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Debt Overhang, Rollover Risk and Investment in Europe

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Abstract

We find that debt overhang and rollover risk translate into sluggish investment in Europe. Using an extensive pan-European firm-bank matched data set covering public and private firms, we document that firms with higher debt overhang – defined as higher corporate indebtedness relative to earnings – invested less prior to the 2008 European crisis, and this negative effect intensified during the crisis. In the run-up to the crisis European firms financed investment increasingly using debt, including short term debt, exposing firms to rollover risk in the event of a reversal in lending conditions. During the crisis period, the investment of firms with longer maturity debt was less curtailed, consistent with an increase in rollover risk, while markets for short-term debt collapsed. We document that the worsening of debt overhang and increasing rollover risk during the crisis can be linked to an increase in sovereign risk in peripheral European countries. Rollover risk in peripheral Europe increased especially for firms with preexisting borrower relationships with banks whose balance sheets deteriorated because of large holdings of peripheral sovereign bonds, highlighting the role of sovereign-bank linkages in affecting firm investment. A simple back of the envelope calculation based on our firm-level estimates suggests that the debt overhang and rollover risk channels together explain more than half of the actual decline in aggregate corporate investment in the aftermath of the crisis.

JEL-Codes: E22, E32, E44, F34, F36, G32
Keywords: Firm Investment, Debt Maturity, Bank and Firm Balance Sheet, Sovereign Risk

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1 Introduction

Investment expenditure in Europe collapsed in the aftermath of the 2008 global financial crisis. Figure 1 and figure 2 show that, by 2014, corporate investment as a share of GDP across the Eurozone had fallen by more than 50 percent from its peak in 2008, with higher declines in the most crisis-affected countries. The decline of investment in Europe has been about double that in the US and Japan over the same period, and the decline has been more persistent, with investment as a share of GDP recovering since 2010 in the US and Japan but not (yet) in Europe.

This collapse in investment followed a boom period during which corporate sector borrowed heavily. Figure 3 shows that indebtedness of EU non-financial corporations, measured as debt liabilities to GDP, increased 30 percent during 2000s. This increase in indebtedness was driven by favorable lending conditions, both low interest rates and lax lending standards, during the boom years.

We investigate whether the high level of corporate indebtedness has been a contributing factor to the observed decline in investment, in other words, whether debt overhang is holding back private-sector investment. In the finance literature, debt overhang is defined as high levels of debt that are curtailing investments because the benefits from additional investment in firms financed with risky debt accrue largely to existing debt holders rather than shareholders (Myers, 1977). This reduced incentive to invest implies that firms with high levels of debt face an underinvestment problem. In the macro literature debt overhang is often more loosely referred to as a situation where high levels of public debt are crowding out private investment.[1] In this paper we refer to debt overhang as a situation where high levels of corporate debt combined with low corporate earnings are holding back corporate investment. A higher ratio of debt-to-earnings signals a lower capacity to repay debt and that a larger fraction of earnings

[1] See for example Aguiar, Amador, and Gopinath (2009), who develop a model of optimal taxation of foreign capital and optimal sovereign debt policy in a small open economy where the government cannot commit to policy, the government's lack of commitment induces a negative correlation between investment and the stock of government debt, which they label a debt overhang effect. In the macroeconomic literature, debt overhang has typically been analyzed in the context of sovereign-debt crises. Krugman (1988) analyzes the choice between financing and forgiving the debt from the perspective of creditors. Bulow and Rogoff (1991) show that a country cannot gain by openly repurchasing its debt at market prices.

needs to be used to cover interest payments instead of new investments. The debt-to-earnings ratio has a comparable counterpart in the loan-to-income ratio often used to assess debt repayment capacity of mortgage borrowers (see for instance (Melzer, 2012)). It is also comparable to debt to GDP ratio at the country level.

The existing explanations for low investment and growth in Europe so far have emphasized the role of low aggregate demand and balance sheet effects. Balance sheet effects can operate via banks, when a deterioration in banks' balance sheets results in a deterioration in lending conditions and the supply of credit, or via firms, when firms with deteriorating balance sheets become risky borrowers. The debt overhang channel we focus on is different from these other channels. A firm with debt overhang may not invest even though its net worth is positive or the bank it borrows from is not weak. If low investment in Europe is mostly due to a debt overhang effect, then recapitalizing banks, while important, is not sufficient. So far this debt overhang channel has not received much attention in the literature. The literature on debt overhang during the recent crisis has thus far focused mostly on debt overhang in the sovereign and banking sectors (Philippon and Schnabl, 2013; Becker and Ivashina, 2014b) or the household sector (Melzer, 2012).[2] The corporate sector has received less attention, in part because of data limitations.[3]

Our data set allows us to distinguish between short-term and long-term debt, in order to assess the influence of debt maturity on firm investment. Short-term debt can be problematic during crises due to rollover risk (Diamond, 1991). Firms with short-term debt might experience increased rollover risk as lenders are often unwilling to renew expiring credit lines during a crisis when collateral values drop and financial conditions deteriorate. For instance, (Acharya, Gale, and Yorulmazer, 2011) show that even small changes in collateral values can lead to dramatic changes in debt capacity when firms' short-term debt needs to be frequently rolled over, potentially leading to a collapse in the market for short-term lending. Similarly firms with expiring debt contracts will find it more difficult to issue new short-term bonds

[2] For instance, Melzer (2012), using US microdata on household expenditures, shows that debt overhang plays an important role in household financial decisions, as negative equity homeowners cut back substantially on home improvements and mortgage principal payments during the recent financial crisis.

[3] An exception is Giroud and Mueller (2015) who study the impact of leverage, not debt overhang, on employment in a sample of US firms.

when interest rates rise due to heightened sovereign risk.[4]

We use a difference-in-difference approach to identify the effect of corporate debt overhang on investment, taking the difference between high and low debt overhang firms and the difference between countries that experienced a crisis and those that did not to identify the effect. We do the same for rollover risk, which we will measure as the share of short term debt in total debt. We capture a country-specific crisis shock using the recession date for the country. We further consider the role of sovereign risk and banking conditions, including banks' exposure to the sovereign, as underlying channels of the crisis shock.

A key challenge for identification is to account for the role of changes in credit demand, together with unobserved firm and bank factors. It might be possible that firms are decreasing investment due to idiosyncratic negative demand or productivity shocks, or due to relationships with weak banks. Bank distress can negatively affect the investment of firms due to the stickiness of bank relationships (Chodorow-Reich, 2014) and the fact that firms in Europe are highly dependent on bank finance, especially small firms for which monitoring costs tend to be high (Hoshi, Kashyap, and Scharfstein, 1990; Bae, Kang, and Lim, 2002). The difference-in-difference approach and the richness of our data set allows us to include firm and lender fixed effects to account for the impact on investment of unobserved time-invariant firm and bank specific conditions, while controlling for the deterioration in the balance sheet of the exact bank that our firms borrow from. To control for demand and productivity shocks we use four-digit industry-country-year fixed effects. These effects will absorb the impact of changes in credit demand for the four-digit sector that our firms operate in and also aggregate demand conditions, including those arising from changes in sovereign and general uncertainty conditions. We assume that most of the fluctuations in aggregate demand derive from country

[4]Debt maturity may also affect the debt overhang by altering incentives to invest. According to Myers (1977), short-term debt reduces the debt overhang problem because the value of shorter debt is less sensitive to the value of the firm and thus receives a much smaller benefit from new investment. In the extreme, if all debt matures before the investment decision, then the firm without debt in place can make investment decisions as if an all-equity firm. Thus, according to Myers (1977) firms with a shorter maturity of debt are expected to experience reduced debt overhang and invest more. However Diamond and He (2014) spell out conditions under which reducing maturity can increase debt overhang. They show that while for immediate investment, shorter-term debt typically imposes lower overhang, for firms with future investment opportunities, shorter-term debt may impose stronger debt overhang in bad times. The reason is that sharing of less risk by shorter-term debt implies more volatile earnings and equity, and hence more debt overhang.

and narrowly defined industry-specific factors, not firm-specific factors. The identifying assumption here is that firms with high debt are subject to similar demand shocks as firms with low debt in the same four-digit industry and country. We are not the first to control for demand using industry fixed effects in general (see, e.g., Nanda and Nicholas, 2013, Acharya, Eisert, Eufinger, and Hirsch, 2014) but to the best of our knowledge we are the first to allow these effects to vary at a very fine level (four-digit) of industry classification and also across countries and over time. While the inclusion of four-digit industry-country-year fixed effects may not capture all firm-specific demand shocks, all we need for our identification approach to be valid is that any remaining variation in firm specific demand conditions does not vary systematically by the level of firm indebtedness.

Consistent with the theories on debt overhang and rollover risk, our findings are twofold. Debt overhang defined as the ratio of total debt to earnings exerts a negative influence on firm investment, both during regular and crisis times, even after controlling for the decline in earnings relative to capital and changes in firm leverage (debt to capital ratio). The crisis times effect is driven primarily by changes in sovereign risk. Our second key finding is that short-term debt does not curtail investment during normal times (if anything it has a positive effect reflecting the fact that most investment is financed by short-term debt) but becomes a drag on investment during crisis times. This is consistent with the view that the crisis has increased rollover risk for short-term debt, forcing firms with short-term debt to reduce investment. As before, we find that firms with more short-term debt reduce investment during the crisis when those firms are located in countries with weak sovereigns. This is consistent with an increase in rollover risk for highly indebted firms during the crisis arising from heightened default risk due to increased sovereign risk, which raises borrowing rates and makes it more difficult to obtain new debt to finance investment. We also find a role for deteriorating bank balance sheets in increasing rollover risk, especially for peripheral European firms. Firms who have a relationship with weak banks decrease investment (consistent with a traditional lending channel) but such firms decrease investment even more if they enter the crisis with a higher share of short-term debt. These results are novel and unique in the literature given the fact that results on debt overhang and rollover risk are obtained after conditioning on the possibility

that firms might also have deteriorating balance sheets and declining earnings.

We obtain these findings using a unique and comprehensive firm-level data set based on AMADEUS in order to identify corporate sector debt overhang effects in Europe. The firm data set is hand-matched to banks and sovereigns. With the exception of Germany, our data covers at least 50 and as much as 90 percent of the economic activity reported in Eurostat. Our data contains information on both income statement and balance-sheet variables. This makes it possible to relate real economic outcomes to financial decisions at the micro level in a large and representative sample of European firms. Our data set covers not only large publicly-listed firms, as in most of the studies focusing on investment and employment in the literature, but also small and privately-held firms. The advantage of including small firms is that a more precise estimate of debt overhang can be obtained because small firms make up a large fraction of economic activity in Europe[5] and because debt overhang is likely to be more pronounced in small firms than in large firms. The reason is that information asymmetries tend to be larger in small firms, increasing the riskiness of debt.[6] In addition for the role of weak bank and firm balance sheets, the effects of banking distress on firms' access to financing are likely to weigh more heavily in Europe than in the United States, because Europe consists primarily of bank-dominated economies dominated by bank-dependent, small firms (Mayer and Vives, 1995). The impact on corporate investment will depend partly on the ability of firms to substitute bank financing for other sources of financing, which only big firms can do (Kashyap, Lamont, and Stein, 1994a,b; Kashyap, Stein, and Wilcox, 1993).

