appendix Tables A6-A9).

VI. CONCLUSION

The economic crisis due to the COVID-19 pandemic could further weaken productivity growth, which has been persistently slow since the GFC. In this paper, we examine the crisis

[21] Because the most acute phase of the crisis was right after the collapse of Lehman Brothers on September 15, 2008—very close to the beginning of 2008Q4, we believe that the change in BLS index during 2008Q4 most accurately captures the crisis shock.

[22] The results include five countries for which the BLS is available: France, Germany, Netherlands, Portugal, and Spain. The BLS measures change in credit condition with a "diffusion index", which is the weighted difference between the share of banks reporting that credit standards have been tightened and the share of banks reporting that they have been eased. A high index indicates more tightening. In results not reported, we having similar findings using a "net percentage" measure, calculated as the unweighted difference between the share of banks reporting that credit standards have been tightened and the share of banks reporting that they have been eased.

impact on firm-level productivity drawing on the experience of the GFC. Using a rich firm-level dataset for European countries that offers comprehensive coverage for SMEs, we find new evidence on an uneven impact: Smaller firms experienced a larger decline in post-crisis TFP growth vis-à-vis their larger counterparts. The impact was progressively larger for medium, small, and micro firms relative to large firms. It was also disproportionately larger for firms that faced more severe tightening of credit conditions. We also find that the post-crisis TFP growth premium associated with firm size was smaller for firms with access to stronger creditor banks. Our results highlight the interplay between smaller firms' credit market vulnerability and the adverse credit supply shock as an impediment to post-GFC TFP growth. Our results imply that the tightening of credit market conditions during the crisis, coupled with limited credit market access, especially among smaller firms, may have contributed to the large and persistent drop in aggregate total factor productivity, as well as the post-crisis TFP divergence between SMEs and large firms.

Figure 1. TFP path for SMEs and large firms

Note: This figure plots the average firm-level TFP for SMEs and large firms. TFP in 2003 is normalized to 100. Firm-level TFP is calcuated using the Wooldridge (2009) method.

Table 1. Summary statistics on firms

Panel A. All firms

	Obs	Mean	St. dev.	Min	Median	Max
ΔTFP growth	358,828	-0.05	0.17	-2.75	-0.04	4.96
TFP growth	358,828	0.03	0.11	-2.48	0.02	2.73
Age	358,828	19	12	5	16	194
Employees	358,828	26	317	0.03	7	157,175
ln(Employees)	358,828	2.1	1.3	-3.6	2.0	12.0
Micro firms	358,828	0.61	0.49	0	1	1
Small firms	358,828	0.31	0.46	0	0	1
Medium-sized firms	358,828	0.07	0.25	0	0	1
Debt maturity	358,828	0.40	0.63	0.00	0.27	65.95
Liquidity	358,828	0.10	0.08	-0.37	0.09	9.74
Leverage	358,828	0.61	0.21	0.01	0.64	1.00
ln(EBITDA)	358,828	11.4	1.6	-1.7	11.3	22.0
ΔIntangible investment rate	340,143	-0.0069	0.0443	-0.5410	0.0000	0.4014
Intangible investment rate	340,143	0.0001	0.0301	-0.5327	0.0000	0.3625
ΔIntangible asset share	353,869	-0.0514	0.1784	-0.9625	0.0000	0.9925
Intangible asset share	353,869	0.1525	0.2420	0.0000	0.0146	0.9983

Panel B. Sample of firm-level CDS regression

	Obs	Mean	St. dev.	Min	Median	Max
ΔTFP growth	45,511	-0.03	0.15	-2.74	-0.02	4.66
TFP growth	45,511	0.02	0.10	-2.33	0.02	2.73
Age	45,511	26	18	5	21	194
Employees	45,511	94	856	0.5	23	157,175
ln(Employees)	45,511	3.2	1.5	-0.8	3.1	12.0
Micro firms	45,511	0.29	0.45	0	0	1
Small firms	45,511	0.41	0.49	0	0	1
Medium-sized firms	45,511	0.23	0.42	0	0	1
Debt maturity	45,511	0.39	0.57	0.00	0.29	34.42
Liquidity	45,511	0.10	0.08	-0.36	0.08	9.74
Leverage	45,511	0.62	0.20	0.02	0.64	1.00
ln(EBITDA)	45,511	12.7	1.8	-0.3	12.6	22.0
ΔCDS (country-level)	8	21.1	7.9	11.8	21.2	34.0
ΔCDS (firm-level)	45,511	44.3	22.4	0.0	38.4	102.7

Panel C. Sample of bank capital regression

	Obs	Mean	St. dev.	Min	Median	Max
ΔTFP growth	20,855	-0.06	0.18	-1.98	-0.04	3.39
TFP growth	20,855	0.02	0.11	-1.82	0.02	1.99
Age	20,855	21	14	5	18	194
Employees	20,855	50	226	1.0	16	19,137
ln(Employees)	20,855	2.8	1.3	0.0	2.8	9.9
Micro firms	20,855	0.35	0.48	0	0	1
Small firms	20,855	0.47	0.50	0	0	1
Medium-sized firms	20,855	0.15	0.36	0	0	1
Debt maturity	20,855	0.48	0.78	0.00	0.33	34.42
Liquidity	20,855	0.08	0.06	-0.37	0.07	0.73
Leverage	20,855	0.63	0.21	0.01	0.66	1.00
ln(EBITDA)	20,855	12.3	1.7	-0.3	12.3	20.4
Bank capitalization (dummy)	20,855	0.07	0.26	0	0	1

Panel D. Sample of CDS presence regression

	Obs	Mean	St. dev.	Min	Median	Max
ΔTFP growth	174,003	-0.04	0.16	-2.75	-0.03	4.96
TFP growth	174,003	0.02	0.10	-2.48	0.01	2.73
Age	174,003	21	14	5	18	194
Employees	174,003	42	448	0.4	13	157,175
ln(Employees)	174,003	2.6	1.3	-0.9	2.5	12.0
Micro firms	174,003	0.42	0.49	0	0	1
Small firms	174,003	0.44	0.50	0	0	1
Medium-sized firms	174,003	0.12	0.32	0	0	1
Debt maturity	174,003	0.40	0.58	0.00	0.29	34.42
Liquidity	174,003	0.09	0.07	-0.37	0.08	9.74
Leverage	174,003	0.62	0.20	0.01	0.65	1.00
ln(EBITDA)	174,003	12.0	1.6	-1.7	11.9	22.0
CDS presence	174,003	0.27	0.45	0	0	1

Note: ΔTFP growth, ΔIntangible investment rate, ΔIntangible asset share are the difference in pre- and post-crisis TFP growth, intangible investment rate, and intangible asset share, respetively. ΔCDS country-level (ΔCDS firm-level) is the standarized change in the country-level (firm-level) CDS between the weeks before and after the Lehman bankruptcy. The change in the country-level CDS is calculated as an average of the changes in the CDS spread of all domestic banks over the same window. The change in the firm-level CDS is calculated as an average of the changes in the CDS spread of a firm's creditor banks over the same window. All other variables are measured as the average of the pre-crisis period.

Table 2. Firm size premium: baseline specification

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00760***	0.0230***	0.0241***			
	[0.000346]	[0.00128]	[0.00133]			
Micro firms				-0.0159***	-0.0533***	-0.0557***
				[0.00147]	[0.00380]	[0.00382]
Small firms				-0.00613***	-0.0294***	-0.0309***
				[0.00144]	[0.00298]	[0.00298]
Medium-sized firms				-0.00202	-0.0133***	-0.0138***
				[0.00134]	[0.00205]	[0.00203]
Age			-0.000757***			-0.000509***
			[4.74e-05]			[4.62e-05]
Age squared			5.67e-06***			4.46e-06***
			[6.08e-07]			[6.07e-07]
Debt maturity		-0.00101*	-0.000664		-0.00409***	-0.00396***
		[0.000498]	[0.000498]		[0.000887]	[0.000868]
Leverage		0.0360***	0.0306***		0.0425***	0.0393***
		[0.00190]	[0.00178]		[0.00211]	[0.00205]
Liquidity		0.0158	0.00549		-0.0310**	-0.0380***
		[0.0127]	[0.0123]		[0.00943]	[0.00950]
TFP growth	-1.199***	-1.201***	-1.202***	-1.195***	-1.200***	-1.201***
	[0.00438]	[0.00448]	[0.00446]	[0.00457]	[0.00473]	[0.00471]
Observations	452,644	358,530	358,530	458,940	361,614	361,614
R-squared	0.612	0.620	0.621	0.609	0.614	0.614
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 3. Firm size premium and county-level exposure to the collapse of Lehman Brothers

