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Debt Overhang and Investment Efficiency

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Debt overhang and investment efficiency

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Abstract

Using a pan-European data set of 8.5 million firms, we find that firms with high debt overhang invest relatively more than otherwise similar firms if they are operating in sectors facing good global growth opportunities. At the same time, the positive impact of a marginal increase in debt on investment efficiency disappears if firm debt is already excessive, if it is dominated by short maturities, and during systemic banking crises. Our results are consistent with theories of the disciplining role of debt, as well as with models highlighting the negative link between agency problems at firms and banks and investment efficiency.

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1 Introduction

The relationship between the firm's capital structure and its investment efficiency is theoretically ambiguous.[1] On the one hand, outside equity increases the incentive to divert funds and consequently underinvest, also in high-net-present-value projects, because the manager has to share the future return to any current investment with outside shareholders. By virtue of requiring a state-independent stream of payments, debt overcomes this problem, resulting in higher investment efficiency (Grossman and Hart, 1982). On the other hand, if the firm is close to bankruptcy, creditors bear most of the return to any additional investment. As a result, a highly-leveraged firm will reduce investment, in particular in high-net-present-value projects, resulting in a reduction in investment efficiency (Myers, 1977).

In this paper we take this theoretical ambiguity to the data and ask whether higher leverage increases or reduces investment efficiency. To answer this question, we construct a uniquely comprehensive data set covering 8.4 million individual firms, operating in 30 industrial sectors over the period 2004–2013. The main data set used in the analysis combines information from two individual sources. The firm-level information comes from the Orbis database. It contains an exhaustive set of firm-specific financial statement items, which allows us to create reliable empirical proxies for investment, sales, operating revenue, cash flow, total assets, sector of operation, and debt. Furthermore, the data allow us to distinguish between short- and long-term debt. Second, we define investment efficiency at the sector level whereby we aim to construct an empirical proxy for growth opportunities that is exogenous to the firm's capital structure or financing conditions. To that end, we match the Orbis data with corresponding sector-specific time-varying global price-to-earnings (PE) ratios, which are obtained from Thomson Reuters. The underlying assumption is that if a sector is exhibiting a high global PE ratio in

[1] Investment efficiency denotes a situation in which firms prefer high-return investment projects over the low-return alternatives.

a particular year, this signals a good global growth potential in the near future. Conversely, a low PE ratio signals that investors expect the sector's profitability to decline in the future. In this setting, investment efficiency implies that identical firms should be more likely to invest in good-global-growth-opportunity sectors (Bekaert et al., 2007), while the converse behavior can be interpreted as investment inefficiency.

The resulting data set allows us to study the impact of financial frictions, in the form of debt overhang, on firm investment depending on the global growth opportunities that the firm is currently facing. Crucially, we are able to address a number of immediate endogeneity concerns. First, by calculating global growth opportunities at the sector level, instead of firm level, we are eliminating the concern that the firm's investment opportunities may be jointly determined with the firm's debt level, generating a spurious correlation between debt and investment efficiency. Second, the structure of the data set allows us to saturate the regressions with firm fixed effects and country-sector-year fixed effects. These absorb the effects of unobservable factors that are firm-specific and time-invariant, as well of time-varying unobservable factors – e.g., related to demand or to technology – that are common to all firms in a particular sector in a particular country at a particular point in time. Investment inefficiency is thus identified through the variation in investment between high-debt and low-debt – but otherwise identical – firms, in sectors facing better versus sector facing poorer growth opportunities.

Our main result is that while on average, higher debt is associated with lower capital investment, this underinvestment problem is mitigated if the firm is facing good growth opportunities. The latter result is consistent with the disciplining role of debt proposed by Grossman and Hart (1982). This result continues obtaining in a battery of alternative tests. For example, it survives when we control for firm fixed effects, for country-sector-year fixed effects, and even for region-sector-year fixed effects; when we use a number of alternative definitions of growth opportunities; when we only look at smaller firms, manufacturing firms, or firms with not a single

missing observation over the sample period; and when we study intangible investment to capture firm investment growth, and sales growth, to capture firm performance.

At the same time, we document three main channels whereby debt can induce an inefficient allocation of investment. First, we test and confirm that for very high levels of debt, it is the firms with the lowest growth opportunities that invest the most. This suggests that excessive levels of debt are associated with a reduction in investment efficiency, and is in line with models that predict risk shifting at excessive levels of firm debt (e.g., Jensen and Meckling (1976)). Second, even within the class of theories that predicts that debt can have a positive impact on investment efficiency, some models argue that this crucially depends on the maturity composition of debt (e.g., Diamond and He (2014)). We find that, given the level of total debt, firms financing themselves with a larger share of short-term debt invest relatively less if they are facing good growth opportunities. This suggests that a debt structure composition skewed towards shorter maturities is also associated with investment inefficiency. Third, we test for how the impact of debt on investment efficiency is affected by credit market distress. We find that firms with higher levels of debt facing good growth opportunities invest less than similar firms with lower growth opportunities during systemic banking crises. The result is stronger for credit constrained firms and for firms that have been unprofitable for 3 years or more. Our results thus provide evidence that credit market distress can neutralize the disciplining role of debt on investment, thereby reducing investment efficiency.

The rest of the paper is organized as follows. In Section 2, we discuss the related literature. Section 3 presents the data. In Section 4, we formulate our empirical strategy. In Section 5, we present our main results and robustness analysis. Section 6 studies the possible sources of investment misallocation. Finally, Section 7 concludes.