The cross-country nature of our data set allows us, as opposed to country-specific case studies, to exploit country differences in the financial conditions, not only of the corporate sector, but also of the sovereign and banking sectors. We do this by linking our firm-level data set to lenders (and their sovereigns) using information from Kompass database on the main banks and secondary banks of the firm. This allows us to identify more precisely the underlying channels for the deterioration of debt overhang in the corporate sector during the

[5]Firms with less than 250 employees make up 70 percent of employment and value added in Europe. See official statistics as of 2013 from Eurostat's Structural Business Statistics. The share of economic activity accounted for by small and medium sized firms in our data is representative of the official data.

[6]Moreover small firms are more likely liquidated rather than reorganized in the event of distress, leading lenders to require more collateral to secure long-term loans (Smith and Warner, 1979).

crisis, including the extent to which stressed conditions of the sovereign and/or banks are contributing to debt overhang in the corporate sector.

Sovereign-bank linkages can arise through different channels. One direct channel arises from banks holding significant amounts of sovereign debt. As sovereign default risk increases and sovereign ratings get downgraded, the net worth of banks holding such sovereign debt will be negatively affected (Gennaioli, Martin, and Rossi, 2014; Baskaya and Kalemli-Özcan, 2014). A second sovereign-to-bank linkage arises from the role of the government in (explicitly or implicitly) backstopping the financial system, through guarantees and bank bailouts (Laeven and Valencia, 2013). This is also reflected in sovereign ratings acting as a ceiling for bank ratings, as documented in Adelino and Ferreira (2014). Such bailouts can add significantly to sovereign debt, increasing sovereign risk (Acharya, Drechsler, and Schnabl, 2014). Weaknesses in the banking sector can reinforce these sovereign-bank linkages. First, as banks' profits decline, government tax revenues from the financial sector are likely to decline, increasing sovereign risk. Second, the financial condition of banks will most likely have a bearing on banks' demand for sovereign bonds. For instance, banks, being protected on the downside by limited liability, have strong incentives to game the regulatory system that places zero risk weights on own sovereign holdings by borrowing in cheap funding currencies to increase their holdings of own sovereign debt. Such carry trade incentives increase as the banks approaches distress, reinforcing the loop between weak bank and weak sovereigns (Acharya and Steffen, 2014).

Our results imply strong economic effects, both at the firm level and at the aggregate level. During crisis times, a one standard-deviation decrease in the earnings-to-debt variable–capturing debt overhang–decreases investment by 0.02 more than during normal times, whereas a similar increase in the share of short term debt–capturing rollover risk–decreases investment by 0.03 more than during normal times. These are large effects relative to the mean investment ratio of 0.11. We use these firm-level estimates to gauge the aggregate implications of debt overhang and rollover risk. A simple back of the envelope calculation suggests that the debt overhang and rollover risk channels we measure can explain more than half of the actual decline in aggregate corporate investment during the crisis. During the crisis, a one percentage

point reduction in debt service capacity reduces the mean investment ratio by 0.07, whereas a similar increase in the fraction of long term debt decreases investment by 0.17. Given the reduction in aggregate debt service capacity of 15 percentage points and increase in aggregate share of long term debt of 9 percentage points over this period, our micro-based estimates of debt overhang and rollover risk imply a decline in aggregate investment of 2.6 percentage points, which each contributing about half. Together this is more than half of the actual decline of 4 percentage points in aggregate investment during the crisis. As a result, debt overhang and rollover risk can explain a substantial part of the actual decline in aggregate corporate investment.

Our paper proceeds as follows. Section 2 presents a literature review. Section 3 presents the data set used in the paper. Section 4 presents the identification methodology. Section 5 presents our main results, extensions and robustness tests of our main results. Section 6 concludes.

2 Related Literature

Our paper relates to a large literature on the role of financial factors in investment decisions. At the macro level, Bernanke and Gertler (1989) were the first to show theoretically that financial frictions, such as those arising from borrowing constraints, have a bearing on corporate investment. Under those financial factors, Lamont (1995) is on of the first in treating corporate debt overhang in a macroeconomic model. The finding is that the effect of debt overhang varies according to economic conditions. When the economy is booming, debt overhang will not bind because investment returns are high. If the economy is in a downturn, however, debt overhang will bind because investment returns are low. Debt overhang thus creates a threshold value for investment returns below which the firm cannot attract funds and invest. As a result, high levels of debt can create multiple equilibria in which the profitability of investment varies with economic conditions. More recently, Occhino and Pescatori (2010) calibrate a model with debt overhang. They show that the debt overhang effect is counter-cyclical, increasing during recessions when default risk is higher, and find that debt overhang improves

the fit to data of a their model, compared to a model where it is absent.

The evidence also supports the hypothesis of the existence of a role of financial factors on investment. Empirically, at the firm level, Whited (1992) shows that adding debt capacity variables to a standard investment model improves the model fit, suggesting that financial factors do play an important role in the firms' investment decisions. Similarly, Bond and Meghir (1994) finds an empirical role for debt in standard investment models. More specifically, a number of papers have documented the significance of debt overhang on corporate investment, by using listed firms data from US. For example, Lang, Ofek, and Stulz (1996) document a negative relationship between debt and investment for firms without valuable growth opportunities. Hennessy (2004) shows that debt overhang distorts the level and composition of investment, with a severe problem of underinvestment for long-lived assets. A significant debt overhang effect is found, regardless of firms' ability to issue additional secured debt. Hennessy, Levy, and Whited (2007) corroborate large debt overhang effects of long-term debt on investment, especially for firms with high default risk.

Closer to our paper is the literature identifying the role of credit conditions on firm investment by using exogenous bank shocks. For instance, Hoshi, Kashyap, and Scharfstein (1990) shows that Japanese firms tied to banks through ownership links fared better during the 1990s Japanese crisis. Along the same lines, Bae, Kang, and Lim (2002) shows that the valuation of Korean firms with durable lending relationships suffered less during the 1997-98 financial crisis. Furthermore, Kalemli-Özcan, Kamil, and Villegas-Sánchez (2010), using data from six Latin-American countries during 1990-2008, shows that only during banking crisis –when banks get a liquidity shock– do foreign-owned firms invest more than domestic firms, and not during recessions or balance-of-payments crisis. In this regards Amiti and Weinstein (2014), employing matched bank-firm loan-level data from Japan, corroborates that banking shocks to the supply of credit have large effects on corporate investment.

Our work also relates to recent empirical literature on sovereign-bank linkages. Gennaioli, Martin, and Rossi (2013) shows that banks tend to hold large amounts of sovereign paper on their balance sheets, and that they increase these exposures during crises, reinforcing bank-sovereign linkages. Using Turkish 1999 earthquake as an exogenous fiscal shock, Baskaya and

Kalemli-Özcan (2014) shows that banks which had higher exposure to government debt reduced their lending more after the earthquake, while Adelino and Ferreira (2014) finds that as sovereign ratings are downgraded, bank ratings are negatively affected as well, increasing banks' funding costs and reducing their credit supply. Focusing on Europe, Popov and Van Horen (2014), using data on syndicated loans, shows that banks with exposure to stressed sovereign debt cut back on lending, especially cross-border lending. Similarly, also using syndicated loans, Becker and Ivashina (2014a) shows that the increase in holdings of sovereign bonds led to a crowding out of corporate lending, while Acharya et al. (2014), using syndicated loans too, shows that firms borrowing from banks in peripheral Europe decreased their investment more.

3 Data and Measurement

3.1 Firm-Level Data

Our firm-level data comes from the ORBIS database (compiled by Bureau van Dijk Electronic Publishing, BvD). ORBIS is an umbrella product that provides firm-level data that covers around 100+ countries worldwide, developed and emerging, since 2005. Certain country subsets of the database that cover different countries (such as Europe) go back to 1996. This is a commercial data set, which contains administrative data on 130 million firms worldwide. The financial and balance-sheet information is initially collected by local Chambers of Commerce and in turn, is relayed to BvD through some 40 different information providers including official business registerers.

The data set has financial accounting information from detailed, harmonized balance-sheets, income statement and profit/loss accounts of financial and non-financial firms. This data set is crucially different from other data sets that are commonly-used in the literature such as COMPUSTAT for the United States, Compustat Global, and Worldscope databases, since 99 percent of the companies in ORBIS are private, whereas former data sets contain mainly information on large listed companies. In ORBIS, only less than 2 percent of the firms are publicly

listed (which is also separately marketed under the product called OSIRIS). Our sample is mainly composed of small and medium size enterprises with less than 250 employees, and these firms account for almost 70 percent of the value added and employment in Europe, both in the manufacturing sector and in the aggregate economy.[7] Given our paper's focus we use the European subset of the ORBIS umbrella, the database known as AMADEUS. One advantage of focusing on European countries is that company reporting is a regulatory requirement (as opposed to firms operating in the US), and therefore firm coverage is superior.

The main financial variables used in the analysis are total assets, sales, operating revenue (gross output), tangible fixed assets, intangible fixed assets, liabilities, and cash flow. We transform financial variables to real using CPI with 2005 base and converting to dollars using the end-of-year 2005 dollar/national currency exchange rate. The data set has detailed sector classification (up to four-digit NACE Rev. 2 industry classification). We drop financial firms and government-owned firms, and use all the other sectors.

It is a well known problem in AMADEUS/ORBIS that although there are many unique firm IDs covered, once the data is downloaded many key variables, such as employment, are missing. This is because employment is not a balance-sheet item but rather reported in memorandum lines. Missing observations may also arise because BvD has an internal policy by which firms that do not report during a certain period of time are automatically deleted from their later vintage products, creating an artificial survival bias. Therefore, it is necessary to download data not only from the most recent product but also from historical disks, as we do (instead of downloading historical data through the Wharton Research Data Services WRDS website commonly used by researchers). In order to maximize the coverage of firms and variables by country over time, we follow the process as described in detail in Gopinath, Kalemli-Özcan, Karabarbounis, and Villegas-Sánchez (2015) and Fons-Rosen, Kalemli-Özcan, Sørensen, Villegas-Sánchez, and Volosovych (2013). We rely on the two products provided by BvD: ORBIS and AMADEUS. The reason to make use of both products is that they have been developed independently and therefore, follow different rules regarding the companies and years that should be included. AMADEUS provides at most data for 10 recent years for the

[7] See Eurostat's Structural Business Statistics (SBS) presented according to NACE Rev. 2 classification.

same company while ORBIS only reports data for up to 5 recent years. In addition, AMADEUS drops firms from the database if they did not report anything during the last 5 years while ORBIS keeps the information for these companies as long as they are active.[8] We make use of several vintages of these two products: ORBIS disk 2005, ORBIS disk 2009, ORBIS disk 2013, AMADEUS online 2010 (from WRDS) and AMADEUS disk 2014. For each vintage we download information on all European countries using the "relative year" option (as opposed to "absolute year" option). This option specifies that for each firm the latest year the company has filed information to BvD is used as the reference year and we obtain information for the previous 5 years relative to the base year. In addition, notice there is a reporting lag of usually 2 years (it varies by country) so that for example the coverage of years 2007 and 2008 from ORBIS 2009 disk (or an online download) will be very poor and therefore, complemented by ORBIS 2013 or AMADEUS 2014. An additional issue is that any online download (BvD or WRDS) will cap the amount of downloads (number of firms) that can be done in a given period of time and this cap unfortunately translates into missing observations in the actual download instead of termination of the download job. Finally, it is sometimes the case that information is updated over time and the value of variables that was not available in early disks is made available in later vintages. As explained above, to maximize not only the number of firms in the sample but the coverage of variable information we merge across all the above mentioned products using a unique firm identifier and updating financial information when missing in early vintages by the value provided in later vintages.