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00426***	0.0137***	0.0145***			
	[0.000402]	[0.000704]	[0.000747]			
ln(Employees) * ΔCDS	0.00325***	0.00888***	0.00924***			
	[0.000476]	[0.00150]	[0.00158]			
Micro				-0.0128***	-0.0352***	-0.0365***
				[0.00200]	[0.00305]	[0.00309]
Micro * ΔCDS				-0.00945***	-0.0277***	-0.0282***
				[0.00205]	[0.00410]	[0.00419]
Small				-0.00340*	-0.0171***	-0.0178***
				[0.00169]	[0.00241]	[0.00243]
Small * ΔCDS				-0.00805***	-0.0207***	-0.0211***
				[0.00169]	[0.00304]	[0.00313]
Medium				-0.00186	-0.00973***	-0.0100***
				[0.00148]	[0.00177]	[0.00178]
Medium * ΔCDS				-0.00366*	-0.00856***	-0.00864***
				[0.00158]	[0.00215]	[0.00218]
Age			-0.000482***			-0.000357***
			[7.54e-05]			[7.47e-05]
Age squared			4.00e-06***			3.50e-06***
			[8.81e-07]			[8.98e-07]
Age * ΔCDS			-0.000335***			-0.000233***
			[6.20e-05]			[5.66e-05]
Age squared * ΔCDS			3.33e-06***			2.82e-06***
			[6.61e-07]			[6.95e-07]
Debt maturity		-0.000519	-0.000216		-0.00233	-0.00221
		[0.00170]	[0.00168]		[0.00171]	[0.00170]
Debt maturity * ΔCDS		0.000262	0.000277		-0.000497	-0.000495
		[0.00111]	[0.00109]		[0.00118]	[0.00117]
Leverage		0.0191***	0.0153***		0.0242***	0.0220***
		[0.00258]	[0.00275]		[0.00251]	[0.00264]
Leverage * ΔCDS		0.0174***	0.0147***		0.0159***	0.0141***
		[0.00238]	[0.00230]		[0.00239]	[0.00236]
Liquidity pre-crisis		0.000896	-0.00554		-0.0252***	-0.0297***
		[0.00778]	[0.00782]		[0.00588]	[0.00599]
Liquidity pre-crisis * ΔCDS		-0.0105	-0.0188		-0.0283**	-0.0336***
		[0.0123]	[0.0119]		[0.00903]	[0.00887]
TFP growth	-1.204***	-1.201***	-1.202***	-1.203***	-1.204***	-1.204***
	[0.00650]	[0.00705]	[0.00702]	[0.00662]	[0.00737]	[0.00734]
Observations	208,681	173,727	173,727	212,577	175,487	175,487
R-squared	0.619	0.630	0.631	0.618	0.625	0.625
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. ΔCDS is the standarized change in the country-level CDS between the weeks before and after the Lehman bankruptcy. The change in the country-level CDS is calculated as an average of the changes in the CDS spread of all domestic banks over the same window. All other independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 4. Firm size premium and firm-level exposure to the collapse of Lehman Brothers

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00230**	0.0127***	0.0127***			
	[0.000820]	[0.00152]	[0.00156]			
ln(Employees) * ΔCDS	0.00760***	0.0192***	0.0193***			
	[0.00121]	[0.00229]	[0.00228]			
Micro				-0.0338***	-0.0869***	-0.0862***
				[0.00359]	[0.00552]	[0.00557]
Micro * ΔCDS				-0.0269***	-0.0609***	-0.0608***
				[0.00297]	[0.00405]	[0.00413]
Small				-0.0111***	-0.0307***	-0.0309***
				[0.00266]	[0.00315]	[0.00322]
Small * ΔCDS				-0.00691	-0.0193***	-0.0189***
				[0.00359]	[0.00535]	[0.00538]
Medium				0.00353	-0.00337	-0.00331
				[0.00304]	[0.00432]	[0.00436]
Medium * ΔCDS				0.00164	-0.00184	-0.00190
				[0.00300]	[0.00384]	[0.00387]
Age			2.03e-05			0.000279
			[0.000159]			[0.000176]
Age squared			-2.26e-07			-3.17e-06
			[1.73e-06]			[2.02e-06]
Age * ΔCDS			0.000307			7.47e-05
			[0.000302]			[0.000149]
Age squared * ΔCDS			-4.44e-06			-8.26e-07
			[3.27e-06]			[1.38e-06]
Debt maturity		-0.00269	-0.00263		-0.00372	-0.00373
		[0.00530]	[0.00530]		[0.00230]	[0.00230]
Debt maturity * ΔCDS		0.00145	0.00149		0.00413	0.00414
		[0.00571]	[0.00570]		[0.00365]	[0.00364]
Leverage		-0.0258***	-0.0257***		-0.0292***	-0.0279***
		[0.00575]	[0.00608]		[0.00489]	[0.00511]
Leverage * ΔCDS		-0.0102	-0.00940		0.00259	0.00266
		[0.00891]	[0.00954]		[0.00572]	[0.00578]
Liquidity		-0.151***	-0.150***		-0.177***	-0.176***
		[0.0267]	[0.0271]		[0.0305]	[0.0309]
Liquidity * ΔCDS		0.0289	0.0277		0.0740**	0.0728**
		[0.0578]	[0.0580]		[0.0244]	[0.0241]
ΔCDS	0.00198	-0.0130	-0.0142	0.000179	0.0303*	0.0277
	[0.00178]	[0.00693]	[0.00756]	[0.00272]	[0.0144]	[0.0147]
Observations	57,277	45,169	45,169	59,047	45,874	45,874
R-squared	0.092	0.113	0.113	0.091	0.108	0.108
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. ΔCDS is the standarized change in the firm-level CDS between the weeks before and after the Lehman bankruptcy. The change in the firm-level CDS is calculated as an average of the changes in the CDS spread of a firm's creditor banks over the same window. All other independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 5. Firm size premium and bank capitalization

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00932***	0.0262***	0.0272***			
	[0.00113]	[0.00363]	[0.00365]			
ln(Employees) * Bank capital	-0.00364	-0.0159**	-0.0172**			
	[0.00218]	[0.00529]	[0.00537]			
Micro				-0.0327***	-0.0750***	-0.0755***
				[0.00416]	[0.00883]	[0.00841]
Micro * Bank capital				0.00465	0.00793	0.0111
				[0.0114]	[0.0259]	[0.0260]
Small				-0.0214***	-0.0469***	-0.0469***
				[0.00376]	[0.00677]	[0.00643]
Small * Bank capital				0.0165*	0.0304*	0.0317*
				[0.00749]	[0.0132]	[0.0133]
Medium				-0.00898**	-0.0197***	-0.0193***
				[0.00342]	[0.00496]	[0.00476]
Medium * Bank capital				0.00987	0.0113	0.0116
				[0.00623]	[0.0103]	[0.0102]
Age			-0.000869***			-0.000541*
			[0.000216]			[0.000215]
Age squared			8.85e-06**			7.14e-06**
			[2.70e-06]			[2.69e-06]
Age * Bank capital			0.00111**			0.000811*
			[0.000389]			[0.000380]
Age squared * Bank capital			-1.16e-05**			-9.64e-06**
			[3.62e-06]			[3.58e-06]
Debt maturity		-0.00429*	-0.00421*		-0.00611***	-0.00623***
		[0.00182]	[0.00179]		[0.00175]	[0.00171]
Debt maturity * Bank capital		-0.0105	-0.0103		-0.00820	-0.00789
		[0.0113]	[0.0113]		[0.0113]	[0.0114]
Leverage		0.0611***	0.0545***		0.0638***	0.0608***
		[0.00588]	[0.00611]		[0.00597]	[0.00630]
Leverage * Bank capital		-0.0717***	-0.0653***		-0.0749***	-0.0718***
		[0.0191]	[0.0193]		[0.0190]	[0.0191]
Liquidity		-0.0872*	-0.104**		-0.122***	-0.130***
		[0.0399]	[0.0401]		[0.0317]	[0.0332]
Liquidity * Bank capital		0.0106	0.0241		0.0359	0.0407
		[0.0582]	[0.0590]		[0.0535]	[0.0551]
Bank capital	0.0415**	-0.162*	-0.167**	-0.00991	-0.0249	-0.0427
	[0.0156]	[0.0661]	[0.0631]	[0.00704]	[0.0491]	[0.0493]
TFP growth	-1.214***	-1.229***	-1.230***	-1.215***	-1.235***	-1.236***
	[0.0133]	[0.0144]	[0.0144]	[0.0131]	[0.0146]	[0.0145]
Observations	24,458	20,542	20,542	25,304	20,940	20,940
R-squared	0.622	0.641	0.641	0.622	0.636	0.636
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. Bank capital is a dummy variable that takes a value of 1 if the average pre-crisis regulatory Tier 1 capital (in percentage of Risk-Weighted Assets) of a firm's credit banks is above the median. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 6. Firm size premium and CDS presence