2 Related literature

Our paper is motivated by a large theoretical literature on the relationship between the firm's capital structure and its investment decisions. There are broadly two classes of models which generate conflicting predictions on how debt financing affects investment efficiency, depending on the nature of the agency cost involved. The first class of models predicts a positive correlation between debt and investment efficiency. Grossman and Hart (1982) argue that the capital structure of the firm can be used to discipline managers who would otherwise waste firm's resources on perks. By taking on more debt, the firm becomes more susceptible to bankruptcy, which provides the manager with an incentive to make sound investments and boost the firm's cash flow, thus reducing the probability of bankruptcy. Therefore, this class of models predict that higher debt levels increase the firm's incentives to invest in value-enhancing projects, thus increasing investment efficiency.

A second class of models predicts a negative correlation between debt and investment, and by extension between debt and investment efficiency. Myers (1977) shows that existing debt can act as a tax on the proceeds of the new investment because part of any increase in value generated by the new investment goes to make the existing lenders whole, and it is therefore unavailable to repay those claimants who put up the new money. This gives rise to a "debt overhang" problem whereby highly leveraged firms will be likely to forego some positive-NPV projects, resulting in an underinvestment.

An interesting combination of these predictions is offered by Jensen and Meckling (1976). They argue that the entrepreneur can divert part of the investment funds to pay for personal perks. Outside equity increases the incentive to underinvest, and instead divert funds, because the manager has to share the future return to any current investment with the shareholders, while by virtue of requiring a state-independent stream of payments, debt overcomes this problem. However, excessive debt leads to asset substitution whereby the managers of highly

leveraged firms prefer to make risky investments even if the latter have negative expected returns because equity holders keep the profits if the investment succeeds, while debtholders stand to lose if the investment fails.

The extant empirical literature has provided a large body of evidence that credit frictions can lead to misallocation of investment away from its most profitable use. Banerjee and Duflo (2005) present extensive evidence on the misallocation of capital in developing countries and argue that credit constraints play a significant role in this misallocation. They argue that credit frictions depress total factor productivity growth because they reduce the efficiency of capital allocation across existing heterogeneous firms, in the process distorting the entry and exit decisions of firms. Kalemli-Özcan and Sørensen (2012) study capital misallocation within and across 10 African countries. They document high variation in firms' marginal product of capital, both across countries and within countries, and relate these differences to firm-specific difficulties in accessing external finance. Gilchrist et al. (2013) develop an accounting framework that allows them to exploit the difference in borrowing costs between firms subject to financing frictions and those that are less affected by them, like firms with access to capital markets. They find a modest productivity loss due to resource misallocation on the intensive margin—about 2 per cent of TFP. Greenwood et al. (2013) find sizable effects of financing frictions on economic development, and argue that differences in financial systems can account for about 30 per cent of cross-country differences in per-capita GDP. Midrigan and Xu (2014) find fairly small losses from misallocation on the intensive margin of about 5 to 10 per cent, due to the ability of firms to accumulate own funds and rely on internal finance. However, they find potentially large losses from inefficiently low levels of entry and technology adoption that may amount to as much as 40 per cent. The mechanism at play is related to the fact that technological choice entails large upfront costs that have a long payback period and that are difficult to finance without significant reliance on external finance.

In addition, economic theory predicts two possible sources of misallocation related to credit frictions. First, indebted firms might invest relatively less because the positive-NPV projects they are willing to fund cannot survive until banks recover and provide the required level of credit. Second, banks in a crisis could engage in zombie lending, whereby forbearance of non-performing loans enables banks to defer losses and to keep refinancing low-productivity projects at the expense of good growth opportunities projects. Evidence to that end has come from a variety of historical episodes, such as the Japanese real estate crisis of the 1980s (Peek and Rosengren, 2005; Caballero et al., 2008) and the recent twin finance and sovereign debt crisis in Europe (Koetter et al., 2017; Schivardi et al., 2017). We contribute to this literature by quantifying the impact of debt overhang in firms and agency problems in banks on firms' investment across industrial sectors facing heterogeneous growth opportunities.

Our work is also related to the literature on the link between the firm's capital structure and its investment decisions. For example, Lang et al. (1996) document a negative relation between leverage and future growth at the firm level. Furthermore, they find that leverage does not reduce growth for firms known to have good investment opportunities, but is negatively related to growth for firms whose growth opportunities are either not recognized by the capital markets or are not sufficiently valuable to overcome the effects of their debt overhang. Hennessy (2004) provides evidence of significant underinvestment by firms resulting from debt overhang. Ahn et al. (2006) find that the negative impact of leverage on investment is significantly greater for high-Q than for low-Q segments within diversified firms, and argue that the disciplining benefit of debt is partially offset by the additional managerial discretion in allocating debt service that is provided by the diversified organizational structure. Gan (2007) uses a source of exogenous variation in collateral value, provided by the land market collapse in Japan, and shows that a shock to collateral value influences firms' debt capacities and corporate investments. Chava and Roberts (2008) identify debt covenants and the transfer of control rights as a mechanism through which financial frictions impact corporate investment. In particular, they show that

capital investment declines sharply following a financial covenant violation, when creditors use the threat of accelerating the loan to intervene in management. The paper most closely related to ours is Kalemli-Özcan et al. (2015), who use a sample similar to our and show that higher debt levels are associated with lower investment. Relative to these papers, we look at the impact of debt on investment efficieny, in addition to investment levels, and we use a large international sample of public and private firms, therefore we can identify a link between debt and misallocation for non-listed firms, too.