Table 1 summarizes the coverage in our data for selected countries. Each entry in the table represents the ratio of the total wage bill recorded in our sample relative to Eurostat, as reported by the Structural Business Statistics (SBS). As Table 1 shows that the coverage in our sample is high and generally ranges from roughly 50 to over 90 percent of the total wage bill.[9]

[8]For example, a company might file information with BvD for the last time in year 2007. However, BvD has information from the Business Registry that this company is still active. In the 2013 AMADEUS disk this company will not be included in the database (it has not reported any financial information for the past five years). However, information for the period 2002-2007 for this company will be available in ORBIS-2013 disk.

[9]We obtain slightly higher coverage when we calculate similar statistics based on gross output. We obtain slightly smaller coverage when we calculate similar statistics based on employment. This is because our data does not cover the self-employed, whereas in Eurostat the closest variable to our employment variable is the "number of persons employed" which includes the self-employed.

The exception is Germany, for which we roughly have one-third of the wage bill starting in 2006. This is due to the law in Germany that stayed in effect until 2009 that small companies do not have to file their accounts. We also match the size distribution in terms of employment to official census data as shown in Gopinath et al. (2015) and Fons-Rosen et al. (2013).

3.2 Matching Firm- and Bank-Level Data

Our analysis makes use of a novel data set of bank-firm relationships in Europe. Our database includes, for each firm, a variable called BANKER showing the name of the firm's main bank(s) relationship, which, following the literature, we assume to be the main bank(s) that the firm borrows from. We obtain this information through the AMADEUS database but the original source is Kompass. This data has been used before by Giannetti and Ongena (2012), among others, to study bank-firm relationships. Kompass provides the bank-firm connections in 70 countries including firm address, executive names, industry, turnover, date of incorporation and, most importantly the firms' primary bank relationships. Kompass collects data using information provided by chambers of commerce and firm registries, but also conducts phone interviews with firm representatives. Firms are also able to voluntarily register with the Kompass directory, which is mostly sold to companies searching for customers and suppliers. We use the 2013 vintage of the database as built in AMADEUS and take both the primary and secondary firm-bank relationship. We checked with 2015 vintage and confirmed (as many others in the literature) that firm-bank relationships are sticky.[10]

Our difference with other papers using Kompass database is that we use the firm-bank match for all countries in Europe, the biggest sample as far as we know, instead of for individual countries or a subregion. And more importantly, since our firm-level sample is representative and bigger compared to other papers, the selection issue caused by the reporting bias is less of a concern in our case.[11]

An initial hurdle is to match bank information to firm data, since the name of the bank

[10] Giannetti and Ongena (2012) use both 2005 and 2010 vintages confirming the same result.

[11] Some firms report their banks and some do not. For example, in Italy and Norway no firm reports their banker names so the firms from these countries will be in our "all-firms sample" but not in our "matched-firms sample".

is the only information available to do so, and there is no standardized procedure to match Bankscope bank names. We make use of the programs *OpenRefine* and *OpenReconcile* that offer several approximate-matching algorithms. We use these programs to match the BANKER variable to the bank names Bankscope. Our match rate is very high: 87.6% of all bank name observations. Most of the unmatched observations correspond to small cooperative banks for which data is not available in Bankscope. Table 2 describes how many of these relations are multiple (with more than one bank) or cross-border (with banks whose parent company is foreign). Many firms report more than one banker and around a third report at least one foreign banker. Firms in France and Slovenia only report a maximum of one bank only; firms in other countries can also report multiple banks. In the case where multiple bank relationships are reported, the first listed bank is the main bank. We use this information to link each firm to its main bank. Next, we combine firm-level data from AMADEUS with bank-level data from Bankscope. Bankscope is a data set, also from BvD, containing balance sheet information about more than 30,000 banks spanning most countries and data up to 16 years.

3.3 Matching Bank-Level Data to Sovereigns

To determine the country of origin of each bank in our sample, we need to trace its ownership information to the ultimate owner. We set the country of origin of each bank equal to the country of origin of the ultimate owner of the bank, even if this entity is incorporated in a foreign country, under the assumption that it is the strength of the parent bank and the safety net provided by the home country of the parent bank that together determine the strength of each subsidiary rather than that of the host country. Banks in the Bankscope database are all recorded as domestic legal entities, including the subsidiaries of foreign parent companies. We therefore need to take an extra step to identify the ultimate sovereign country of each bank, i.e., the sovereign country of the entity that is the ultimate owner of the bank. We trace this information using the Global Ultimate Owner (GUO) variable. Then, we use its consolidated balance sheet reported directly in Bankscope. This is important to capture the internal capital markets of the bank.

Whenever the GUO information is missing, a couple of criteria are used. First, some of the banks listed are actually branches of foreign banks. These are matched by hand to their GUO abroad. Second, some banks are reported to be independent or "single location" (i.e., they have only one branch). For these banks, the GUO is the bank itself. And finally, using the independence indicator provided by BvD, for banks with high degree of independence (i.e., values B-, B or B+), the GUO will be also the bank itself, as in the previous case.

For robustness, we also simply use the unconsolidated balance sheet and country of origin of the subsidiary bank instead of the parent bank. This distinction turns out to be important when we evaluate bank weakness with respect to sovereign holdings.

In terms of cleaning the matched data set, we drop observations with problematic values both on the bank and firm side. Total fixed assets, intangible fixed assets, total assets, sales, long-term debt, loans, credits, other current liabilities, total shareholder funds and liabilities, and total liabilities cannot be negative. Also, ratios of short-term debt and long-term debt to total liabilities above one are removed from the sample. We drop firm-year observations in four-digit sector and years with less than 10 observations. On the bank side we drop central banks and governmental credit institutions, which represent less than 2% of all firm-banker relations. All variables are winsorized before entering the regressions.

3.4 Measurement and Descriptive Statistics

Investment in real capital expenditures can be measured on a gross or net basis. If investment expenditures just match the depreciation of capital equipment, then gross investment is positive, but net investment remains unchanged. Therefore, net investment matters most regarding future productivity. Consequently, we use net investment rate in our empirical work, computed as the annual change in fixed tangible assets.[12] (gross investment rate is then computed as net investment plus depreciation rate.)[13] An additional advantage of using net investment is that we retain observations that otherwise would be lost due to missing data on

[12] Using net investment is common in the literature; see for example Lang, Ofek, and Stulz (1996).

[13] Using an alternative measure, such as the change of the natural logarithm of capital stock between current and past period, does not alter results.

depreciation. Despite loss of such observations, we also show robustness results with gross investment. We use both measures as a ratio to lagged capital stock, i.e. investment rates.

We measure debt overhang as the ratio of total debt to earnings. Earnings is measured as EBITDA (earnings before interest, tax, depreciation, and amortization), and total debt is measured as the sum of long-term debt, loans, credit, and other current liabilities. We also use net debt – total debt minus cash – to EBITDA as an alternative measure. [14] The rationale for this measure of debt overhang is as follows. Debt overhang is not only about high levels of debt but rather the ability to generate sufficient cash flows to repay the debt (both principal and interest payments).[15] Hence it is different than leverage, that is the inverse of a firm's net worth and therefore captures traditional balance sheet effects.

To capture leverage, and thus a firms' balance-sheet strength, we use debt-to-capital ratio. A company will not have any debt overhang problem, even if it has a lot of debt, if it generates sufficiently high cash flows to cover debt payments and leave enough cash flow available for investment. The same company might have high leverage though. Debt overhang is thus distinct from firm leverage because leverage does not capture the ability to repay debt from generating sufficient cash flow. Nevertheless, we show results both with and without the debt-to-EBITDA (debt service capacity) and debt-to-capital (leverage) ratios to stress the importance of this distinction. In fact, figure 4 makes clear that, with the exception of Greece, none of the peripheral European countries entered the crisis with high leverage. This may be interpreted as having low debt overhang at the onset of the crisis. As figures 5 and 6 show, this was clearly not the case.

To capture rollover risk we use the share of long term debt in total debt (maturity). [16] An increase in short term debt poses increased rollover risk during bad times. The maturity structure of debt may also indirectly capture debt overhang effects, as in the model in Diamond and

[14] The ratio of net debt to EBITDA is widely used by financial analysts and loan officers to determine a firm's ability to repay its debt and thus to determine the existence of debt overhang.

[15] We also used interest paid on financial instruments and financial expenses that include write-offs, obtaining similar qualitative results. We prefer to use the level of debt because information on interest paid is missing for many firms and debt repayment capacity is not only about interest payments but also principal repayment

[16] Long-term debt comprises all borrowing from credit institutions (loans and credits) and bonds, whose residual maturities are longer than one year. Short-term debt comprises all current liabilities, i.e. loans, trade credits and other current liabilities, with residual maturities shorter than one 1 year.

He (2014) where more short-term debt increases debt overhang especially during bad times due to increased rollover risk. [17] Moreover, small firms finance investment predominantly with short-term debt and hence there is an inherent negative correlation between long-term debt share in total debt and investment during regular times. It is therefore important to also control for firms size to assess the independent effect of debt maturity on firm investment. We thus use the share of long-term debt in total debt as a variable capturing the role of maturity.

We measure cash flow using the EBITDA-to-capital ratio, which is typically used in the literature to measure financial constraints. Given mis-measurement problems in measuring a firm's growth opportunities, cash flow is likely to also capture growth opportunities. [18] To measure productivity and future growth opportunities we follow the literature and use sales growth.

We measure bank weakness of the firm's main lender using the share of sovereign holdings of the bank over total assets in periphery countries. We use both the subsidiary bank's sovereign holdings and the holdings of its parent bank. The distinction is important only if the parent bank is located in another country than the subsidiary. Following Gennaioli, Martin, and Rossi (2013) we assume that most of the bank's sovereign bond holdings are domestic bonds. Based on confidential data from the ECB's IBSI database, containing financial statements for the majority of banks in our sample, around 70% of euro area banks' sovereign bond holdings are domestic, with a even higher percentage in peripheral countries.

Bank weakness is then determined depending on whether the bank's sovereign holdings are those of periphery countries based on the domicile of the bank. This measurement is justified by the "doom loop" between banks and sovereigns during this crisis. We also used alternative measures of bank weakness based on bank leverage and total capital ratio. However given that most bank assets and liabilities are not marked to market, these balance sheet variables do not register large enough movements to qualify as reliable measures of bank weakness.

We measure sovereign weakness using the sovereign spread between the country's long-

[17] In contrast to the model in Myers (1977) where debt overhang operates through long-term debt.