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00788***	0.0249***	0.0259***			
	[0.000444]	[0.00172]	[0.00181]			
ln(Employees) * CDS presence	-0.00197***	-0.00775***	-0.00761***			
	[0.000479]	[0.00144]	[0.00152]			
Micro				-0.0225***	-0.0681***	-0.0695***
				[0.00235]	[0.00499]	[0.00516]
Micro * CDS presence				0.00446	0.0211***	0.0199***
				[0.00259]	[0.00482]	[0.00499]
Small				-0.0116***	-0.0411***	-0.0417***
				[0.00219]	[0.00382]	[0.00398]
Small * CDS presence				0.00545*	0.0164***	0.0153***
				[0.00248]	[0.00377]	[0.00390]
Medium				-0.00585**	-0.0190***	-0.0191***
				[0.00221]	[0.00297]	[0.00304]
Medium * CDS presence				0.00435	0.00661*	0.00585
				[0.00258]	[0.00321]	[0.00326]
Age			0.000213			-0.000510***
			[0.000161]			[0.000104]
Age squared			-3.79e-06			5.62e-06**
			[2.47e-06]			[1.86e-06]
Age * CDS presence			-3.97e-05			0.000133
			[0.000208]			[0.000138]
Age squared * CDS presence			6.52e-07			-2.85e-06
			[2.66e-06]			[2.18e-06]
Debt maturity		-0.000501	-0.000484		-0.00201	-0.00190
		[0.00167]	[0.00165]		[0.00112]	[0.00111]
Debt maturity * CDS presence		-0.00224	-0.00213		-0.00160	-0.00149
		[0.00308]	[0.00306]		[0.00197]	[0.00197]
Leverage		-0.0481***	-0.0476***		0.0459***	0.0426***
		[0.00459]	[0.00476]		[0.00245]	[0.00242]
Leverage * CDS presence		0.0162*	0.0155*		-0.00879**	-0.00870*
		[0.00682]	[0.00716]		[0.00328]	[0.00341]
Liquidity		-0.202***	-0.201***		-0.0307*	-0.0374**
		[0.0442]	[0.0452]		[0.0132]	[0.0136]
Liquidity * CDS presence		0.0709	0.0695		0.00375	0.00679
		[0.0632]	[0.0642]		[0.0178]	[0.0191]
CDS presence	0.00316*	-0.0465***	-0.0495***	-0.00594*	-0.0679***	-0.0682***
	[0.00143]	[0.00923]	[0.00968]	[0.00235]	[0.0124]	[0.0127]
TFP growth	-1.205***	-1.204***	-1.205***	-1.203***	-1.205***	-1.206***
	[0.00649]	[0.00702]	[0.00699]	[0.00661]	[0.00737]	[0.00734]
Observations	208,681	173,727	173,727	212,577	175,487	175,487
R-squared	0.619	0.629	0.630	0.061	0.624	0.624
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. CDS presence is a dummy variable that takes a value of 1 if at least one of the firm's creditor banks is traded in the CDS market. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 7. Credit market access: bank capitalization

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			Dummy (high capitalization)			
ln(Employees)	0.211***	0.281**	0.290**			
	[0.0590]	[0.103]	[0.104]			
Micro				-0.986***	-0.862*	-0.842*
				[0.248]	[0.342]	[0.351]
Small				-0.668**	-0.485	-0.431
				[0.224]	[0.347]	[0.326]
Medium				-0.280	-0.0722	-0.0453
				[0.188]	[0.308]	[0.294]
Age	-0.00342		-0.0143			-0.0112
	[0.00748]		[0.0108]			[0.0110]
Age squared	4.25e-05		0.000118			0.000102
	[6.36e-05]		[8.10e-05]			[8.43e-05]
Debt maturity		-0.0269***	-0.129		-0.113	-0.113
		[0.00694]	[0.0735]		[0.0687]	[0.0690]
Leverage		0.00134	0.257		0.365	0.296
		[0.00838]	[0.445]		[0.448]	[0.444]
Liquidity		-0.567***	1.851		1.344	1.154
		[0.107]	[1.394]		[1.294]	[1.245]
Observations	18,936	15,480	15,480	19,813	15,823	15,823
R2	0.770	0.733	0.732	0.768	0.659	0.653
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is a dummy variable that takes a value of 1 if the pre-crisis regulatory Tier 1 capital (in percentage of Risk-Weighted Assets) of a firm's top credit banks is above the median. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 8. Credit market access: CDS presence

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			Dummy (CDS presence)			
ln(Employees)	0.249***	0.0924***	0.0684**			
	[0.0300]	[0.0253]	[0.0257]			
Micro				-1.465***	-0.584***	-0.492***
				[0.0763]	[0.111]	[0.109]
Small				-1.142***	-0.517***	-0.447***
				[0.0602]	[0.110]	[0.106]
Medium				-0.557***	-0.229**	-0.188*
				[0.0535]	[0.0840]	[0.0811]
Age			0.0113***			0.0112***
			[0.00180]			[0.00165]
Age squared			-5.39e-05***			-5.76e-05***
			[1.34e-05]			[1.25e-05]
Debt maturity		-0.0269***	0.0519**		0.0531**	0.0469*
		[0.00694]	[0.0185]		[0.0185]	[0.0186]
Leverage		0.00134	-0.0716		-0.189*	-0.0677
		[0.00838]	[0.0728]		[0.0797]	[0.0725]
Liquidity		-0.567***	-2.094***		-2.350***	-2.082***
		[0.107]	[0.346]		[0.360]	[0.354]
Observations	208,712	173,737	173,737	212,592	175,489	175,489
R2	0.224	0.218	0.219	0.223	0.218	0.219
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable CDS presence, which takes a value of 1 if at least one of the firm's creditor banks is traded in the CDS market. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 9. Intangible investment

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔIntangible investment rate			
ln(Employees)	7.97e-05	0.00109***	0.00104***			
	[0.000112]	[0.000143]	[0.000149]			
Micro firms				-0.00277***	-0.00221***	-0.00760***
				[0.000426]	[0.000443]	[0.000703]
Small firms				-0.00316***	-0.00279***	-0.00659***
				[0.000398]	[0.000392]	[0.000662]
Medium-sized firms				-0.00130***	-0.00112**	-0.00319***
				[0.000355]	[0.000351]	[0.000500]
Age			2.15e-06		4.65e-05**	
			[1.41e-05]		[1.44e-05]	
Age squared			2.67e-07		-1.54e-07	
			[1.51e-07]		[1.44e-07]	
Debt maturity		0.000411**	0.000392**			0.000282*
		[0.000138]	[0.000139]			[0.000141]
Leverage		-0.00927***	-0.00911***			-0.00901***
		[0.000883]	[0.000875]			[0.000887]
Liquidity		0.00269*	0.00301*			0.00196
		[0.00128]	[0.00126]			[0.00111]
Intangible investment rate	-1.176***	-1.203***	-1.202***	-1.173***	-1.201***	-1.201***
	[0.0129]	[0.0115]	[0.0115]	[0.0128]	[0.0115]	[0.0115]
Observations	428,281	339,845	339,845	434,084	342,766	342,766
R-squared	0.701	0.718	0.718	0.700	0.718	0.718
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average intangible investment rate between the pre- and post-crisis periods. Intangible investment rate is calcuated as the change in the stock of intangible assets divided by value added. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 10. Share of intangible assets

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔIntangible share			
ln(Employees)	0.00114	0.00266*	0.00350**			
	[0.000927]	[0.00115]	[0.00113]			
Micro firms				-0.00540***	-0.00916***	-0.00805***
				[0.000688]	[0.00101]	[0.000999]
Small firms				-0.00734***	-0.00971***	-0.00888***
				[0.000633]	[0.000936]	[0.000923]
Medium-sized firms				-0.00349***	-0.00496***	-0.00450***
				[0.000516]	[0.000661]	[0.000655]
Age			-0.000634***			0.000125***
			[9.23e-05]			[2.24e-05]
Age squared			5.69e-06***			-6.73e-07**
			[9.01e-07]			[2.24e-07]
Debt maturity		0.00656***	0.00679***		0.00211***	0.00206***
		[0.00152]	[0.00159]		[0.000471]	[0.000463]
Leverage		-0.0384***	-0.0424***		-0.0151***	-0.0141***
		[0.00274]	[0.00307]		[0.00157]	[0.00151]
Liquidity		-0.115***	-0.123***		-0.0175***	-0.0153***
		[0.0175]	[0.0184]		[0.00310]	[0.00285]
Intangible share	-0.372***	-0.443***	-0.444***	-1.276***	-1.299***	-1.299***
	[0.0308]	[0.0314]	[0.0314]	[0.0100]	[0.00928]	[0.00929]
Observations	445,809	353,571	353,571	443,082	349,407	349,407
R-squared	0.393	0.466	0.466	0.677	0.688	0.688
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average investment asset share between the pre- and post-crisis periods. Investment asset share as the stock of intangible assets divided by the sum of physical and intangible assets All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 11. Patent applications