Our paper is also related to the extensive literature on the finance-and-growth nexus. For example, Rajan and Zingales (1998) show that industries that rely more in external finance grow faster in more developed financial systems. Many subsequent papers have extended this analysis, piling up more evidence that indeed financial development has a disproportionately large impact on industries and firms that are more dependent on external finance relative to others and that it relaxes external financing constraints. For instance, Wurgler (2000) shows that in countries with more developed financial systems, growing industries increase investment more, and declining industries decrease investment more, than those in countries with less developed financial systems. Claessens and Laeven (2003) show that weak property rights reduce growth by leading to a suboptimal allocation of resources. Beck et al. (2008) emphasize the removal of obstacles to growth for small firms. They show that industries that are naturally composed of small firms grow faster in countries with more developed financials systems. A number of firm-level studies provide some evidence on the allocation of capital and economic development. Demirgüç-Kunt and Maksimovic (1998) show that firms in financially more developed countries are able to better exploit profitable opportunities and grow faster than peers in less financially developed economies, while Beck et al. (2001) confirm these findings using an extended sample of firms. Love (2003) and Beck et al. (2005) argue that financial development reduces financial constraints, particularly for small firms. Most related to our paper are the studies by Bekaert et al. (2007) and by Fisman and Love (2007) which show that financial development and financial

liberalization have a relatively higher impact on growth in industries facing good global growth opportunities.

3 Data

3.1 Firm-level data

Our firm-level data come from the Orbis data set provided by Bureau van Dijk (BvD). Orbis contains financial and ownership data for more than 170 million firms from more than 100 countries world-wide. Financial data include balance sheet information and income statements, while ownership data contain information about the shareholders of the company. The database has been compiled since 2005 by BvD and is currently updated quarterly. Every vintage contains a history of up to ten years of financial information for an individual firm. BvD offers to link the latest vintage with historical vintages going back to 2005. The analysis in this paper is based on the vintage as of the second quarter of 2015 linked with all historical files available from BvD.

A common feature of Orbis is that financial information for a given firm and year is updated from one vintage to the next. When constructing the historical files, special care is taken to put the latest available information for any given year and company. The resulting data set contains many more firm-year observations than are available in the latest vintage alone. This is because the companies may drop out from the sample over time. For instance, there are about 30% more companies in the historical files compared to the latest vintage. The reason is that BvD deletes companies that do not report for a certain period from each vintage. Such companies are nevertheless included in the linked historical files, thereby reducing the survivorship bias that is present in a single vintage. At this stage, the data set contains about 100 million firm-year observations, but about a quarter of those relate to firms that have not provided financial

information in any given year.

For our analysis, we take companies with financial data in the period 2004−2013 and we work with unconsolidated accounts. We start with a total of 46,080,758 firms. We first note that the number of firms varies significantly by country. For example, there are on average 372 firms per year in Cyprus, and 664,469 firms per year in France. Table 1 reports the Orbis coverage relative to Eurostat; it shows that while some countries are well represented in Orbis, some have very low coverage. We drop countries for which Orbis coverage relative to Eurostat is below 10%. These countries are Cyprus (1% coverage), Czech Republic (8% coverage), Greece, Lithuania (5% coverage), Malta (4% coverage), and Poland (3% coverage), and so we are left with the remaining 22 EU countries. Table 2 reports the number of firms by country and year over the sample period.

In terms of firm-specific information, we make use of the following variables: total assets, tangible fixed assets, intangible fixed assets, cash, long-term debt, loans, creditors and other current liabilities, cash flow, sales. Our consistency checks make sure that balance-sheet identities hold within a small margin and entries are meaningful from an accounting point of view. Following Kalemli-Özcan et al. (2015), we drop firm-year observations in which total assets, fixed assets, intangible fixed assets, sales, long-term debt, loans, creditors, other current liabilities, or total shareholder funds and liabilities have negative values. Furthermore, we drop firm-year observations for which some basic accounting identities are violated by more than 10 per cent. These identities ensure that (i) total asset match total liabilities, (ii) total assets match the sum of fixed assets and current assets, and (iii) current liabilities match the sum of loans, trade credit and other current liabilities.

We also drop country-specific sectors, such as agriculture and mining; sectors with high government ownership, such as public administration; and heavily regulated sectors, such as finance. For our analysis we retain only firms in Manufacturing (NACE Rev. 2 Section C), Construction

(F), Wholesale and retail trade (G), Transportation and storage (H), Accommodation and food service activities (I), Information and communication (J), Professional, scientific and technical activities (M) and we drop firm-year observations if there are less than 10 firms in each NACE Rev. 2 digit 4 sector.

Finally, we winsorize all variables at the 1% level. After applying all these procedures, we are left with 8,427,633 unique firms over the sample period 2004−2013, and a maximum of 44,701,224 firm-year observations for 22 European countries.

Table 3 presents summary statistics on all relevant variables used in the empirical tests. In general, there is a good deal of variation in the variables of interest whose impact on investment we seek to identify. For example, while the net investment ratio is a positive 0.34% on average, it varies widely with a standard deviation of 2.27%. Total debt is on average around three-quarters of total assets, but this variable also exhibits considerable variation.[2] The composition of debt varies, too, with short-term debt accounting on average for 84% of total debt. The average firm also has around 150,000 euro worth of assets, a cash flow-to-assets ratio of 0.05, and a sales-to-assets ratio of 1.82.