[18] See Gomes (2001) on the critique of using cash flow to measure financial constraints when used along with other growth measures such as sales growth and Tobin's Q.

term government bond and German *Bunds*. We also define a weak sovereign binary variable for the sovereign of the country in which the firm is located. The weak-sovereign variable equals 1 when the Moody's foreign-currency long-term debt rating classification of the firm's sovereign falls below the A1 notch. This is the median rating for euro area countries before the European sovereign crisis intensified. Alternatively we use a sovereign default risk variable, measured as the cumulative probability of corporate default of the corresponding Moody's rating notch (as an average over 1983-2010). We also created similar variables based on the sovereign of the bank, obtaining similar results since most banks in our sample are domestic, as opposed to a sample consisting of only Eastern European countries.

Table 3 shows descriptive statistics on all variables. In general, there is a good deal of variation that allows the identification of the econometric effects of interest. For instance, while the average net investment ratio is a positive 18 percent, it varies widely with a standard deviation of 59 percent and a minimum value of -60.6 percent. Firm leverage also varies widely, with a large fraction of firms close to zero or no long-term debt and with short-term debt on average being three times as large as long-term debt. Banks' financial capitalization also varies markedly, despite bank regulation, with the regulatory capital ratio ranging from a low of 7 percent to well above its average of 12.9 percent. Sovereign risk varies much less during the first part of the sample period but its variation increases markedly as the sovereign-debt crisis intensifies.

Table 4 shows the same statistics for the matched firm-bank sample. As it can be seen, there is not a systematic difference between all firms and matched firms sample and we believe we do not have a selection issue in terms of bank reporting. However, we will still run regressions not requiring bank variables for both samples in order to ensure our results do not change among samples.

4 Identification

To identify the effects of debt overhang and rollover risk on firm investment, we use a difference-in-difference investment specification, including country-sector-year, bank, and firm fixed ef-

fects. These absorb the impact on investment of changing country (including sovereign) and sector conditions, and aggregate demand. Specifically, firm and bank fixed effects will control for unobserved, time-invariant heterogeneity across firms and banks; industry fixed effects at four-digit-level sector codes, will absorb time-varying demand conditions, since most of the aggregate demand fluctuations derive from country- and industry-specific factors, not from firm-specific factors. All variables are winsorized at the 1% level.

We first run the following difference-in-difference regression of investment on debt, starting without interactions and then interacting all variables with the variable $POST_{ct}$. This is a binary variable equal to 1 starting the year when country c enters recession. For most countries, the recession started in 2008, but for some, it started in 2009 or 2007. The baseline econometric model is:

$$\begin{aligned}\left(\frac{\text{Investment}}{\text{Capital}}\right)_{isct} &= \beta\,\text{Overhang}_{isc,t-1} \times POST_{ct} + \lambda\,\text{Overhang}_{isc,t-1} \\ &+ \delta\,\text{Maturity}_{isc,t-1} \times POST_{ct} + \omega\,\text{Maturity}_{isc,t-1} \\ &+ \psi\,\text{Leverage}_{isc,t-1} \times POST_{ct} + \epsilon\,\text{Leverage}_{isc,t-1} \\ &+ \mathbf{X}_{isc,t-1}{}'\boldsymbol{\gamma} + \alpha_i + \omega_{cst} + \varepsilon_{isct}\end{aligned} \tag{1}$$

where α_i is a firm-specific fixed effect and ω_{cst} is a country-sector-year fixed effect. The vector $\mathbf{X}_{isc,t-1}$ contains the control variables including cash flow (measured as ratio of EBITDA to capital) and sales growth (Δ log Sales) and firm size measured as log of capital. All right-hand side variables are lagged. We use the reciprocal of our debt-overhang measure (ratio of debt to EBITDA), which is debt service capacity since earnings – measured by EBITDA – may be zero or negative; this way, a higher EBITDA-to-debt ratio means lower debt overhang via higher debt service capacity. The ratio of long-term debt to total debt captures the role of maturity, which acts differently in crisis times when rollover risk increases. The ratio of total debt to capital measures firm leverage and captures balance sheet weakness.

We also run the same regression before and after 2010 as this year marks the sovereign debt crisis, treating the crisis as an exogenous event that was not influenced by any of the

individual countries. [19] This regression measures the effect of our key variables on investment and how this effect differs before and after the crisis began. Subsequently we replace the variable $POST_{ct}$ with weak-bank or weak-sovereign variables. In regressions with weak banks, we add lender (bank) fixed effects. Note that the direct effect of the weak-sovereign variable will be at country-time level, hence it is not included as it is absorbed by country-year effects.

5 Debt Overhang and Rollover Risk

Table 5 shows our benchmark results with debt leverage and maturity but excluding the debt service capacity variable. In the tables that follow we include this variable to allow a comparison between the two specifications and in particular to show the relevance of the debt service capacity variable over and above the simple leverage ratio in capturing debt overhang and determining corporate investment.

The first three columns correspond to the unbalanced-panel sample of all firms, for all of Europe, the euro area and the periphery of the euro area respectively. The following three columns correspond to the continuous-panel sample of all firms for the same country groupings and hence not allow entry and exit. As shown in all columns, there is a positive effect of leverage on investment. However, when the average maturity of debt is high, this effect is dampened. The control variables enter with the expected signs. Cash flow enters positively, signifying the presence of financing constraints, and sales growth enters positively signifying the positive effect of growth opportunities on firm investment. Firm size enters negatively capturing decreasing returns to scale. The results indicate that firms with high levels of long-term debt will underinvest. At the same time firms finance investment with leveraging their short-term debt. The results are similar between the periphery and other euro area countries, and also in the continuing sample of firms in spite of the fact that in those last three columns we lose more than half of the observations.

Table 6 shows results when controlling for the capacity to serve debt – measured by the

[19] This assumption is somewhat problematic for Greece which was the first country to experience sovereign stress causing financial contagion to other highly-indebted countries in Europe. However our results are robust to excluding Greece.

EBITDA-to-debt ratio, that is inverse of debt overhang. The results on the other variables are qualitatively and quantitatively unaltered, suggesting that the results on the debt service capacity variable are not due to collinearity with the leverage and/or cash flow variables. It's economic effect is as big as leverage and even bigger in the continuing sample of firms. These results indicate that firms with high levels of debt relatively to earnings will underinvest, suggesting that these firms are suffering from debt overhang, not only due to high debt that is already captured by leverage variable but due to low earnings. Indeed, the results confirm that debt service capacity is an important determinant of investment. In what follows, we therefore only present results of regression models that include the debt service capacity variable.

Table 7 shows regression results that allow for differential effects of all variables during the crisis period 2009–2013. The results show that during the crisis period, higher indebtedness is not as positively correlated to investment rates as during normal times. Moreover the positive effect of debt service capacity on investment are primarily driven by the crisis period and gets intensified. This depicts a situation where debt overhang has become a drag on investment during the crisis. Furthermore, the benefit of having shorter debt maturity diminishes during the crisis, pointing to rollover risks. Both of these effects are more pronounced in the periphery, as one would expect. In short, rollover risks and debt overhang effects are both worsened during crises. [20] Columns (4)-(6) again undertake similar regressions in each country sample for continuing firms. Results are qualitatively similar across the two samples with the exception of size – measured as the logarithm of capital – which is more negative during the post period in the continuing firms sample in contrast to the all firms sample. This indicates that there is exit from the sample during the crisis by predominantly smaller firms, who tend to invest disproportionately more.

Our results are economically significant. During crisis times, a one standard-deviation decrease in the earnings-to-debt variable decreases investment by 0.02 more than during normal times, whereas a similar increase in the share of short term debt decreases investment by 0.03

[20] In our regressions, POST is country specific. However, setting it to be 2008 or 2010 for all countries do not alter results.

more than during normal times. These effects are more pronounced for periphery countries and are large relative to the mean investment ratio of 0.11

Since during crises, the effects of all our key variables (overhang, leverage and maturity) change, we now want to understand what drives these changes from regular to crisis times. Therefore, we investigate the role of weak sovereigns and weak banks as potential drivers of these changes.

5.1 Role of Weak Banks and Weak Sovereigns

Next we ask whether the decline in investment – and the effect of debt overhang – during the crisis is due to weak banks (a firm-bank specific credit supply shock) or weak sovereigns, or both.

Table 8 show that both the debt overhang and rollover risk channels are stronger in countries with weak sovereigns, measured by their sovereign spreads. Firms in such countries reduce investment further if they have a debt overhang or have high share of short-term debt. The effect of leverage on investment is also negative in countries with increased sovereign risk. These results are consistent with our interpretation that borrowing costs are higher in countries with heightened sovereign risk and earnings are lower given the future uncertainty. Both of these effects will intensify debt overhang and rollover risk. The fact that these effects even hold within the sample of peripheral countries which all had weak sovereigns during the crisis and less variation in weak sovereign variable suggests the importance of future uncertainty on debt service capacity.

To investigate the role of weak banks, we will use the firm-bank matched samples. One concern is that not every firm reports the name of their bank. This raises the likelihood of selection bias in the matched sample. Note that this is not about not having a match because the firm does not borrow. Our firm-bank matches are based on firm-bank relationships, not on the amount of their loans. Most of the time we fail a match because the bank has missing balance-sheet data from Bankscope, which is often the case with smaller banks. All our results up to this point hold in matched samples too as shown in our online appendix.

Table 9 shows that rollover risk operates via weak sovereign-weak bank linkages only for firms in periphery (GIIPS) countries. There is no effect of weak banks on debt overhang measured via debt service capacity. We define weak banks as those that are exposed to distressed sovereigns via sovereign bond holdings, where holdings are obtained from BANKSCOPE and hence we do not know the identity of the sovereign. Firms who borrow from banks with deteriorated balance sheets due to high sovereign exposure, reduce investment to a greater extent, as shown by the coefficient on the weak bank variable (capturing the direct bank lending channel). But those firms reduce investment even more so if they have a high share of short term debt and if these firms are located in peripheral countries. In all countries, firms with high leverage also reduce investment more if they borrow from weak banks. This suggests that banks with exposures to distressed sovereigns through sovereign bond holdings cut back on their lending to relationship firms by not rolling over maturing loans only in peripheral euro area countries. Most of the weak banks are in these countries, as shown by the results of the European Banking Authority (EBA)'s banking stress tests. The effect operating via firm leverage probably reflects that weak firms tend to borrow from weak banks (since we control weak bank effect with bank fixed effects). Since most of these sovereign debt holdings are domestic, the banks' balance sheets are hampered more in periphery countries when the sovereign risk of these countries increased.

Next we ask whether sovereign shocks are transmitted to firms by simply being located in a periphery country or by borrowing from a periphery country bank. In table 10 we show that during normal times, GIIPS dependence—a dummy variable equal to one if the relationship bank of the firm has its domicile in a periphery country (subsidiary) or is headquartered in a periphery country (parent)—implies a positive effect of leverage and short term debt on investment. This effect is reversed during crises, when firms with high leverage and higher share of short term debt reduce their investment to a larger extent if they have a relationship with a periphery bank. Although debt service capacity and hence debt overhang is still important, firms who borrow from periphery banks reduce investment even if they have high debt service capacity. Of course these firms are mostly in peripheral countries and rollover risk becomes more important during the crisis for those firms, as shown in Table 8, column 3. The total effect

of debt service capacity during the crisis (post) is still positive, confirming our results in table 7. These results support the view that one factor underlying the increase in debt overhang and rollover risk for firms in peripheral Europe was a strengthening of bank-sovereign linkages.