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔPatent applications			
ln(Employees)	0.760***	0.948***	0.957**			
	[0.207]	[0.253]	[0.304]			
Micro firms				-2.100***	-2.485***	-2.193***
				[0.560]	[0.623]	[0.638]
Small firms				-1.854***	-2.069***	-1.907***
				[0.535]	[0.611]	[0.566]
Medium-sized firms				-1.337*	-1.853**	-1.823**
				[0.543]	[0.654]	[0.626]
Age			0.0137			0.0352
			[0.0424]			[0.0410]
Age squared			-0.000179			-0.000284
			[0.000306]			[0.000316]
Debt maturity		0.154*	0.161*		0.145*	0.146*
		[0.0645]	[0.0639]		[0.0662]	[0.0654]
Leverage		1.093	1.111		1.300	1.468
		[1.271]	[1.169]		[1.310]	[1.221]
Liquidity		-1.119	-1.119		-1.769	-1.752
		[2.525]	[2.505]		[2.540]	[2.527]
Patent applications	-0.329***	-0.330***	-0.330***	-0.325***	-0.326***	-0.326***
	[0.0380]	[0.0384]	[0.0389]	[0.0386]	[0.0392]	[0.0398]
Observations	2,346	2,045	2,045	2,346	2,045	2,045
R-squared	0.678	0.685	0.685	0.677	0.684	0.684
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average investment asset share between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 12. Placebo test

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	-0.00526	-0.000571	0.000752			
	[0.00725]	[0.0150]	[0.0144]			
ln(Employees) * Bank capital	0.00795	-0.00729	-0.0107			
	[0.0130]	[0.0258]	[0.0261]			
Micro				0.0732	0.0409	0.0401
				[0.0459]	[0.0601]	[0.0589]
Micro * Bank capital				-0.0470	0.0972	0.0990
				[0.0575]	[0.115]	[0.114]
Small				0.0689	0.0480	0.0493
				[0.0439]	[0.0495]	[0.0481]
Small * Bank capital				-0.0442	0.0818	0.0732
				[0.0559]	[0.0704]	[0.0738]
Medium				0.0509	0.0373	0.0326
				[0.0473]	[0.0511]	[0.0497]
Medium * Bank capital				-0.117	-0.00310	0.0108
				[0.0603]	[0.0636]	[0.0617]
Age		-0.0105	-0.0133			-0.00367
		[0.0330]	[0.0320]			[0.00186]
Age squared		0.0646	0.0937			6.39e-05
		[0.0554]	[0.0608]			[3.39e-05]
Age * Bank capital		0.00257	-0.0115			0.00518*
		[0.0395]	[0.0412]			[0.00230]
Age squared * Bank capital		0.189	0.256**			-6.31e-05
		[0.0995]	[0.0966]			[3.44e-05]
Debt maturity		-0.0605	-0.121		-0.0104	-0.0139
		[0.172]	[0.172]		[0.0329]	[0.0317]
Debt maturity * Bank capital		0.846**	1.067***		0.0208	0.0465
		[0.251]	[0.221]		[0.0486]	[0.0561]
Leverage		-0.0105	-0.0133		0.00851	-0.00481
		[0.0330]	[0.0320]		[0.0402]	[0.0425]
Leverage * Bank capital		0.0646	0.0937		0.234**	0.276***
		[0.0554]	[0.0608]		[0.0825]	[0.0799]
Liquidity		0.00257	-0.0115		-0.0681	-0.137
		[0.0395]	[0.0412]		[0.170]	[0.170]
Liquidity * Bank capital		0.189	0.256**		0.805***	0.999***
		[0.0995]	[0.0966]		[0.230]	[0.242]
TFP growth	-1.268***	-1.281***	-1.286***	-1.267***	-1.279***	-1.282***
	[0.0558]	[0.0687]	[0.0666]	[0.0569]	[0.0689]	[0.0665]
Observations	544	462	462	555	466	466
R-squared	0.758	0.755	0.759	0.761	0.757	0.760
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-2000 periods. All independent variables are measured at the pre-recession period. Bank capital is a dummy variable that takes a value of 1 if the average pre-recession regulatory Tier 1 capital (in percentage of Risk-Weighted Assets) of a firm's credit banks is above the median. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 13. Firm size versus balance sheet vulnerabilities: baseline specification

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00762***		0.0242***			
	[0.000346]		[0.00134]			
Micro firms				-0.0159***		-0.0557***
				[0.00147]		[0.00382]
Small firms				-0.00613***		-0.0309***
				[0.00144]		[0.00298]
Medium-sized firms				-0.00202		-0.0138***
				[0.00134]		[0.00203]
Age		-0.000264***	-0.000758***		-0.000264***	-0.000509***
		[5.14e-05]	[4.74e-05]		[5.14e-05]	[4.62e-05]
Age squared		2.84e-06***	5.67e-06***		2.84e-06***	4.46e-06***
		[6.43e-07]	[6.08e-07]		[6.43e-07]	[6.07e-07]
Debt maturity		-0.00565***	-0.000657		-0.00565***	-0.00396***
		[0.00117]	[0.000497]		[0.00117]	[0.000868]
Leverage		0.0447***	0.0306***		0.0447***	0.0393***
		[0.00228]	[0.00178]		[0.00228]	[0.00205]
Liquidity		-0.0750***	0.00561		-0.0750***	-0.0380***
		[0.00964]	[0.0123]		[0.00964]	[0.00950]
TFP growth	-1.199***	-0.000264***	-0.000758***	-1.195***	-1.204***	-1.201***
	[0.00439]	[5.14e-05]	[4.74e-05]	[0.00457]	[0.00493]	[0.00471]
Observations	452,305	361,614	358,238	458,940	361,614	361,614
R-squared	0.612	0.611	0.621	0.609	0.611	0.614
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table 14. Firm size versus balance sheet vulnerabilities: extended specification

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00420***		0.0145***			
	[0.000404]		[0.000753]			
ln(Employees) * ΔCDS	0.00330***		0.00928***			
	[0.000478]		[0.00160]			
Micro				-0.0128***		-0.0365***
				[0.00200]		[0.00309]
Micro * ΔCDS				-0.00945***		-0.0282***
				[0.00205]		[0.00419]
Small				-0.00340*		-0.0178***
				[0.00169]		[0.00243]
Small * ΔCDS				-0.00805***		-0.0211***
				[0.00169]		[0.00313]
Medium				-0.00186		-0.0100***
				[0.00148]		[0.00178]
Medium * ΔCDS				-0.00366*		-0.00864***
				[0.00158]		[0.00218]
Age		-0.000223**	-0.000484***		-0.000223**	-0.000357***
		[7.45e-05]	[7.56e-05]		[7.45e-05]	[7.47e-05]
Age squared		2.63e-06**	4.00e-06***		2.63e-06**	3.50e-06***
		[8.94e-07]	[8.82e-07]		[8.94e-07]	[8.98e-07]
Age * ΔCDS		-7.86e-05	-0.000334***		-7.86e-05	-0.000233***
		[5.86e-05]	[6.24e-05]		[5.86e-05]	[5.66e-05]
Age squared * ΔCDS		1.90e-06**	3.34e-06***		1.90e-06**	2.82e-06***
		[7.30e-07]	[6.62e-07]		[7.30e-07]	[6.95e-07]
Rollover risk		-0.00396*	-0.000291		-0.00396*	-0.00221
		[0.00178]	[0.00169]		[0.00178]	[0.00170]
Rollover risk * ΔCDS		-0.00125	0.000322		-0.00125	-0.000495
		[0.00133]	[0.00110]		[0.00133]	[0.00117]
Leverage		0.0282***	0.0152***		0.0282***	0.0220***
		[0.00258]	[0.00275]		[0.00258]	[0.00264]
Leverage * ΔCDS		0.0145***	0.0147***		0.0145***	0.0141***
		[0.00253]	[0.00230]		[0.00253]	[0.00236]
Liquidity		-0.0578***	-0.00536		-0.0578***	-0.0297***
		[0.00638]	[0.00784]		[0.00638]	[0.00599]
Liquidity * ΔCDS		-0.0553***	-0.0189		-0.0553***	-0.0336***
		[0.00732]	[0.0120]		[0.00732]	[0.00887]
TFP growth	-1.204***	-1.209***	-1.202***	-1.203***	-1.209***	-1.204***
	[0.00652]	[0.00766]	[0.00704]	[0.00662]	[0.00766]	[0.00734]
Observations	208,295	175,487	173,417	212,577	175,487	175,487
R-squared	0.619	0.619	0.631	0.618	0.619	0.625
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. . ΔCDS is the standarized change in the country-level CDS between the weeks before and after the Lehman bankruptcy. The change in the country-level CDS is calculated as an average of the changes in the CDS spread of all domestic banks over the same window. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

References

Ackerberg, Daniel A., Kevin Caves, and Garth Frazer. 2015. Identification Properties of Recent Production Function Estimators. *Econometrica* 83:2411–51.

Afonso, Gara, Anna Kovner, and Antoinette Schoar. 2011. Stressed, Not Frozen: The Federal Funds Market in The Financial Crisis. *Journal of Finance* 66:1109–39.

Aghion, Philippe, George-Marios Angeletos, Abhijit Banerjee, and Kalina Manova. 2010. Volatility and Growth: Credit Constraints and the Composition of Investment. *Journal of Monetary Economics* 57:246–65.