3.2 Growth opportunities

The decision to undertake investment heavily depends on the investment opportunities that are available to the firm. Investment opportunities are typically unobserved to the econometrician and the empirical corporate finance literature has relied on several proxies, such as market-to-book value as a proxy for Tobin's Q (Smith and Watts, 1992; Booth, 2001; Allayannis et al., 2003). However, there are several problems with this approach. For one, most of these proxies are endogenous to the firm's capital structure and financing decisions. Second, these proxies

[2]Because of negative shareholders' funds, for some companies debt-to-asset ratio exceeds one. It is because of potential losses and provisions which were booked on balance with negative signs. As it is an allowed practice, we do not exclude such companies from our sample.

might be influenced by the local economic conditions in which the firm is operating, thus in turn introducing some spurious correlation with the investment outcome. Finally, they are only observed for listed firms. In order to study the impact of debt overhang on investment in relation to firm's investment opportunities, and to do so both for large firms and for SMEs, we need to rely on an empirical proxy that is exogenous to the firms' characteristics, capital structure decisions, and local economic conditions, and that can be constructed for non-listed firms, too.

We therefore rely on the price-to-earnings (PE) ratios at the sector level as an exogenous proxy variable for firms' investment opportunities. Holding a number of factors, such as risk, constant, higher PE ratios indicate high global growth opportunities (Bekaert et al., 2007). The rationale is that high PE ratios signal high investors' expectations about future growth in a particular sector. Other authors have proposed current growth of US industries as a measure of growth opportunities (Fisman and Love, 2007). While the main advantage of the PE ratio is that it is forward-looking, we nevertheless also use, in robustness tests, current US sales growth as an alternative measure of growth opportunities. Our approach is similar in spirit to Rajan and Zingales (1998), who construct a time-invariant, industry-specific measure of external financial dependence. Our measure of growth opportunities is also sector-specific, but at the same time it is time-varying, and so it should capture the evolution of the global growth potential of an industry, independent of local economic conditions and firms' capital structure.

We collect data on global PE ratios for the period 2004-2013 from Datastream for 39 industrial sectors. These industrial sectors are then matched to 662 four-digit industries as defined in NACE Rev. 2 classification and are subsequently merged to Orbis data. Mapping the two classification and cleaning our sample of firms results in the merging of a number of sectors, leaving us with 30 unique sectors. Appendix Table A1 lists all sectors used.[3]

[3]The matching key between Orbis and Datastream is available upon request.

3.3 Financial distress indicators

Last but not least we consider an alternative to the debt overhang measure. In particular, we focus on two indicators of financial distress which highlight the ability of a company to receive external funds and its overall financial condition. The former is a novel index of financial constraints, derived from the European Investment Bank (EIB) investment survey, and the latter is constructed in the spirit of the classification proposed by the Bank of England in the August inflation report in 2013.[4]

The EIB Group Survey on Investment and Investment Finance (EIBIS) is an EU-wide survey that gathers qualitative and quantitative information on investment activities by both SMEs and larger corporates, their financing requirements and the difficulties they face. Using a stratified sampling methodology, EIBIS is representative across all 28 Member States of the EU and applies to four firm size classes (micro, small, medium and large) and four sector groupings (manufacturing, services, construction and infrastructure) within countries. It is designed to build a panel of observations over time, and is set up in such a way that survey data can be linked to firms' reported balance sheet and profit and loss data. The first wave of the survey took place between July and November 2016 and the second one between April and August 2017. The technical details behind the survey are described by Brutscher and Ferrando (2016) and Ipsos (2017).

The EIBIS considers financially constrained companies as those firms that are dissatisfied with the amount of finance obtained, firms that sought external finance but did not receive it, and firms that did not seek external finance because they thought borrowing costs would be too high or that they would be turned down. To construct the index we follow a two-step approach. First, we pool the survey responses from 2016 and 2017 waves, and we estimate the probability

[4]There are several other potential classifications of financial distress, based on debt coverage ratios or Altman Z-scores, for instance. For simplicity and greater coverage we choose the one that involves the least data manipulation.

of being financially constrained on size, cash flow, financial leverage and cash holdings, as well as on sector- and country-specific dummies. In the second step we fit the estimated coefficients to the full Orbis data set. The resulting score is used to rank the firms according to their probability of being credit constrained or not. For each year, financially constrained firms are finally identified as those with a value of the score greater than a country threshold, which is directly derived from the survey. The procedure is parallel to the ones used by Ferrando et al. (2015) and Ferrando and Wolski (2018).

Bank of England (2013) considers loss-making companies. In line with the proposed methodology, we count companies as financially distressed, if they record negative profits for three consecutive years.

4 Empirical strategy

Given the data set we have assembled, our goal is to study differences in investment across firms, distinguishing between sectors facing different growth opportunities, and conditioning on firms' debt. To that end, we estimate the following panel regression model with multi-dimensional fixed effects:

$$\frac{I_{fcst}}{K_{fcst-1}} = \beta_1 \frac{Debt_{fcst-1}}{Assets_{fcst-1}} + \beta_2 \frac{Debt_{fcst-1}}{Assets_{fcst-1}} \times GGO_{st} + \gamma X_{fcst-1} + \mu_f + \phi_{cst} + \varepsilon_{fcst}, \qquad (1)$$