Overall, results highlight the importance of sovereign risk in intensifying debt overhang and rollover risk, which operate in part through a deterioration in banks' balance sheets from exposures to their own sovereign bonds, especially in periphery countries.

5.2 Aggregate Implications

Our results imply that debt overhang played an important role in hindering firm level investment before the crisis, and that this effect intensified during the crisis – particularly for firms whose countries experienced sovereign distress. Rollover risk, on the other hand, only operated during the crisis. How much of the decline in aggregate corporate investment since the onset of the crisis is due to debt overhang and rollover risk? Since our data has extensive coverage and representative of the census data, we track aggregate patterns well (see figure 7). Hence we will use a back of the envelope calculation to link our micro estimates to the actual macro level decline in investment.

According to official macroeconomic statistics from Eurostat, the average net investment rate (net investment over GDP) of the non-financial corporate sector in the euro area fell by half during the crisis period from 2009 to 2013 compared to its pre crisis level in 2008. In Europe as a whole, it fell by 65% during the crisis period. On the other hand, the ratio of non-financial corporate debt to GDP in the euro area increased by 22% during the period 2009-2013 relative to the pre-crisis year 2008.

Now, compare this to our micro-level estimates. The mean investment rate (as a ratio of capital) declined by 40% during the crisis period 2009 to 2013 compared to its pre crisis level in 2008, while leverage increased by 52% and the share of long-term debt increased by 56% over the same period, pointing to a lengthening of debt maturity profile as markets for short term debt collapsed.

During the crisis, a one percentage point decrease in debt service capacity reduced the

mean investment ratio by 0.07, whereas a similar increase in debt maturity reduced investment by 0.17. Given the decrease in aggregate debt service capacity of 15 percentage points and a decrease in the aggregate fraction of long term debt of 9 percentage points, aggregate investment would have declined by 2.6 percentage points, with each contributing about half of this effect. Together this is more than half of the actual decline of 4 percentage points in aggregate investment. As a result, debt overhang and rollover risk can explain a substantial part of the actual decline in aggregate corporate investment.

6 Conclusion

We analyze a comprehensive dataset of European firms – including both small and large firms – to study the determinants of corporate investment prior to and during the European sovereign debt crisis. We find evidence consistent with debt overhang, defined as corporate indebtedness relative to earnings, holding back investment in Europe especially during the crisis. We also show that rollover risk lowered investment as evidenced by a negative impact of shorter debt maturity on investment during the crisis.

The increased debt overhang and heightened rollover risk during the crisis can be linked to an increase in sovereign risk, which reflects both a direct effect from the reduction in creditworthiness of the sovereign and an indirect effect from the intensification of weak bank-weak sovereign linkages. Specifically we find evidence that an increase in sovereign risk, by weakening the balance sheets of banks that hold risky sovereign debt, translates into an increase in rollover risk for firms who have a relationship with these weak banks, especially in peripheral countries.

We identify these results using detailed firm-level data and a difference-in-difference estimation approach, comparing investment of high debt overhang firms with low debt overhang across crisis and normal times, and absorbing demand shocks through country-industry-year fixed effects. Furthermore we use confidential ECB data on the exposures of banks to (own) sovereign debt together with information on the main bank relation of each firm to identify the role of sovereign-bank linkages in driving the effect of debt overhang and rollover risk.

These regressions also include banker fixed effects alongside firm fixed effects.

In quantitative terms, the debt overhang and rollover risk channels are important channels alongside the weak bank and weak firm balance sheet channels. A simple back of the envelope calculation based on our firm-level estimates suggests that the debt overhang and rollover risk channels explain more than half of the actual decline in aggregate corporate investment during the crisis.

These results highlight that debt overhang played a significant role in holding back corporate investment during the European debt crisis despite unprecedented monetary policy measures that have brought interest rates down to the zero lower bound. This suggests that other growth-enhancing policies, such as the asset purchase program recently implemented by the European Central bank, are needed to reduce the debt overhang and stimulate the real economy.

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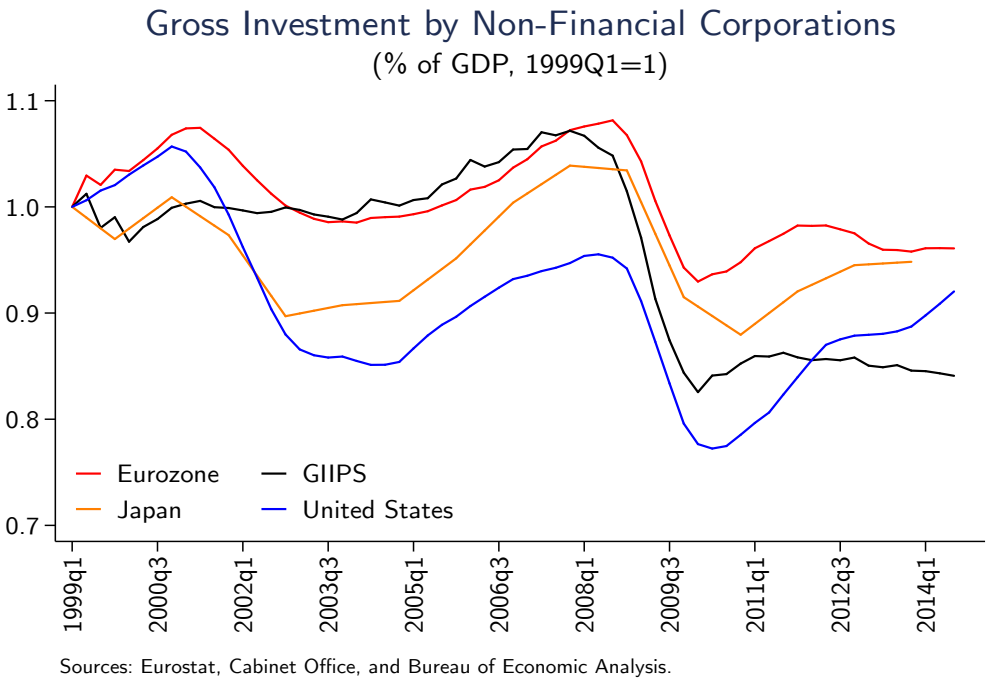