Aghion, Philippe, Philippe Askenazy, Nicolas Berman, Gilbert Cette, and Laurent Eymard. 2012. Credit constraints and the cyclicality of R&D investment: Evidence from France. *Journal of the European Economic Association* 10:1001–1024.

Alcalá, Francisco and Antonio Ciccone. 2004. Trade and Productivity. *Quarterly Journal of Economics* 119:613–46.

Andrews, Dan, Chiara Criscuolo, and Peter N. Gal. 2016. The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy. Technical Report, The Organisation for Economic Co-operation and Development.

Augustin, Patric, Marti G. Subrahmanyam, Dragon Yongjun Tang, and Sarah Qian Wang. 2014. Credit Default Swaps: A Survey. *Foundations and Trends in Finance* 9(1–2):1–196.

Beck, Thorsten, Asli Demirgüç-Kunt, and Vojislav Maksimovic. 2005. Financial and Legal Constraints to Growth: Does Firm Size Matter? *Journal of Finance*. 61(1):137-177.Beltratti, Andrea and Stulz, René M. 2012. The Credit Crisis Around the Globe: Why Did Some Banks Perform Better? *Journal of Financial Economics*, 105(1):1–17

Berger, Allen. N. and Christa H. Bouwman, 2013. How Does Capital Affect Bank Performance During Financial Crises? *Journal of Financial Economics* 109(1):146–176.

Bernanke, Ben S., Gertler, Mark, and Gilchrist, Simon. 1999. The Financial Accelerator in a Quantitative Business Cycle Framework. in: J. B. Taylor & M. Woodford (ed.), Elsevier, *Handbook of Macroeconomics*, Ed. 1, Vol. 1, Chapter 21:1341–1393.

Brunnermeier, Markus K. 2009. Deciphering the Liquidity and Credit Crunch 2007–2008. *Journal of Economic Perspectives* 23:77–100.

Buera, Francisco J. and Yongseok Shin. 2013. Financial Frictions and the Persistence of History: A Quantitative Exploration. *Journal of Political Economy* 121(2):221–72.

Burdett, Kenneth and Dale T. Mortensen. 1998. Wage Differentials, Employer Size and Unemployment. *International Economic Review* 39:257–73.

Chodorow-Reich, Gabriel. 2013. The Employment Effects of Credit Market Disruptions: Firm-Level Evidence from the 2008–9 Financial Crisis. *Quarterly Journal of Economics* 129:1–59.

Corrado, Carol, Charles Hulten, and Daniel Sichel. 2005. Measuring Capital and Technology: An Expanded Framework. In C. Corrado, J. Haltiwanger, and D. Sichel (eds), *Measuring*

Capital in the New Economy, National Bureau of Economic Research, 11–41.

Custodio, Claudio, Miguel Ferreira, and Luis Laureano. 2013. Why are US Firms Using More Short-Term Debt? Journal of Financial Economics 180(1):182–212.

Duval, Romain, Gee Hee Hong, and Yannick Timmer. 2020. Financial Frictions and the Great Productivity Slowdown. *Review of Financial Studies* 33(2):475–503.

Falato Antonio and Jae Sim. 2014. Why Do Innovative Firms Hold So Much Cash? Evidence from Changes in State R&D Tax Credits. FEDS Working paper 2014–72.

Fort, Teresa C., John Haltiwanger, Ron S. Jarmin, and Javier Miranda. 2013. How Firms Respond to Business Cycles: The Role of Firm Age and Firm Size. *IMF Economic Review* 61(3):520–559.

Gal, Peter N. 2013. Measuring total factor productivity at the firm level using OECD-ORBIS. Working Paper, OECD.

Gertler, Mark and Simon Gilchrist. 1994. Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms. *Quarterly Journal of Economics* 109(2):309–340.

Gertler, Mark, and R. Glenn Hubbard. Financial Factors in Business Fluctuations. in *Financial Market Volatility: Causes, Consequences, and Policy*:33-71. Kansas City: Federal Reserve Bank of Kansas City.

Giannetti, Mariassunta and Steven Ongena. 2012. "Lending by Example'": Direct and Indirect Effects of Foreign Banks in Emerging Markets. *Journal of International Economics* 86:167–80.

Gopinath, Gita, Sebnam Kalemli-Özcan, Loukas Karabarbounis, and Carolina Villegas-Sanchez. 2017. Capital allocation and productivity in south Europe. *The Quarterly Journal of Economics*, 132:1915–67.

Hadlock, Charles J. and Joshua R. Pierce. 2010. New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index. *The Review of Financial Studies* 23(5):1909–40.

Huber, Kilian. 2018. Disentangling the Effects of a Banking Crisis: Evidence from German Firms and Counties. *American Economic Review* 108:868–98.

Kalemli-Özcan¸ Sebnem, Luc Laeven and David Moreno. 2020. Debt overhang in Europe: Evidence from the European Crisis. NBER Working Paper 24555.

Kalemli-Özcan¸ Sebnem, Bent Sorensen Carollina Villegas-Sanchez Vadym Volosovych, and Sevcan Yesiltas. 2019. How to Construct Nationally Representative Firm Level Data from the Orbis Global Database: New Facts and Aggregate Implications. NBER Working Paper 21558.

Kapan, Tümer and Camelia Minoiu. 2018. Balance Sheet Strength and Bank Lending: Evidence from The Global Financial Crisis. *Journal of Banking and Finance*. 92:35–50.

Kaplan, Steven N. and Luigi Zingales. 1997. Do Investment–Cash Flow Sensitivities Provide Useful Measures of Financial Constraints? *Quarterly Journal of Economics* 112:159–216.

Kiyotaki, Nobuhiro and John Moore. 1997. Credit Cycles. *Journal of Political Economy*

105(2):211–248.

Mian, Atif and Amir Sufi. 2014. What Explains the 2007–2009 Drop in Employment? *Econometrica* 82:2197–223.

Levinsohn, James and Amil Petrin. 2003. Estimating Production Functions Using Inputs to Control for Unobservables. *Review of Economic Studies* 70:317–41.

Midrigan, Virgiliu and Daniel Yi Xu. 2014. Finance and Misallocation: Evidence from Plant-Level Data" *American Economic Review* 104(2):422–58.

Moll, Benjamin. 2014. "Productivity Losses from Financial Frictions: Can Self-Financing undo Capital Misallocation?" *American Economic Review* 104: 3186–221.

Moscarini, Giuseppe and Fabien Postel-Vinay. 2013. Stochastic Search Equilibrium. *The Review of Economic Studies* 80(4):1545–81.

Olley, G. Steven and Ariel Pakes. 1996. The dynamics of productivity in the telecommunications equipment industry. *Econometrica* 64:1263–97.

Opler, Tim, Lee Pinkowitz, René M. Stulz, and Rohan Williamson. 2001. The Determinants and Implications of Corporate Cash Holdings. *Journal of Financial Economics,* 52(1):3–46.

Rajan, Raghuram G. 1992. Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt. Journal of Finance 47(4):1367–1400.

Rajan, Raghuram G. and Luigi Zingales. 1998. Financial dependence and growth. *American Economic Review* 88:559–86.

Siemer, Michael. 2019. Employment Effects of Financial Constraints During the Great Recession. *Review of Economics and Statistics*. 101(1):16–29.

Stein, Jeremy C. 2002. Information Production and Capital Allocation: Decentralized Versus Hierarchical Firms. Journal of Finance 57(5):1891–1921.

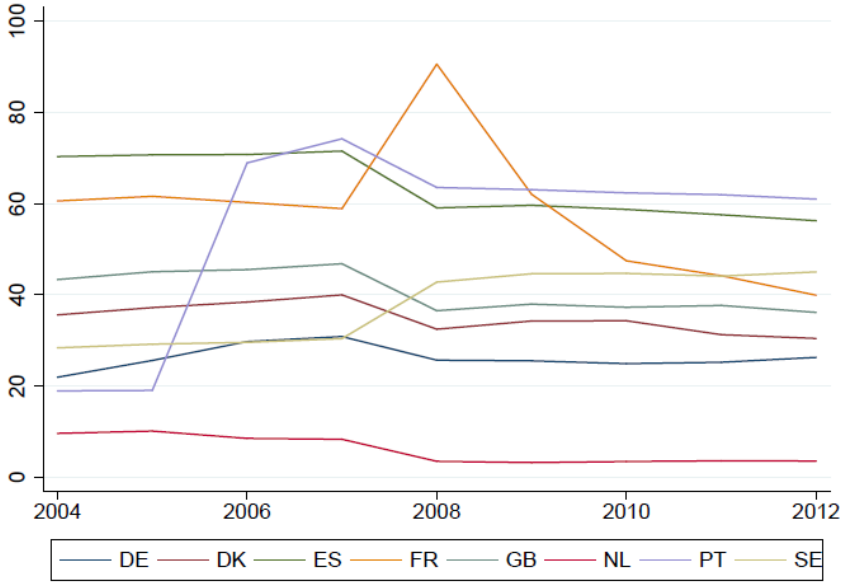
Whited, Tony, and Guojun Wu. 2006. Financial Constraints Risk. *Review of Financial Studies* 19:531–59.