where I_{fcst} is investment by firm f, located in country c, operating in sector s in year t, and K_{fcst-1} is that same firm's stock of tangible capital at the end of the previous year. I_{fcst} is calculated as the firm's year-on-year percentage change in tangible capital. $Debt_{fcst-1}/Assets_{fcst-1}$ denotes the firm's total debt divided by total assets. In our main specification. GGO_{st} is the sector-specific price-to-earnings ratio, and it varies over time and across sectors. In robustness tests, we also employ alternative proxies for growth opportunities, such as a country-industry-specific price-to-earnings ratio, the average sales' growth for a particular US industry in a

particular year, and the price-to-cash flow ratio.[5] By using a lagged value of debt and a contemporaneous value of growth opportunities, we attempt to circumvent the possibility that leverage levels are determined by growth opportunities (see, e.g., Barclay and Smith (1995)). By X_{fcst-1} we denote a vector of lagged control variables including the logarithm of total assets, the ratio of cash flow to total assets, and the ratio of sales to total assets. Its inclusion allows us to capture the independent impact of various firm-specific developments, such as shocks to overall debt, profits, cash flow, or assets.

Vector μ_f stands for time-invariant firm fixed effects. Controlling for firm fixed effects is enormously important because any variation across firms in the propensity to invest can be driven by a number of unobservable firm-specific time-invariant factors, without any panel variation existing. Term ϕ_{cst} is an interaction of country, sector, and year dummies. This combination of fixed effects absorbs any time-varying shocks to demand or to technology that are specific to a particular sector in a particular country during a particular year (e.g., health care equipment and services in Italy in 2010). In this way, identification is achieved by comparing the average investment levels of two otherwise identical firms operating in better and worse growth opportunities sectors.[6] Finally, ε_{fcst} is the idiosyncratic error term. We do not include the variable GGO_{cst} separately in the model specification above because its direct effect on investment is absorbed by the country-sector-year fixed effects.

The coefficients of interest are β_1 and β_2. A negative coefficient β_1 would imply that all else equal, investment declines with the level of firm debt. A positive coefficient β_2 would imply that all else equal, investment increases with the level of firm debt in sectors facing good global growth opportunities.

[5]The price-to-cash flow ratio is computed as the price divided by cash earnings per share, adjusted for capital changes. At the sector level, it is derived by dividing the market value by the latest total cash earnings amount.

[6]To control more tightly for the confounding effect of regional factors, such as demand or technology, on individual sectors, in robustness tests we also include an interaction of region, sector, and year dummies.

In addition to the main model, we estimate three alternative specifications to address concerns that our model may be misspecified. First, it is possible that the true effect of debt overhang on the level and composition of investment is non-linear, and by forcing a linear specification onto the data, our regression could yield biased estimates. Jensen and Meckling (1976) provide a theoretical underpinning for this hypothesis. They argue that reasonable levels of debt financing discipline firm investment by preventing the manager from empire building. At the same time, excessive levels of debt may be detrimental to investment efficiency because firms close to bankruptcy can engage in asset substitution, investing in negative-NPV projects that yield a high return in some rare states of the world. The union of the two arguments points to a concave relationship between debt overhang and investment efficiency.

To account for this possibility, we estimate the following variant of Model (1):

$$\begin{aligned}\frac{I_{fcst}}{K_{fcst-1}} &= \beta_1 \frac{Debt_{fcst-1}}{Assets_{fcst-1}} + \beta_2 \frac{Debt_{fcst-1}}{Assets_{fcst-1}} \times GGO_{st} \\ &+\beta_3 \frac{Debt_{fcst-1}}{Assets_{fcst-1}}^2 + \beta_4 \frac{Debt_{fcst-1}}{Assets_{fcst-1}}^2 \times GGO_{st} + \gamma X_{fcst-1} + \mu_f + \phi_{cst} + \varepsilon_{fcst}.\end{aligned} \tag{2}$$

The only difference with Model (1) is that we add the square of the debt-to-assets ratio, in level and in interaction with the proxy for global growth opportunities. Consistent with the hypothesis in Jensen and Meckling (1976), we expect $\beta_4 < 0$, suggesting that investment efficiency declines with debt at excessive levels of debt.

Our second extension is related to the possibility that the maturity composition of debt may matter for the overall impact of debt overhang on investment efficiency. The theoretical mechanisms highlighted in the literature have ambiguous empirical implications. On the one hand, short-term debt can reduce the overhang cost of leverage, and so firms with a shorter maturity of debt should experience reduced debt overhang and should invest more (Myers, 1977). Moreover, because short-term debt needs to be constantly renegotiated and rolled-over, from the borrowers' point of view a shorter maturity of debt can be used as a signal for being a "good" firm, while from the creditors' point of view, a shorter maturity of debt enables

better monitoring of managers (Diamond, 1991, 1993). These theories predict that investment efficiency declines with the maturity of debt. On the other hand, Diamond and He (2014) argue that (risky) short-term debt can impose an even greater overhang problem than long-term debt and it can distort firms' investment decisions because short-term debt shares even less risk with equity than long-term debt. This generates a mechanism whereby investment efficiency increases with debt maturity, making the relationship between debt maturity and investment efficiency an ultimately empirical question.

To bring these theoretical ambiguity to the data, we estimate the following model:

$$\begin{aligned} \frac{I_{fcst}}{K_{fcst-1}} &= \beta_1 \frac{Debt_{fcst-1}}{Assets_{fcst-1}} + \beta_2 \frac{Debt_{fcst-1}}{Assets_{fcst-1}} \times GGO_{st} \\ &+ \beta_3 STDebt_{fcst-1} + \beta_4 STDebt_{fcst-1} \times GGO_{st} \\ &+ \gamma X_{fcst-1} + \mu_f + \phi_{cst} + \varepsilon_{fcst} \end{aligned} \tag{3}$$

In this specification, the difference with Model (1) is that we have added the share of debt that matures in 1 year or less, denoted by $STDebt_{fcst}$, in level and in the interaction with the proxy for global growth opportunities. Given the theoretical ambiguity highlighted above, both $\beta_4 < 0$ and $\beta_4 > 0$ would be consistent with at least one theoretical mechanism.