Figure 1: Evolution of Gross Investment

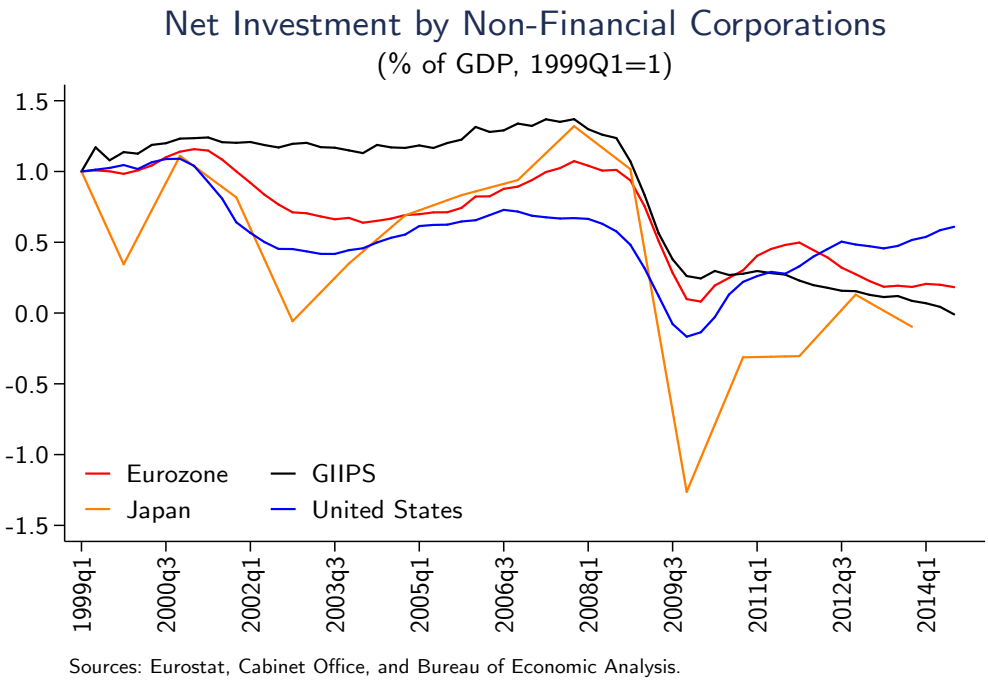

Figure 2: Evolution of Net Investment

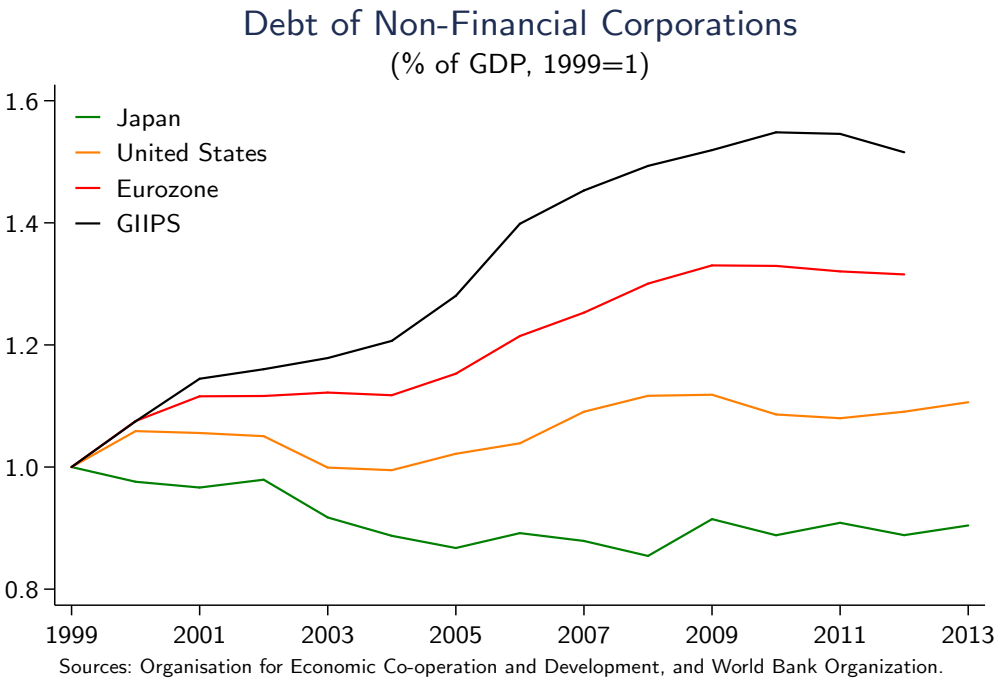

Figure 3: Evolution of Corporate Debt to GDP

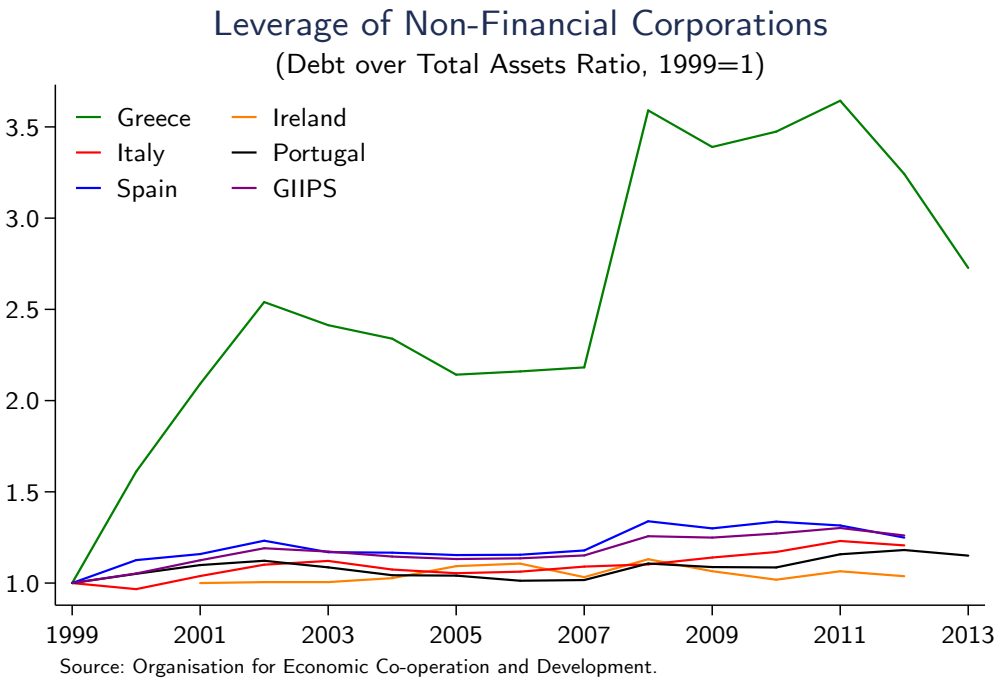

Figure 4: Evolution of Leverage in South Europe

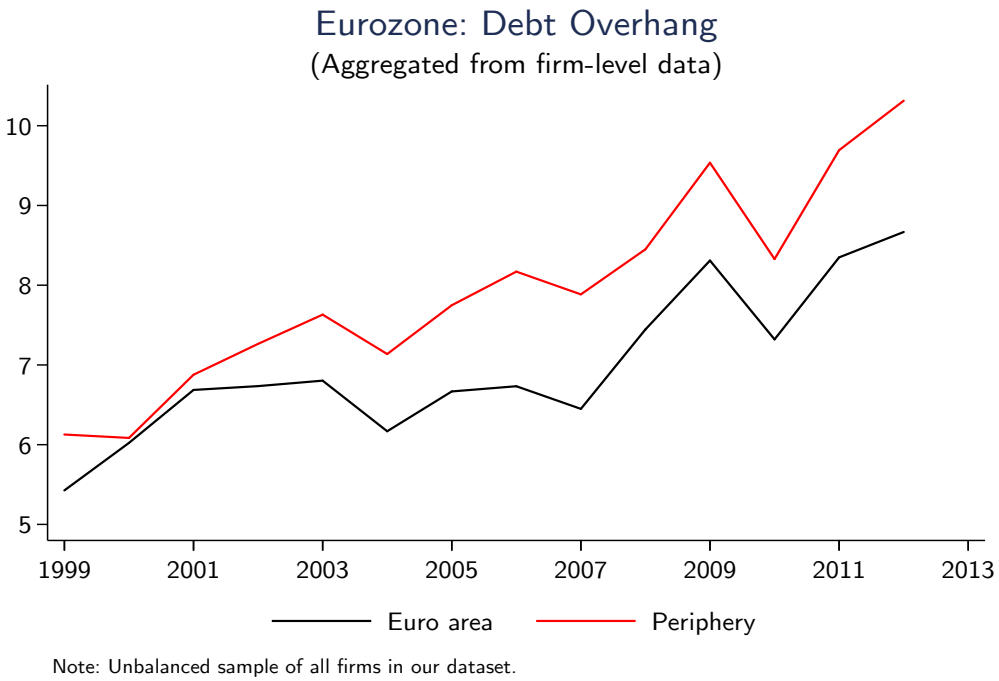

Figure 5: Evolution of Debt Overhang in Europe

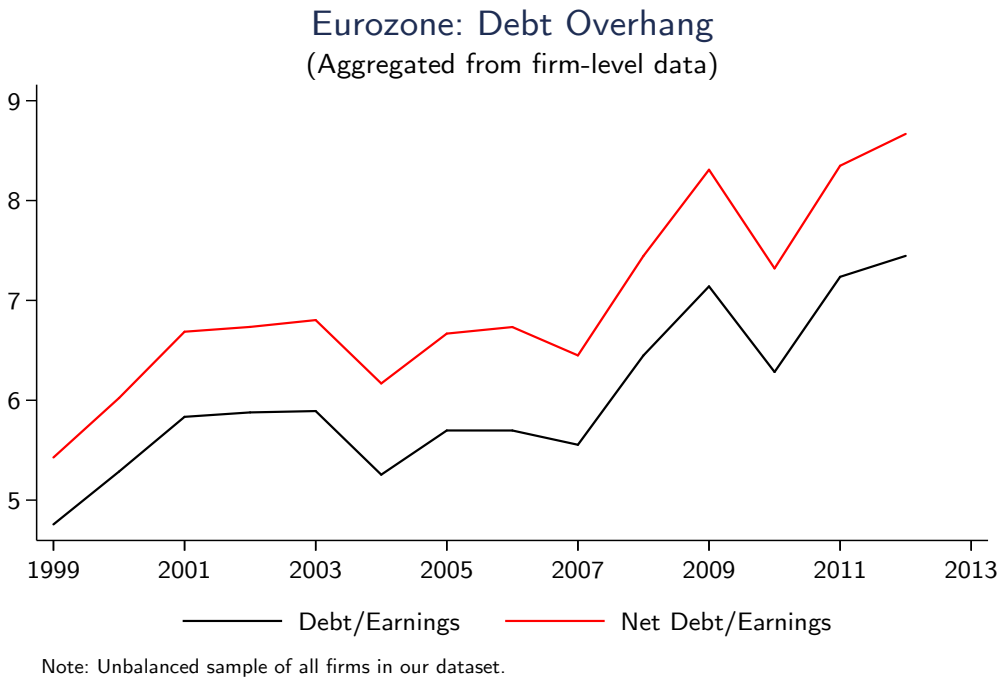

Figure 6: Evolution of Debt Overhang: Different Measures

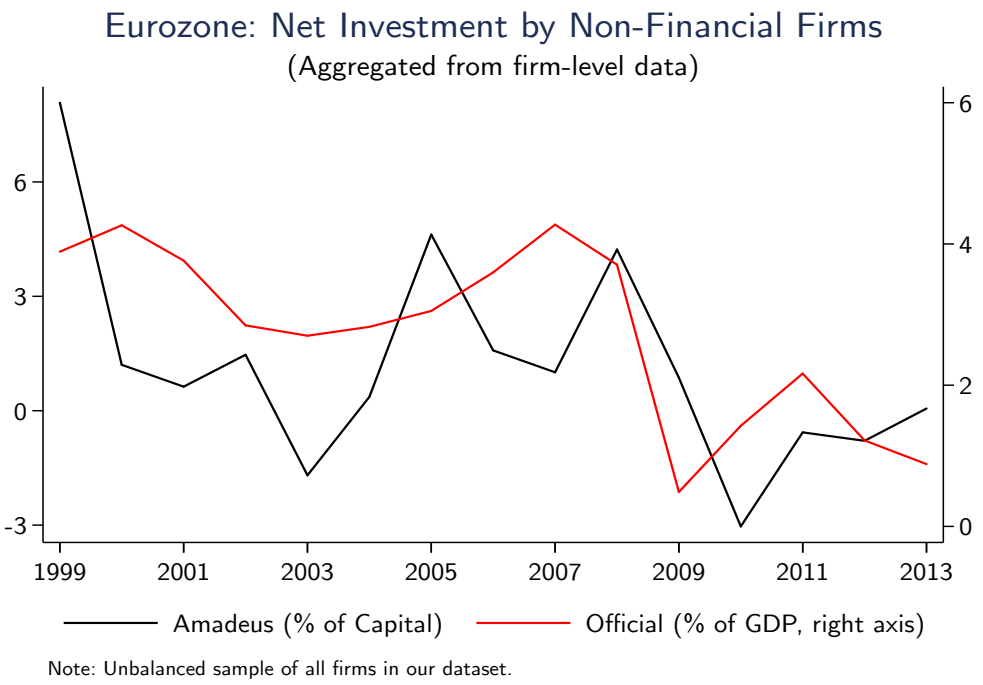

Figure 7: Corporate Investment in AMADEUS vs Eurostat

Table 1: Coverage Relative to Eurostat: Selected Countries

	Spain	Italy	Germany	France
1999	0.69	0.59		0.70
2000	0.71	0.63		0.70
2001	0.73	0.62		0.72
2002	0.75	0.69		0.75
2003	0.74	0.68		0.73
2004	0.75	0.71		0.66
2005	0.74	0.72		0.67
2006	0.74	0.73	0.34	0.72
2007	0.74	0.73	0.34	0.73
2008	0.72	0.84	0.28	N/A
2009	0.72	0.81	0.28	0.71
2010	0.73	0.83	0.30	0.73
2011	0.74	0.86	0.28	0.75
2012	0.71	0.85	0.25	0.73

Table 2: Firm-banker relation descriptions:

(% out of total number of firms of respective sample)

	More than one banker %	At least one foreign banker #
Austria	37.89	34.11
Bosnia and Herzegovina	68.23	94.27
Bulgaria	34.82	89.10
Croatia	72.63	94.84
Cyprus	71.90	41.32
Denmark	6.23	26.69
Estonia	37.98	97.39
France	0.00	11.23
Germany	55.11	12.25
Greece	80.03	19.21
Iceland	10.33	0.50
Ireland	0.03	7.16
Latvia	36.40	89.70
Lithuania	22.29	95.37
Netherlands	35.76	1.90
Poland	2.46	67.69
Portugal	70.91	37.34
Russia	9.36	7.05
Serbia	88.86	93.61
Slovenia	0.00	50.14
Spain	61.22	35.79
Turkey	91.16	47.51
Ukraine	30.22	60.82
United Kingdom	0.46	6.71
Total	35.31	23.31

Table 3: All Firms Sample Summary Statistics

	Obs.	Mean	Std.Dev.	Min.	Median	Max.
Net Investment/Capital[1]	8,760,198	0.175	0.975	-0.873	-0.050	5.443
Short-Term Debt/Assets	8,271,660	0.497	0.319	0.000	0.476	1.610
Long-Term Debt/Assets	8,760,198	0.128	0.225	0.000	0.001	1.010
Debt/Assets	8,760,198	0.617	0.338	0.011	0.622	1.965
Debt/Capital	8,756,457	2.888	5.815	0.000	0.701	23.829
Sales Growth[2]	5,744,848	0.067	0.581	-2.060	0.017	3.561
log(Assets)	8,760,198	14.587	1.786	8.784	14.643	19.226
log(Capital)	8,760,177	12.718	2.470	-8.300	12.904	28.741
Net Worth/Assets[3]	8,759,544	0.305	0.336	-1.120	0.286	0.970
Long-Term Debt/Debt	8,737,055	0.191	0.298	0.000	0.001	1.000
Cash Flow	5,751,696	1.219	2.392	-1.159	0.387	10.121
EBITDA/Debt	5,751,342	0.229	0.347	-0.349	0.137	1.674
Weak Sovereign (Firm)[4](%)	8,142,714	1.774	6.399	-2.284	0.285	82.885

[1]Increase in real capital stock over lagged real capital stock.
[2]Logarithmic change of real sales.
[3]Net worth equals assets minus liabilities.
[4]Weak Sovereign of the firm sovereign spread is the spread of the 10-year government bond at constant maturity of the country of the firm, over German Bund.