Wooldridge, Jeffrey M. 2009. On Estimating Firm-Level Production Functions Using Proxy Variables to Control for Unobservables. *Economics Letters* 104:112–114.

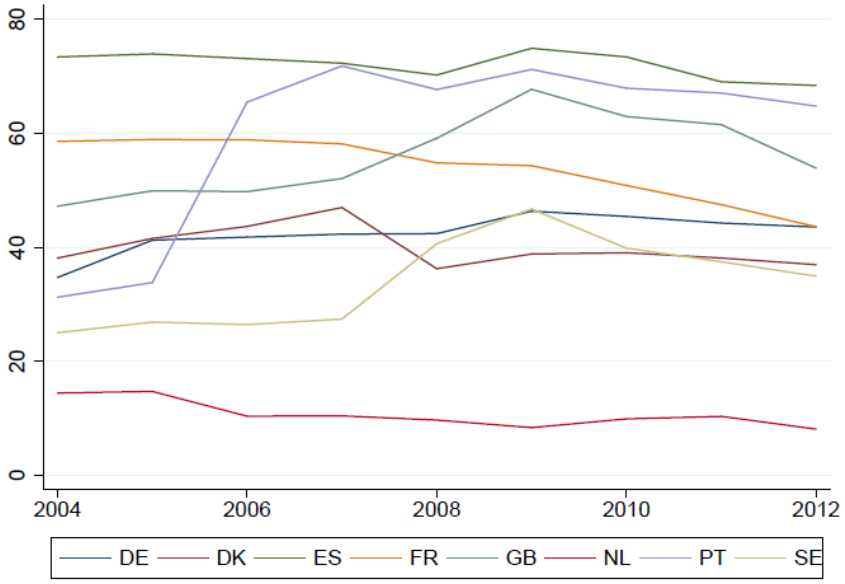
Appendix

Figure A1. Orbis dataset sample coverage

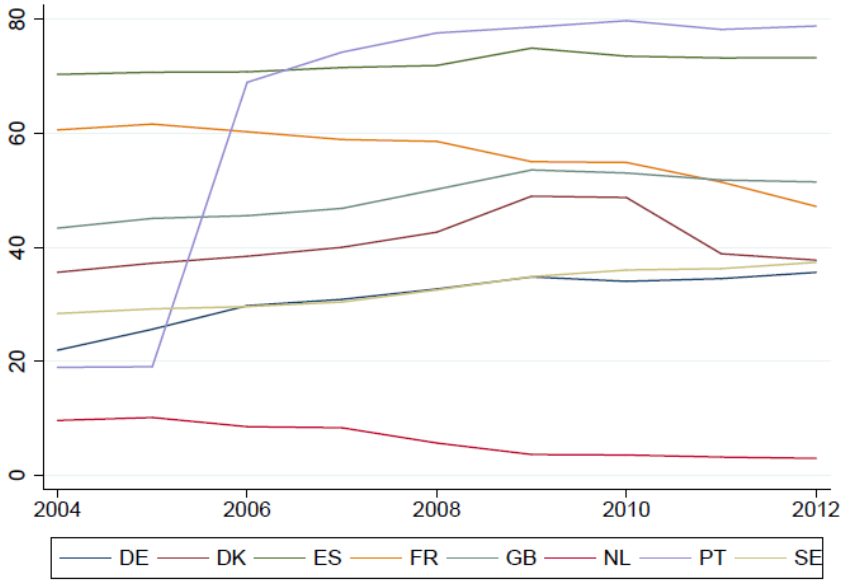
Panel A: Employment, all industries (in percentage of Eurostat SBS coverage)



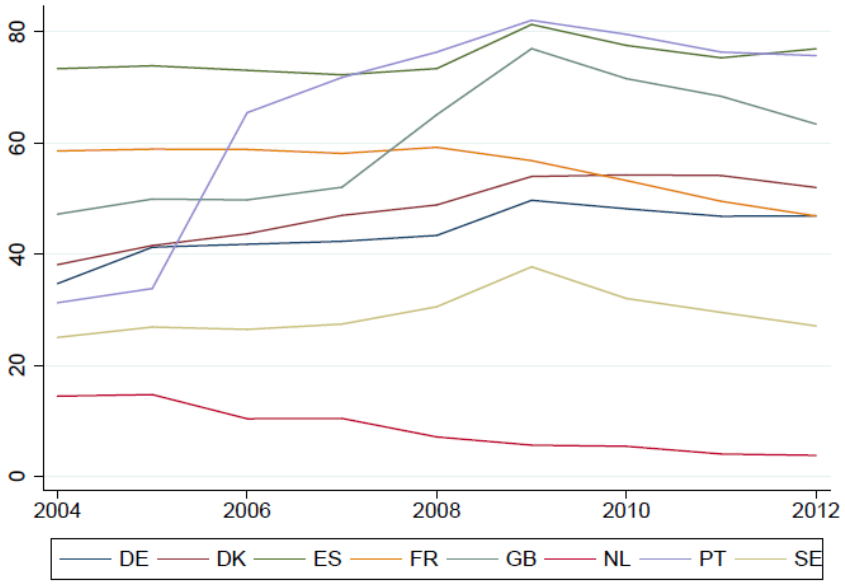
Panel B: Gross output, all industries (in percentage of Eurostat SBS coverage)



Panel C: Employment, manufacturing industry (in percentage of Eurostat SBS coverage)



Panel D: Gross output, manufacturing industry (in percentage of Eurostat SBS coverage)



Note: This figure plots the coverage of Orbis data in our sample of countries relative to Eurostat SBS. The Orbis sample is restricted to firms that report data on employment, gross output, tangible fixed assets, and materials.

Table A1. Robustness to bank capitalization

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.0107***	0.0287***	0.0289***			
	[0.000779]	[0.00130]	[0.00142]			
ln(Employees) * Bank capital	-0.00542*	-0.0224***	-0.0227***			
	[0.00236]	[0.00296]	[0.00334]			
Micro				-0.0294***	-0.0701***	-0.0677***
				[0.00647]	[0.00725]	[0.00700]
Micro * Bank capital				0.00238	0.0101	0.00807
				[0.00908]	[0.0156]	[0.0152]
Small				-0.0177*	-0.0396***	-0.0375***
				[0.00677]	[0.00816]	[0.00789]
Small * Bank capital				0.0134	0.0339**	0.0332**
				[0.0113]	[0.0101]	[0.0107]
Medium				-0.00682	-0.0152*	-0.0140*
				[0.00685]	[0.00595]	[0.00565]
Medium * Bank capital				0.00519	0.00817	0.00727
				[0.00781]	[0.00649]	[0.00678]
Age			-0.000428			8.01e-06
			[0.000359]			[0.000356]
Age squared			6.66e-06			3.66e-06
			[6.50e-06]			[6.25e-06]
Age * Bank capital			0.000494			9.85e-05
			[0.000559]			[0.000550]
Age squared * Bank capital			-6.30e-06			-3.20e-06
			[7.22e-06]			[6.97e-06]
Debt maturity		-0.00423*	-0.00434*		-0.00605**	-0.00625**
		[0.00164]	[0.00162]		[0.00199]	[0.00199]
Debt maturity * Bank capital		-0.000587	-0.000199		0.00114	0.00161
		[0.00707]	[0.00697]		[0.00702]	[0.00695]
Leverage		0.0535***	0.0517***		0.0585***	0.0605***
		[0.00722]	[0.00759]		[0.00843]	[0.00850]
Leverage * Bank capital		-0.0468**	-0.0454**		-0.0509***	-0.0531**
		[0.0133]	[0.0148]		[0.0143]	[0.0157]
Liquidity		-0.0455**	-0.0499**		-0.0846***	-0.0784***
		[0.0149]	[0.0164]		[0.0167]	[0.0180]
Liquidity * Bank capital		-0.00832	-1.73e-05		0.0265	0.0240
		[0.0497]	[0.0517]		[0.0541]	[0.0566]
TFP growth	-1.201***	-1.198***	-1.199***	-1.202***	-0.0701***	-0.0677***
	[0.0144]	[0.0129]	[0.0133]	[0.0146]	[0.00725]	[0.00700]
Observations	10,601	7,997	7,997	10,786	8,080	8,080
R-squared	0.620	0.619	0.619	0.620	0.613	0.613
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. Bank capital is a dummy variable that takes a value of 1 if the pre-crisis regulatory Tier 1 capital (in percentage of Risk-Weighted Assets) of a firm's top credit banks is above the median. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table A2. Robustness to bank's CDS presence