One final possibility is that the effect of debt overhang on allocative efficiency varies across good and bad times, and could be negative during financial crises when creditors hit the leverage constraints or they suffer from liquidity drains. Economic theory predicts two possible sources of investment inefficiency during a systemic banking crisis. First, indebted firms might invest relatively less because the positive-NPV projects they are willing to fund cannot survive until banks recover and provide the required level of credit. Second, banks in a crisis could engage in zombie lending, whereby forbearance of non-performing loans enables banks to defer losses and to keep refinancing low-productivity projects at the expense of good growth opportunities projects (Peek and Rosengren, 2005; Caballero et al., 2008; Koetter et al., 2017; Schivardi et al., 2017).

To test these theories, we estimate the following model:

$$\begin{aligned}\frac{I_{fcst}}{K_{fcst-1}} &= \beta_1 \frac{Debt_{fcst-1}}{Assets_{fcst-1}} + \beta_2 \frac{Debt_{fcst-1}}{Assets_{fcst-1}} \times GGO_{st} \\ &+\beta_3 Debt_{fcst-1}/Assets_{fcst-1} \times BankingCrisis_{ct} \\ &+\beta_4 Debt_{fcst-1}/Assets_{fcst-1} \times GGO_{st} \times BankingCrisis_{ct} \\ &+\gamma X_{fcst-1} + \mu_f + \phi_{cst} + \varepsilon_{fcst}\end{aligned} \tag{4}$$

Here $BankingCrisis_{ct}$ is a dummy variable equal to 1 if country c is experiencing a systemic banking crisis in year t, where the banking-crisis taxonomy is based on Laeven and Valencia (2013). Again, both signs of β_4 coefficient are possible under standard theories. For $\beta_4 > 0$ one would observe no investment inefficiency during a banking crisis. For $\beta_4 < 0$, the effect is consistent with one or both inefficiency theories outlined above.

5 Empirical results

5.1 Debt overhang and investment efficiency

We start the presentation of our empirical tests by reporting our first set of results on the effect of the debt overhang on firms' investment and investment efficiency. Our main test is motivated by two conflicting theoretical mechanisms. On the one hand, in indebted firms creditors bear most of the return to any additional investment. Such firms will reduce overall investment levels, even the ones with high-NPV projects (Myers, 1977). On the other hand, should debt bring discipline to a company, the underinvestment problem can be mitigated, particularly for firms facing good global growth opportunities (Grossman and Hart, 1982).

Table 4 presents our benchmark specification. We present three versions of Model (1), all of which include firm fixed effects and firm-specific time-varying variables, but which differ in how saturated the specification is with country, sector, and year fixed effects. We start with a specification that doesn't include any aggregate-scale fixed effects (column (1)). This

specification allows us to include our measure of global growth opportunities, the PE ratio in levels as well as in interaction with firm leverage. We next add country-year and sector-year fixed effects, which control for country-specific and industry-specific trends (column (2)). Finally, we include country-sector-year fixed effects (column (3)). This is our preferred specification as it allows us to compare firms with different levels of debt in the same industry and country during the same point in time, netting out all other factors that are common to all firms in a sector-country during the same year.

Across all specifications, we find that firms richer in cash flow, firms with higher sales-to-assets ratios, and smaller firms invest on average more, all else equal. The former two are standard effects relating profitability to investment, and the latter is a standard scale effect. In column (1), we also find that firms invest more if they operate in sectors that are facing better global growth opportunities in the current year. This is also largely expected as actual investment should be strongly affected by the investment opportunities that a firm is currently facing. Numerically, a two-standard-deviation increase in the sector's price-to-earnings ratio increases net investment by 0.026 percentage points, or about 8% of the sample mean.

In terms of the main variables of interest, we find that a higher debt-to-asset ratio is uniformly associated with lower investment. Increasing the debt-to-assets ratio decreases investment by about one-quarter of a standard deviation. This result is consistent with Kalemli-Özcan et al. (2015), who show that higher leverage at the firm level is associated with lower average investment in a similar sub-sample of countries during a similar sample period. This result also confirms the standard debt overhang mechanism described in Myers (1977), whereby firms with too much outstanding debt fail to invest in projects that yield a positive expected return because equity holders benefit less from any additional investment.[7]

[7] Appendix Table A2 demonstrates that the main result documented in Table 4 is remarkably stable when we control more tightly for the confounding effect of regional factors, such as demand or technology, on individual sectors, by include on the right-hand side of the regression an interaction of region, sector, and year dummies.

Looking at the coefficient on the interaction between debt and our measures of growth opportunities, we find that firms facing better prospects, as measured by global PE ratio, invest more compared to firms with the same level of debt but with weaker growth opportunities. This result is confirmed across specifications, and it is uniformly significant at the 1% statistical level. The point estimates in column (3) imply that the overall effect of debt on investment becomes positive whenever industries are characterized by a PE ratio higher than 42.2.

5.2 Robustness analysis

In this sub-section, we provide additional evidence from robustness tests in which we make use of different measures of global growth opportunities, we restrict our sample along several dimensions, and we look at different measures of firm performance.