Table 4: Matched Firms Sample Summary Statistics

	Obs.	Mean	Std.Dev.	Min.	Median	Max.
Net investment/Capital[1]	7,457,654	0.111	0.642	-0.649	-0.046	3.334
Short-Term Debt/Assets	6,791,571	0.451	0.296	0.000	0.430	1.427
Long-Term Debt/Assets	7,457,654	0.172	0.256	0.000	0.042	1.143
Debt/Assets	7,457,654	0.603	0.326	0.024	0.607	1.920
Debt/Capital	5,464,892	4.103	7.791	0.000	1.028	31.346
Sales Growth[2]	4,746,381	0.034	0.370	-1.335	0.009	1.947
log(Assets)	7,457,654	14.796	1.676	9.804	14.761	19.364
log(Capital)	5,466,208	13.022	2.271	-5.589	13.112	26.128
Net Worth/Assets[3]	7,457,258	0.326	0.321	-1.040	0.313	0.958
Long-Term Debt/Debt	7,450,546	0.264	0.342	0.000	0.082	1.000
Cash Flow	3,533,889	0.999	1.746	-0.622	0.383	7.401
EBITDA/Debt	3,533,711	0.244	0.345	-0.302	0.151	1.684
Weak Sovereign (Firm)[4]	4,914,516	0.872	4.219	-0.092	0.078	82.885
Weak Bank[5]	2,771,968	4.441	4.082	0.000	3.425	16.875
Weak Sovereign (Bank)[4]	5,019,941	0.857	4.226	-2.284	0.091	82.885

[1]Increase in real capital stock over lagged real capital stock.
[2]Logarithmic change of real sales.
[3]Net worth equals assets minus liabilities.
[4]Weak Sovereign of the firm sovereign spread is the spread of the 10-year government bond at constant maturity of the country of the firm, over German Bund. Of the banker, it correspond to the spread of the sovereign of the lender.
[5]Share of sovereign bonds holdings over total assets.

Table 5: Benchmark Results

Dependent variable: Net investment/Capital

	(1)	(2)	(3)	(4)	(5)	(6)
Firm Sample	All Firms	All Firms	All Firms	Continuous	Continuous	Continuous
Region	Europe	Euro area	Periphery	Europe	Euro area	Periphery
Leverage	0.0381***	0.0390***	0.0398***	0.0350***	0.0348***	0.0349***
	(106.40)	(94.85)	(73.84)	(55.29)	(49.22)	(36.74)
Maturity	-0.218***	-0.237***	-0.225***	-0.239***	-0.244***	-0.229***
	(-61.92)	(-56.41)	(-41.30)	(-39.90)	(-34.91)	(-25.33)
Cash Flow	0.0285***	0.0270***	0.0241***	0.0222***	0.0201***	0.0132***
	(54.71)	(42.82)	(27.52)	(20.63)	(16.11)	(7.70)
Sales growth	0.0483***	0.0464***	0.0513***	0.0351***	0.0337***	0.0360***
	(37.93)	(29.30)	(27.14)	(14.72)	(11.93)	(10.53)
Size	-0.367***	-0.346***	-0.334***	-0.467***	-0.462***	-0.452***
	(-228.12)	(-177.36)	(-142.14)	(-137.71)	(-116.02)	(-95.44)
Observations	4,469,687	3,037,897	1,935,803	1,435,166	1,055,784	679,546
R^2	0.41	0.39	0.37	0.40	0.39	0.36
Firm FE	yes	yes	yes	yes	yes	yes
Country-sector-year FE	yes	yes	yes	yes	yes	yes
Banker FE	no	no	no	no	no	no

t-statistics in parentheses
Clustered errors at the firm level.
Notes: Net investment is the % annual change of total fixed assets, at constant 2005 dollars. Leverage corresponds to the ratio of debt to capital. Maturity is the share of debt whose residual maturity is greater than a year (long-term debt). Cash Flow corresponds to EBITDA (firm earnings before interest, tax, depreciation and amortisation) to capital.
Right-hand side variables are lagged with respect to LHS.
** $p < 0.05$, *** $p < 0.01$

Table 6: High Debt or Low Earnings?

Dependent variable: Net investment/Capital

	(1)	(2)	(3)	(4)	(5)	(6)
Firm Sample	All Firms	All Firms	All Firms	Continuous	Continuous	Continuous
Region	Europe	Euro area	Periphery	Europe	Euro area	Periphery
Leverage	0.0382***	0.0391***	0.0400***	0.0353***	0.0351***	0.0352***
	(106.62)	(94.94)	(73.88)	(55.61)	(49.44)	(36.90)
Debt Service Capacity	0.0279***	0.0309***	0.0313***	0.0610***	0.0620***	0.0628***
	(12.35)	(8.88)	(7.12)	(12.75)	(9.40)	(7.42)
Maturity	-0.215***	-0.234***	-0.221***	-0.235***	-0.240***	-0.224***
	(-61.06)	(-55.71)	(-40.63)	(-39.24)	(-34.42)	(-24.85)
Cash Flow	0.0268***	0.0254***	0.0225***	0.0183***	0.0166***	0.00975***
	(47.49)	(36.76)	(23.80)	(15.55)	(12.03)	(5.24)
Sales growth	0.0475***	0.0458***	0.0508***	0.0331***	0.0322***	0.0344***
	(37.15)	(28.87)	(26.78)	(13.78)	(11.32)	(10.00)
Size	-0.368***	-0.347***	-0.335***	-0.469***	-0.464***	-0.453***
	(-228.27)	(-177.49)	(-142.37)	(-138.21)	(-116.37)	(-95.71)
Observations	4,469,557	3,037,869	1,935,789	1,435,153	1,055,784	679,546
R^2	0.41	0.39	0.37	0.40	0.39	0.36
Firm FE	yes	yes	yes	yes	yes	yes
Country-sector-year FE	yes	yes	yes	yes	yes	yes
Banker FE	no	no	no	no	no	no

t-statistics in parentheses

Clustered errors at the firm level.

Notes: Net investment is the % annual change of total fixed assets, at constant 2005 dollars. Leverage corresponds to the ratio of debt to capital. Debt service capacity is measured by the ratio of EBITDA (firm earnings before interest, tax, depreciation and amortisation) to debt. Maturity is the share of debt whose residual maturity is greater than a year (long-term debt). Cash Flow corresponds to EBITDA to capital.

Right-hand side variables are lagged with respect to LHS.

** $p < 0.05$, *** $p < 0.01$

Table 7: Debt Overhang and Rollover Risk: Crisis Results

Dependent variable: Net investment/Capital

	(1)	(2)	(3)	(4)	(5)	(6)
Firm sample	All Firms	All Firms	All Firms	Continuous	Continuous	Continuous
Region	Europe	Euro area	Periphery	Europe	Euro area	Periphery
POST×Leverage	-0.0128***	-0.0125***	-0.0173***	-0.00701***	-0.00588***	-0.00856***
	(-27.58)	(-23.35)	(-23.77)	(-9.91)	(-7.26)	(-7.47)
Leverage	0.0453***	0.0464***	0.0503***	0.0403***	0.0394***	0.0419***
	(101.31)	(88.62)	(71.42)	(48.29)	(41.42)	(31.37)
POST×Maturity	0.0718***	0.0875***	0.119***	0.0277***	0.0267***	0.0530***
	(14.55)	(14.71)	(15.47)	(3.74)	(2.97)	(4.41)
Maturity	-0.250***	-0.280***	-0.285***	-0.251***	-0.256***	-0.259***
	(-58.34)	(-53.34)	(-40.74)	(-31.14)	(-26.27)	(-19.49)
POST×Debt Service Capacity	0.0436***	0.0558***	0.0728***	0.0551***	0.0784***	0.120***
	(13.08)	(11.11)	(11.13)	(8.28)	(8.40)	(9.36)
Debt Service Capacity	0.00938***	0.00454	-0.00284	0.0255***	0.00753	-0.0217
	(3.46)	(1.06)	(-0.51)	(3.81)	(0.78)	(-1.64)
POST×Cash Flow	-0.0000989	0.000663	-0.00367**	0.00233	0.00136	-0.00796**
	(-0.12)	(0.65)	(-2.54)	(1.40)	(0.69)	(-2.82)
Cash Flow	0.0264***	0.0243***	0.0230***	0.0163***	0.0154***	0.0146***
	(36.85)	(27.46)	(18.54)	(9.45)	(7.46)	(5.02)
POST×Sales growth	0.00184	-0.00207	-0.0109***	0.00297	-0.00777	-0.0212**
	(0.73)	(-0.66)	(-2.88)	(0.58)	(-1.27)	(-2.82)
Sales growth	0.0462***	0.0466***	0.0563***	0.0307***	0.0366***	0.0475***
	(25.69)	(19.56)	(19.29)	(7.16)	(6.98)	(7.25)
POST×Size	0.00898***	0.00710***	0.0107***	-0.00430***	-0.00494***	-0.00105
	(10.83)	(6.79)	(8.07)	(-3.39)	(-3.17)	(-0.54)
Size	-0.374***	-0.353***	-0.344***	-0.467***	-0.461***	-0.454***
	(-221.93)	(-170.52)	(-137.80)	(-129.69)	(-107.80)	(-88.69)
Observations	4,469,557	3,037,869	1,935,789	1,435,153	1,055,784	679,546
R^2	0.41	0.39	0.38	0.40	0.39	0.36
Firm FE	yes	yes	yes	yes	yes	yes
Country-sector-year FE	yes	yes	yes	yes	yes	yes
Banker FE	no	no	no	no	no	no

t-statistics in parentheses
Clustered errors at the firm level.
Notes: Net investment is the % annual change of total fixed assets, at constant 2005 dollars. Leverage corresponds to the ratio of debt to capital. Debt service capacity is measured by the ratio of EBITDA (firm earnings before interest, tax, depreciation and amortisation) to debt. Maturity is the share of debt whose residual maturity is greater than a year (long-term debt). Cash Flow corresponds to EBITDA to capital. POST is a dummy that takes a value of 1 when the country of the firm enters in recession during the International Financial Crises. Most of countries entered into recession in 2008, although some entered in 2007 and 2009, and a few did not enter recession.
Right-hand side variables are lagged with respect to LHS.
** $p < 0.05$, *** $p < 0.01$