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00841***	0.0251***	0.0262***			
	[0.000577]	[0.00118]	[0.00120]			
ln(Employees) * CDS presence	-0.00294***	-0.00798***	-0.00787***			
	[0.000770]	[0.00154]	[0.00161]			
Micro				-0.0240***	-0.0675***	-0.0689***
				[0.00247]	[0.00424]	[0.00429]
Micro * CDS presence				0.00762*	0.0205***	0.0194***
				[0.00319]	[0.00518]	[0.00524]
Small				-0.0127***	-0.0403***	-0.0410***
				[0.00198]	[0.00352]	[0.00354]
Small * CDS presence				0.00759**	0.0154***	0.0144***
				[0.00279]	[0.00421]	[0.00430]
Medium				-0.00621***	-0.0181***	-0.0182***
				[0.00185]	[0.00275]	[0.00275]
Medium * CDS presence				0.00488	0.00531	0.00458
				[0.00256]	[0.00338]	[0.00342]
Age			-0.000820***			-0.000548***
			[8.36e-05]			[8.02e-05]
Age squared			7.82e-06***			6.27e-06***
			[1.39e-06]			[1.38e-06]
Age * CDS presence			0.000270			0.000154
			[0.000140]			[0.000135]
Age squared * CDS presence			-4.22e-06*			-3.22e-06
			[1.86e-06]			[1.86e-06]
Debt maturity		0.00111	0.00142		-0.00180*	-0.00170
		[0.000901]	[0.000907]		[0.000890]	[0.000898]
Debt maturity * CDS presence		-0.00396*	-0.00380*		-0.00218	-0.00206
		[0.00161]	[0.00162]		[0.00161]	[0.00160]
Leverage		0.0417***	0.0357***		0.0458***	0.0425***
		[0.00257]	[0.00236]		[0.00249]	[0.00246]
Leverage * CDS presence		-0.00859*	-0.00775		-0.00818*	-0.00804
		[0.00377]	[0.00413]		[0.00377]	[0.00412]
Liquidity		0.0120	0.00140		-0.0313**	-0.0379**
		[0.00798]	[0.00893]		[0.0104]	[0.0116]
Liquidity * CDS presence		-0.0114	-0.00548		0.00653	0.00959
		[0.0136]	[0.0136]		[0.0165]	[0.0179]
TFP growth	-1.205***	-1.204***	-1.205***	-1.203***	-1.205***	-1.206***
	[0.0142]	[0.0132]	[0.0131]	[0.0147]	[0.0145]	[0.0144]
Observations	207,734	172,853	172,853	211,636	174,610	174,610
R-squared	0.621	0.632	0.632	0.620	0.626	0.626
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. CDS presence is a dummy variable that takes a value of 1 if the firm's top creditor banks is traded in the CDS market. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table A3. Robustness to credit condition measures

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00312***	0.0140***	0.0153***			
	[0.000586]	[0.00176]	[0.00187]			
ln(Employees) * Credit tightening	0.0158***	0.0350***	0.0353***			
	[0.00268]	[0.00983]	[0.0104]			
Micro				0.000862	-0.00964	-0.0128*
				[0.00298]	[0.00555]	[0.00565]
Micro * Credit tightening				0.00594*	0.00282	0.000774
				[0.00291]	[0.00466]	[0.00470]
Small				0.00672*	0.00676	0.00578
				[0.00292]	[0.00399]	[0.00401]
Small * Credit tightening				-0.0681***	-0.168***	-0.167***
				[0.0101]	[0.0258]	[0.0265]
Medium				-0.0535***	-0.126***	-0.125***
				[0.0101]	[0.0200]	[0.0204]
Medium * Credit tightening				-0.0377***	-0.0728***	-0.0723***
				[0.00985]	[0.0144]	[0.0147]
Age			-0.000552***			-0.000463***
			[0.000121]			[0.000117]
Age squared			3.76e-06*			3.79e-06*
			[1.63e-06]			[1.67e-06]
Age * Credit tightening			-0.000830			-5.49e-05
			[0.000463]			[0.000446]
Age squared * Credit tightening			6.88e-06			8.33e-07
			[6.49e-06]			[6.71e-06]
Debt maturity		0.00807*	0.00945**		0.00156	0.00220
		[0.00350]	[0.00344]		[0.00352]	[0.00349]
Debt maturity * Credit tightening		-0.0230**	-0.0257**		-0.0148	-0.0162
		[0.00871]	[0.00858]		[0.00875]	[0.00868]
Leverage		0.0108**	0.00578		0.0217***	0.0183***
		[0.00406]	[0.00408]		[0.00380]	[0.00389]
Leverage * Credit tightening		0.0705***	0.0665***		0.0542***	0.0546***
		[0.0152]	[0.0140]		[0.0146]	[0.0143]
Liquidity		0.120***	0.118***		0.0589***	0.0541**
		[0.0239]	[0.0220]		[0.0172]	[0.0174]
Liquidity * Credit tightening		-0.407**	-0.442***		-0.371***	-0.381***
		[0.125]	[0.118]		[0.0920]	[0.0906]
TFP growth	-1.197***	-1.191***	-1.193***	-1.194***	-1.193***	-1.194***
	[0.00522]	[0.00511]	[0.00508]	[0.00548]	[0.00561]	[0.00558]
Observations	363,308	286,133	286,133	368,643	288,788	288,788
R-squared	0.606	0.615	0.616	0.604	0.608	0.608
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. Credit tightening is the change in the credit standards in 2008Q4 from euro area bank lending survey. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table A4. Robustness to firm size

	(1)	(2)	(3)	(4)
Dependent variable		ΔTFP growth		
ln(Total assets)	-0.00394***	-0.00577***	0.0127***	0.0118***
	[0.000571]	[0.000662]	[0.00266]	[0.00269]
Age		0.00143***		0.000656***
		[0.000113]		[0.000121]
Age squared		-1.33e-05***		-7.03e-06***
		[1.38e-06]		[1.41e-06]
Debt maturity			-0.00959***	-0.00946***
			[0.00162]	[0.00162]
Leverage			-0.0267***	-0.0234***
			[0.00311]	[0.00303]
Liquidity			-0.212***	-0.208***
			[0.0350]	[0.0346]
Observations	452,538	452,538	359,928	359,928
R-squared	0.056	0.058	0.082	0.082
Industry*country FEs	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table A5. Robustness to firm size and exposure to the collapse of Lehman Brothers

	(1)	(2)	(3)	(4)
Dependent variable		ΔTFP growth		
ln(Total assets)	-0.00271***	-0.00361***	0.00347	0.00305
	[0.000620]	[0.000651]	[0.00198]	[0.00199]
ln(Total assets) * ΔCDS	-0.000379	-0.00147*	0.00546**	0.00500*
	[0.000667]	[0.000732]	[0.00190]	[0.00194]
Age		0.000848***		0.000394**
		[0.000140]		[0.000150]
Age squared		-8.55e-06***		-4.04e-06*
		[1.66e-06]		[1.73e-06]
Age * ΔCDS		0.000647***		0.000158
		[0.000131]		[0.000137]
Age squared * ΔCDS		-5.50e-06***		-1.06e-06
		[1.52e-06]		[1.46e-06]
Debt maturity			-0.00381	-0.00372
			[0.00279]	[0.00279]
Debt maturity * ΔCDS			-0.00686**	-0.00682**
			[0.00229]	[0.00229]
Leverage			-0.0139***	-0.0118**
			[0.00402]	[0.00407]
Leverage * ΔCDS			-0.0208***	-0.0190***
			[0.00365]	[0.00362]
Liquidity			-0.169***	-0.166***
			[0.0217]	[0.0214]
Liquidity * ΔCDS			-0.172***	-0.169***
			[0.0200]	[0.0197]
Observations	209,294	209,294	174,781	174,781
R-squared	0.060	0.062	0.089	0.089
Industry*country FEs	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. ΔCDS is the standarized change in the country-level CDS between the weeks before and after the Lehman bankruptcy. The change in the country-level CDS is calculated as an average of the changes in the CDS spread of all domestic banks over the same window. All other independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table A6. Robustness to pre-crisis TFP control: baseline specification

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00630***	0.0290***	0.0291***			
	[0.000654]	[0.00172]	[0.00173]			
Micro firms				-0.0331***	-0.0989***	-0.0989***
				[0.00237]	[0.00595]	[0.00586]
Small firms				-0.0284***	-0.0694***	-0.0700***
				[0.00232]	[0.00474]	[0.00470]
Medium-sized firms				-0.0132***	-0.0338***	-0.0348***
				[0.00211]	[0.00311]	[0.00312]
Age			0.000215*			0.000501***
			[0.000107]			[0.000112]
Age squared			-4.39e-06**			-6.34e-06***
			[1.36e-06]			[1.38e-06]
Debt maturity		-0.00117	-0.00111		-0.00473***	-0.00478***
		[0.000886]	[0.000901]		[0.000952]	[0.000952]
Leverage		-0.0407***	-0.0405***		-0.0333***	-0.0310***
		[0.00329]	[0.00328]		[0.00317]	[0.00315]
Liquidity		-0.187***	-0.187***		-0.235***	-0.231***
		[0.0222]	[0.0224]		[0.0237]	[0.0238]
Observations	452,644	358,530	358,530	458,940	361,614	361,614
R-squared	0.056	0.095	0.095	0.056	0.087	0.087
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. All independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table A7. Robustness to pre-crisis TFP control: exposure to the collapse of Lehman Brothers