5.2.1 Alternative measures of growth opportunities

Another potential concern is associated with the use of PE ratios to proxy for global growth opportunities. For example, high PE ratios can result from high TFP growth and not necessarily from investment, hence, they should lead to a more efficient use of resources, but not necessarily to more capital accumulation. Moreover, PE ratios can be high as a result of high leverage in a sector, compromising them as a proxy for growth opportunities. They could be high due to industry-specific bubbles driven by investor exuberance. Finally, global PE ratios may capture poorly the growth opportunities of small non-exporting firms.

In order to address these criticisms, in Table 5 we employ three alternative proxies for global growth opportunities. In column (1), we replace the PE ratio with the logarithm of the PE ratio. This should reduce the dependence of our results on extreme values of industry-specific outliers. We find that the presence of PE ratios, potentially inflated by overconfidence in stock markets, does not explain our main result.

In column (2), we use a measure of price-to-earnings which is derived from country-industry data rather than from global industry data. Because a number of countries have either no firms or very few firms in some industries, this measure exhibits much larger volatility over time, and the total number of observations declines by 2.8 million. However, the advantage of this measure is that it captures better the effect of local factors that plausibly drive growth opportunities. The points estimates reported strongly suggest that the way growth opportunities interact with firm-level debt to determine investment choices is not driven by a particular choice of measuring growth opportunities globally or locally.

In column (3) we look at annual sales growth over the sample period of the industries in our data set in the United States. This approach is akin to Fisman and Love (2007) who argue that because deep and liquid financial markets make US corporates relatively free of financing constraints, the actual performance of US industries – in terms of sales growth – is a good proxy for the industry's potential performance. This makes US industry-wide sales growth a conceptually sound measure of the global growth opportunities that the industry is facing. We find that the interaction of this variable with the firm's debt overhang has a positive, statistically significant effect on firm investment. The data thus suggest that the main result of the paper is not driven by a particular choice of proxy for growth opportunities.

Finally, in column (4), we use instead a measure of price-to-cash-flow ratio adjusted for capital changes, in order to reduce the sensitivity of our estimates to TFP-driven PE values. Our main result continues to hold in this specification as well.

5.2.2 Robust sample

In our main tests we have been working on the full sample of firms available in Orbis database, with the exclusion of some specific sectors (such as utilities and financial firms). However, our results could be affected by the composition of the sample in several ways.

First, our results could be partly driven by the fact that our sample is unbalanced and includes firms that enter or exit the market during the course of the period considered. If some firms exit because they default and close, our results could reflect the inclusion of unproductive firms with high levels of debt. For this reason, in column (1) of Table 6 we run our benchmark model on a smaller set of firms which are present in our sample for 10 consecutive years; doing so reduces the sample size from roughly 15 to about 2.3 million firm-year observations. The main result reported in Table 4 still holds, suggesting that the disciplining role of debt is a stable feature of the data. Remarkably, even though the number of observations declines by 85%, the numerical impact of the interaction of debt overhang and global growth opportunities on capital investment is almost identical to the one reported when using the full sample.

Second, in our analysis we include manufacturing as well as service sectors. Given that the investment variable is computed as the percentage change in tangible fixed assets, one could argue that this empirical proxy would not be a reliable measure of investment for firms in non-manufacturing industries whose production function is skewed away from tangible factors. We address this concern by restricting our sample to manufacturing sectors only (column (2) of Table 6).[8] Our main results are robust to this alternative specification and still significant at the 1% statistical level. Moreover, the magnitude of the effect proves remarkably stable to focusing on only one major economic sector.

Finally, there could be substantial firm-size heterogeneity within industry that can interact with growth opportunities to determine firm investment. For example, Gopinath et al. (2017) show that capital misallocation crucially depends on company size, with misallocation more likely to take place in smaller firms. To account for this possibility, we split the firms in our sample in three sub-classes: firms with fewer than 50 employees; firms with between 50 and 250 employees; and firms with more than 250 employees. The evidence presented in columns (3)–(5)

[8]The setups aims at exploiting the cross-sector differences in asset composition. In Section 5.2.3 we consider firm-specific differences by looking at alternative definition of investment, focusing on intangible assets.

strongly suggests that large firms are exempt from the patter documented so far (column (5)). For firms with fewer than 250 employees, however, it is still the case that while higher debt reduces investment, it leads to a more efficient allocation of investment along the menu of growth opportunities. Our results are thus consistent with Gopinath et al. (2017) in that we document one individual channel whereby smaller firms reduce investment in response to information frictions. At the same time, this effect is attenuated by good global growth opportunities, suggesting that in the case of smaller firms, debt serves as a disciplining investment device.

5.2.3 Alternative measure of investment

Another possible concern related to our analysis so far is that some of the most innovative firms invest in intangible assets, such as patents and R&D, rather than in tangible assets, such as machinery and equipment. To the extent that tangible and intangible investment are imperfectly correlated, our empirical framework may be mismeasuring the true effect of debt overhang on investment. While the literature has provided evidence that intangible investment responds to firm financing conditions (Brown et al., 2012), the link between debt overhang and the optimal allocation of intangible investment is ultimately an empirical question.