Table 8: Debt Overhang and Rollover Risk: The Role of Weak Sovereigns

Sample: Matched firms
Dependent variable: Net investment/Capital

	(1) Europe	(2) Euro area	(3) Periphery
Weak Sovereign×Leverage	-0.00181***	-0.00201***	-0.00212***
	(-13.27)	(-14.24)	(-14.32)
Leverage	0.0210***	0.0226***	0.0244***
	(56.38)	(55.24)	(38.54)
Weak Sovereign×Maturity	0.00746***	0.00873***	0.0108***
	(4.80)	(5.37)	(6.45)
Maturity	-0.172***	-0.178***	-0.201***
	(-40.19)	(-38.66)	(-30.54)
Weak Sovereign×Debt Service Capacity	0.00365***	0.00295**	0.00371**
	(2.92)	(2.24)	(2.80)
Debt Service Capacity	0.0104***	0.00850**	-0.00133
	(2.87)	(2.09)	(-0.27)
Weak Sovereign×Cash Flow	-0.000312	-0.000535	-0.000161
	(-0.81)	(-1.33)	(-0.39)
Cash Flow	0.0283***	0.0290***	0.0255***
	(30.73)	(28.58)	(16.18)
Weak Sovereign×Sales growth	0.00126	0.000895	-0.000349
	(1.07)	(0.70)	(-0.27)
Sales growth	0.0442***	0.0461***	0.0500***
	(19.30)	(18.54)	(16.01)
Weak Sovereign×Size	0.00293***	0.00319***	0.00277***
	(9.83)	(10.40)	(9.13)
Size	-0.271***	-0.268***	-0.255***
	(-125.26)	(-114.19)	(-92.30)
Observations	1,509,221	1,230,813	735,145
R^2	0.36	0.34	0.31
Firm FE	yes	yes	yes
Country-sector-year FE	yes	yes	yes
Banker FE	no	no	no

t-statistics in parentheses
Clustered errors at the firm level.
Notes: Net investment is the % annual change of total fixed assets, at constant 2005 dollars. Leverage corresponds to the ratio of debt to capital. Debt service capacity is measured by the ratio of EBITDA (firm earnings before interest, tax, depreciation and amortisation) to debt. Maturity is the share of debt whose residual maturity is greater than a year (long-term debt). Cash Flow corresponds to EBITDA to capital. Weak Sovereign of the firm sovereign spread is the spread of the 10-year government bond at constant maturity of the country of the firm, over German Bund.
Right-hand side variables are lagged with respect to LHS.
** $p < 0.05$, *** $p < 0.01$

Table 9: Debt Overhang and Rollover Risk: The Role of Weak Banks

Sample: Matched firms
Dependent variable: Net investment/Capital

	(1) Europe	(2) Euro area	(3) Periphery
Weak Bank×Leverage	-0.0245***	-0.0278***	-0.0479***
	(-4.66)	(-5.13)	(-5.93)
Leverage	0.0176***	0.0189***	0.0205***
	(32.91)	(33.78)	(23.07)
Weak Bank×Maturity	-0.0129	0.0136	0.294***
	(-0.22)	(0.22)	(3.40)
Maturity	-0.158***	-0.170***	-0.227***
	(-26.79)	(-27.21)	(-23.83)
Weak Bank×Debt Service Capacity	0.000229	-0.000984	-0.000783
	(0.46)	(-1.61)	(-1.12)
Debt Service Capacity	0.0195***	0.0346***	0.0244***
	(4.08)	(5.71)	(3.33)
Weak Bank×Cash Flow	0.00752	0.00565	0.0548*
	(0.45)	(0.32)	(2.38)
Cash Flow	0.0214***	0.0216***	0.0123***
	(14.10)	(12.99)	(5.26)
Weak Bank×Sales growth	0.0666	0.0890	0.0450
	(1.43)	(1.62)	(0.70)
Sales growth	0.0319***	0.0272***	0.0342***
	(8.72)	(6.48)	(6.47)
Weak Bank×Size	0.0570***	0.0641***	0.0745***
	(4.91)	(5.10)	(5.29)
Size	-0.390***	-0.377***	-0.367***
	(-104.54)	(-89.38)	(-81.58)
Weak Bank	-0.751***	-0.800***	-0.996***
	(-4.42)	(-4.34)	(-4.86)
Observations	1,275,006	993,970	628,125
R^2	0.48	0.47	0.41
Firm FE	yes	yes	yes
Country-sector-year FE	yes	yes	yes
Banker FE	yes	yes	yes

t-statistics in parentheses
Clustered errors at the firm-banker level.
Notes: Net investment is the % annual change of total fixed assets, at constant 2005 dollars. Leverage corresponds to the ratio of debt to capital. Debt service capacity is measured by the ratio of EBITDA (firm earnings before interest, tax, depreciation and amortisation) to debt. Maturity is the share of debt whose residual maturity is greater than a year (long-term debt). Cash Flow corresponds to EBITDA to capital. Weak Bank is measured by the share of sovereign holdings of the bank over total assets. Includes bonds of all maturities and all sovereign issuers.
Right-hand side variables are lagged with respect to LHS.
** $p < 0.05$, *** $p < 0.01$.

Table 10: Debt Overhang and Rollover Risk: Bank-Sovereign Linkages

Dependent variable: Net investment over capital.
Sample: Unbalanced panel

	(1)	(2)	(3)	(4)
GIIPS dependence:	**Parent Bank**		**Subsidiary Bank**	
Region sample:	**Europe**	**Euro Area**	**Europe**	**Euro Area**
POST × GIIPS dependence × Leverage	-0.0104***	-0.0120***	-0.0126***	-0.0136***
	(-14.96)	(-16.52)	(-15.03)	(-16.05)
GIIPS dependence × Leverage	0.00694***	0.00706***	0.00805***	0.00812***
	(11.79)	(11.45)	(10.97)	(11.05)
POST × Leverage	-0.00387***	-0.00239***	-0.00498***	-0.00399***
	(-8.74)	(-4.83)	(-12.00)	(-8.69)
Leverage	0.0217***	0.0225***	0.0230***	0.0239***
	(53.83)	(49.76)	(60.54)	(56.74)
POST × GIIPS dependence × Maturity	0.0653***	0.0701***	0.0982***	0.0921***
	(8.71)	(8.46)	(11.55)	(10.57)
GIIPS dependence × Maturity	-0.0502***	-0.0475***	-0.0736***	-0.0653***
	(-8.70)	(-7.49)	(-10.62)	(-9.36)
POST × Maturity	0.00678	0.0115	0.0106**	0.0186***
	(1.24)	(1.83)	(2.15)	(3.30)
Maturity	-0.145***	-0.169***	-0.151***	-0.177***
	(-33.26)	(-33.36)	(-38.67)	(-39.60)
POST × GIIPS dependence × Debt Service Cap.	-0.0174***	-0.0152**	-0.0254***	-0.0167**
	(-3.21)	(-1.98)	(-3.81)	(-2.22)
GIIPS dependence × Debt Service Cap.	0.000481	-0.00596	0.0155***	0.00676
	(0.12)	(-1.00)	(2.86)	(1.18)
POST × Debt Service Cap.	0.0276***	0.0170***	0.0255***	0.0154***
	(7.67)	(2.72)	(7.71)	(2.87)
Debt Service Cap.	0.000818	0.0146***	-0.00104	0.00891**
	(0.29)	(2.73)	(-0.40)	(2.07)
POST × GIIPS dependence × Cash Flow	-0.00230	-0.00501**	-0.00765***	-0.0134***
	(-1.23)	(-2.42)	(-3.57)	(-6.07)
GIIPS dependence × Cash Flow	-0.00334**	-0.00179	-0.00398**	0.00133
	(-2.21)	(-1.07)	(-2.28)	(0.75)
POST × Cash Flow	0.000403	0.00495***	0.00259**	0.00802***
	(0.33)	(3.38)	(2.26)	(5.90)
Cash Flow	0.0304***	0.0276***	0.0297***	0.0264***
	(29.25)	(21.54)	(30.77)	(22.79)

t-statistics in parentheses
Clustered errors at the firm-banker level.
Notes: Net investment is the % annual change of total fixed assets, at constant 2005 dollars. POST is a dummy that takes a value of 1 when the country of the firm enters in recession during the International Financial Crises. GIIPS dependence is a dummy equal to one if the bank is located (parent or subsidiary) in Greece, Ireland, Italy, Portugal or Spain. Leverage corresponds to the ratio of debt to capital. Debt service capacity is measured by the ratio of EBITDA (firm earnings before interest, tax, depreciation and amortisation) to debt. Maturity is the share of debt whose residual maturity is greater than a year (long-term debt). Cash Flow corresponds to EBITDA to capital. Debt Service Capacity is the ratio of EBITDA to Debt. Size is measured with the log of the capital stock.
Right-hand side variables are lagged with respect to LHS.
** $p < 0.05$, *** $p < 0.01$.

Table 10: Banks and Sovereigns (continued)

Dependent variable: Net investment over capital.
Sample: Unbalanced panel

	(1)	(2)	(3)	(4)
GIIPS dependence:	**Parent Bank**		**Subsidiary Bank**	
Region sample:	**Europe**	**Euro Area**	**Europe**	**Euro Area**
POST × GIIPS dependence × Sales growth	0.00241	0.0000381	0.000957	-0.000948
	(0.46)	(0.01)	(0.15)	(-0.14)
GIIPS dependence × Sales growth	0.00266	0.00797	0.0103**	0.0152***
	(0.71)	(1.56)	(2.06)	(2.82)
POST × Sales growth	0.0162***	0.0181***	0.0152***	0.0155***
	(4.36)	(3.27)	(4.61)	(3.44)
Sales growth	0.0422***	0.0347***	0.0416***	0.0349***
	(16.28)	(8.30)	(18.82)	(11.12)
POST × GIIPS dependence × Size	0.000972***	0.00146***	0.00149***	0.00207***
	(4.30)	(5.59)	(5.44)	(7.48)
GIIPS dependence × Size	0.00689***	0.00407***	-0.0000980	-0.000580**
	(7.83)	(3.79)	(-0.42)	(-2.49)
POST × Size	0.00534***	0.00232***	0.00518***	0.00193**
	(7.18)	(2.63)	(6.98)	(2.20)
Size	-0.281***	-0.266***	-0.278***	-0.263***
	(-161.36)	(-124.65)	(-167.27)	(-134.03)
Observations	2,823,435	2,127,174	2,823,435	2,127,174
R^2	0.37	0.35	0.37	0.35
Firm FE	yes	yes	yes	yes
Country-sector-year FE	yes	yes	yes	yes
Banker FE	yes	yes	yes	yes

t-statistics in parentheses
Clustered errors at the firm-banker level.
Notes: Net investment is the % annual change of total fixed assets, at constant 2005 dollars. POST is a dummy that takes a value of 1 when the country of the firm enters in recession during the International Financial Crises. GIIPS dependence is a dummy equal to one if the bank is located (parent or subsidiary) in Greece, Ireland, Italy, Portugal or Spain. Leverage corresponds to the ratio of debt to capital. Debt service capacity is measured by the ratio of EBITDA (firm earnings before interest, tax, depreciation and amortisation) to debt. Maturity is the share of debt whose residual maturity is greater than a year (long-term debt). Cash Flow corresponds to EBITDA to capital. Debt Service Capacity is the ratio of EBITDA to Debt. Size is measured with the log of the capital stock.
Right-hand side variables are lagged with respect to LHS.
** $p < 0.05$, *** $p < 0.01$.