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.000521	0.00936***	0.00931***			
	[0.000891]	[0.00163]	[0.00165]			
ln(Employees) * ΔCDS	0.00805***	0.0197***	0.0201***			
	[0.000737]	[0.00167]	[0.00172]			
Micro				-0.0105**	-0.0422***	-0.0419***
				[0.00326]	[0.00545]	[0.00541]
Micro * ΔCDS				-0.0271***	-0.0593***	-0.0596***
				[0.00328]	[0.00570]	[0.00570]
Small				-0.0230***	-0.0465***	-0.0468***
				[0.00268]	[0.00408]	[0.00407]
Small * ΔCDS				-0.00857**	-0.0285***	-0.0286***
				[0.00296]	[0.00479]	[0.00481]
Medium			0.000219		-0.0240***	-0.0246***
			[0.000145]		[0.00294]	[0.00293]
Medium * ΔCDS			-2.94e-06		-0.0129***	-0.0129***
			[1.70e-06]		[0.00355]	[0.00358]
Age			-0.000258			0.000338*
			[0.000134]			[0.000141]
Age squared			1.38e-06			-4.13e-06*
			[1.43e-06]			[1.68e-06]
Age * ΔCDS		-0.00157	0.000266			-6.18e-05
		[0.00202]	[0.00268]			[0.000126]
Age squared * ΔCDS		-0.00195	-0.00207			2.91e-07
		[0.00132]	[0.00179]			[1.40e-06]
Debt maturity		-0.0239***	-0.0207***		-0.00109	-0.00109
		[0.00310]	[0.00409]		[0.00264]	[0.00264]
Debt maturity * ΔCDS		-0.0242***	-0.0261***		-0.00389*	-0.00391*
		[0.00213]	[0.00386]		[0.00186]	[0.00185]
Leverage		-0.158***	-0.141***		-0.0201***	-0.0189***
		[0.0114]	[0.0161]		[0.00400]	[0.00408]
Leverage * ΔCDS		-0.158***	-0.152***		-0.0220***	-0.0220***
		[0.00860]	[0.0167]		[0.00386]	[0.00381]
Liquidity pre-crisis		4.04e-07***	4.04e-07*		-0.163***	-0.162***
		[1.07e-07]	[1.89e-07]		[0.0176]	[0.0177]
Liquidity pre-crisis * ΔCDS		3.36e-07***	3.50e-07*		-0.174***	-0.173***
		[8.95e-08]	[1.59e-07]		[0.0165]	[0.0165]
Observations	208,681	173,727	173,727	212,577	175,487	175,487
R-squared	0.063	0.109	0.109	0.062	0.100	0.100
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. ΔCDS is the standarized change in the country-level CDS between the weeks before and after the Lehman bankruptcy. The change in the country-level CDS is calculated as an average of the changes in the CDS spread of all domestic banks over the same window. All other independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table A8. Robustness to pre-crisis TFP control: bank capitalization

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.0176***	0.0451***	0.0449***			
	[0.00131]	[0.00356]	[0.00363]			
ln(Employees) * Bank capital	-0.00903**	-0.0252***	-0.0251***			
	[0.00299]	[0.00732]	[0.00729]			
Micro				-0.0690***	-0.142***	-0.137***
				[0.00572]	[0.0102]	[0.0104]
Micro * Bank capital				0.0299*	0.0354	0.0344
				[0.0149]	[0.0328]	[0.0314]
Small				-0.0480***	-0.0919***	-0.0881***
				[0.00576]	[0.00925]	[0.00937]
Small * Bank capital				0.0212	0.0588**	0.0557**
				[0.0123]	[0.0203]	[0.0205]
Medium				-0.0191***	-0.0405***	-0.0383***
				[0.00519]	[0.00748]	[0.00764]
Medium * Bank capital				-0.00116	0.0123	0.0104
				[0.0105]	[0.0169]	[0.0170]
Age			0.000155			0.000669*
			[0.000327]			[0.000300]
Age squared			-1.47e-06			-4.42e-06
			[3.29e-06]			[3.16e-06]
Age * Bank capital			-5.72e-06			-0.000429
			[0.000708]			[0.000681]
Age squared * Bank capital			-1.44e-06			1.46e-06
			[6.12e-06]			[6.05e-06]
Debt maturity		-0.00417	-0.00419		-0.00715**	-0.00735**
		[0.00240]	[0.00242]		[0.00266]	[0.00268]
Debt maturity * Bank capital		-0.00753	-0.00720		-0.00466	-0.00439
		[0.0131]	[0.0130]		[0.0132]	[0.0131]
Leverage		-0.0592***	-0.0579***		-0.0554***	-0.0487***
		[0.00814]	[0.00872]		[0.00809]	[0.00867]
Leverage * Bank capital		0.0227	0.0211		0.0176	0.0116
		[0.0327]	[0.0328]		[0.0327]	[0.0328]
Liquidity		-0.482***	-0.479***		-0.541***	-0.522***
		[0.0534]	[0.0542]		[0.0481]	[0.0495]
Liquidity * Bank capital		0.280**	0.270**		0.312***	0.287**
		[0.0939]	[0.0958]		[0.0901]	[0.0932]
Bank capital	0.0415**	-0.162*	-0.167**	-0.00397	-0.212**	-0.211**
	[0.0156]	[0.0661]	[0.0631]	[0.0117]	[0.0814]	[0.0783]
Observations	24,458	20,542	20,542	25,304	20,940	20,940
R-squared	0.079	0.128	0.128	0.077	0.116	0.116
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. Bank capital is a dummy variable that takes a value of 1 if the average pre-recession regulatory Tier 1 capital (in percentage of Risk-Weighted Assets) of a firm's credit banks is above the median.All other independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.

Table A9. Robustness to pre-crisis TFP control: CDS presence

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable			ΔTFP growth			
ln(Employees)	0.00836***	0.0336***	0.0336***			
	[0.000831]	[0.00215]	[0.00216]			
ln(Employees) * CDS presence	-0.00206**	-0.0104***	-0.0102***			
	[0.000726]	[0.00217]	[0.00213]			
Micro				-0.0372***	-0.117***	-0.115***
				[0.00448]	[0.00849]	[0.00818]
Micro * CDS presence				0.00607	0.0325***	0.0317***
				[0.00471]	[0.00936]	[0.00896]
Small				-0.0280***	-0.0808***	-0.0802***
				[0.00429]	[0.00701]	[0.00681]
Small * CDS presence				0.000597	0.0188*	0.0181*
				[0.00456]	[0.00734]	[0.00707]
Medium				-0.0128**	-0.0379***	-0.0379***
				[0.00417]	[0.00545]	[0.00538]
Medium * CDS presence				0.00188	0.00745	0.00702
				[0.00469]	[0.00587]	[0.00578]
Age			0.000213			0.000544**
			[0.000161]			[0.000165]
Age squared			-3.79e-06			-6.15e-06*
			[2.47e-06]			[2.52e-06]
Age * CDS presence			-3.97e-05			-0.000229
			[0.000208]			[0.000213]
Age squared * CDS presence			6.52e-07			2.31e-06
			[2.66e-06]			[2.70e-06]
Debt maturity		-0.000501	-0.000484		-0.00415*	-0.00425*
		[0.00167]	[0.00165]		[0.00176]	[0.00175]
Debt maturity * CDS presence		-0.00224	-0.00213		-9.79e-05	-5.97e-05
		[0.00308]	[0.00306]		[0.00313]	[0.00312]
Leverage		-0.0481***	-0.0476***		-0.0437***	-0.0402***
		[0.00459]	[0.00476]		[0.00472]	[0.00500]
Leverage * CDS presence		0.0162*	0.0155*		0.0162*	0.0141
		[0.00682]	[0.00716]		[0.00720]	[0.00771]
Liquidity		-0.202***	-0.201***		-0.251***	-0.244***
		[0.0442]	[0.0452]		[0.0500]	[0.0503]
Liquidity * CDS presence		0.0709	0.0695		0.0927	0.0869
		[0.0632]	[0.0642]		[0.0729]	[0.0732]
CDS presence	0.00265	-0.100***	-0.100***	-0.00517	-0.125***	-0.122***
	[0.00219]	[0.0145]	[0.0142]	[0.00442]	[0.0218]	[0.0208]
Observations	208,681	173,727	173,727	212,577	175,487	175,487
R-squared	0.062	0.101	0.101	0.061	0.092	0.093
Industry*country FEs	Yes	Yes	Yes	Yes	Yes	Yes

Note: The dependent variable is the difference in the average TFP growth between the pre- and post-crisis periods. CDS presence is a dummy variable that takes a value of 1 if at least one of the firm's creditor banks is traded in the CDS market. All other independent variables are measured at the pre-crisis period. Standard errors (in brackets) are clustered at the four digit industry*country level. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent respectively.