To address this concern, we now provide additional evidence on the level and composition effect of debt on investment in intangible assets. In practice, we re-estimate the preferred specification from Table 4, whereby we replace tangible investment with intangible investment as the main dependent variable. The evidence presented in column (1) of Table 7 suggests that the impact of debt overhang is very similar, both on its own and in interaction with global growth opportunities. In particular, intangible investment increases with cash flow, with firm sales, and with growth opportunities, and it declines with firm size. Crucially, intangible investment declines with the debt-to-asset ratio (underinvestment effect), but less so if the firm is facing good growth opportunities (disciplining effect). We conclude that the investment

patterns we established in the previous tables are not confined to the impact of debt overhang and growth opportunities on tangible investment.

We next seek to provide complementary evidence to the conjecture that higher investment efficiency results in higher growth for the firms in question. To that end, we re-estimate our main regression model after replacing tangible investment with sales growth as the main dependent variable. We calculate sales growth as the year-on-year log difference in total sales, but the results are robust to calculating sales growth as a percentage change instead. Column (1) of Table 7 presents evidence consistent with the idea that firms which invested more because of how their level of debt interacted with their growth opportunities also experienced a larger increase in sales.

6 Sources of investment inefficiency

In the previous section, we imposed a linear relationship between the debt-to-assets ratio and investment. However, this model could be misspecified, for at least three separate reasons. First, the relationship between debt and investment could be non-monotonic. Second, the maturity composition of debt could play a role in the evolution of investment efficiency. Third, the relationship between debt overhang and investment efficiency may vary with credit market conditions. In this Section, we explore these theoretical possibilities more formally.

6.1 Excessive debt

We first account for the possibility that the relationship between debt and investment is non-monotonic. Our evidence so far suggests that debt can have a disciplining effect on investment, a finding consistent with Jensen and Meckling (1976). However, the same paper argues that after a certain level, by bringing the firm closer to bankruptcy, debt can give the manager an incentive to invest in low- or even negative-NPV projects that however yield a very high return

in some rare states of the world. We hypothesize that at excessive levels of debt, the disciplining role of debt is dominated by the manager's incentive to engage in asset substitution. We test for this mechanism by turning to Model (2), which augments Model (1) with the square of the debt-to-asset ratio, both on its own and in interaction with the price-to-earnings ratio.

The estimates from this set of tests are reported in Table 8. We find that the relationship between debt and investment is on average negative, but can turn positive for very high levels of debt. In our preferred specification with firm-specific time-varying factors, firm fixed effects, and country-sector-year fixed effects, we also find that while high price-to-earnings ratio have a positive effect on the interaction between debt overhang and investment, that impact turns negative at excessive levels of debt.

Overall, our results suggest that, for plausible levels of PE ratio, the misallocation problem can only be observed for firms with debt-to-asset ratios above two. Such high values can only be found among firms which expect substantial losses. Since such examples are rare but certainly possible, our results thus provide some evidence that there is misallocation of investment due to high debt levels at the firm level. These facts are consistent with prior theories of debt overhang and misallocation, and evidence thereof (Jensen and Meckling, 1976; Berkovitch and Kim, 1990). We explore the role of financial distress more in Section 6.3.

6.2 Maturity composition of debt

One class of economic theories predicts that short-term debt helps reduce the overhang cost of leverage (Myers, 1977). Thus, firms with a shorter maturity of debt should invest more, due to a lower debt overhang problem. The intuition behind this theoretical result is that short-term debt is less sensitive to the value of the firm, and thus receives a smaller benefit from new investment: if debt matures before the investment decision is made, then the firm can make investment as if an "all-equity" firm would. In this case, a company would not have to incur

the agency costs of debt, whereby the firm is discouraged from making new investment because all the proceeds would accrue to existing debt holders.

Moreover, the very same nature of short-term debt can help mitigate the agency conflicts between creditors and borrowers: given that short-term debt needs to be constantly renegotiated and rolled-over, from the borrowers' point of view a shorter maturity of debt can be used as a signaling device for being a "good" firm, and enable them to obtain better loan conditions and renewal of loans, while from the creditors' point of view, a shorter maturity of debt enables better monitoring of managers (Diamond, 1991, 1993).

In contrast, Diamond and He (2014) spells out conditions under which short-term debt can distort firms' investment decisions. They show that risky short-term debt can impose an even greater overhang problem than the long-term equivalent because, while long-term debt prevents equity from receiving any payoff from investment when the payoffs are below a bankruptcy threshold, short-term debt may share even less repayment risk with equity over time. This is because short-term debt is going to be paid earlier than long-term debt, as there is less uncertainty to be resolved, and the transfer from equity to debt holders might be even greater. Therefore, economic theory does not make clear predictions about the relationship between the maturity composition of debt and investment efficiency.

In Table 9, we enrich our benchmark specification to account for the role that short term debt plays in exacerbating the debt overhang problem and distorting investment away from an efficient allocation. In practice, we estimate Model (3) whereby we augment our main Model (1) with a variable that captures the share of short-term debt (i.e., debt with maturity of less than 1 year) out of total debt, both by itself and in interaction with our measure of growth opportunities. From a practical perspective, it is important to notice that small firms finance investment predominantly with short-term debt (see also Kalemli-Özcan et al. (2015)); as shown in Table 3, the average share of short-term debt in our sample of firms amounts to more than

80%.

We find that, for a given level of the total debt-to-assets ratio, firms that finance themselves with a larger share of short-term debt invest more. This is consistent with Kalemli-Özcan et al. (2015), who find that only long-term debt depresses investment, while short-term debt increases it. They argue that these results are consistent with a mechanism whereby short-term debt does not deter investment because its value is less sensitive to the value of the firm, and so it receives a smaller benefit from new investment (Myers, 1977).

As for the interaction term between the debt variable and the growth opportunity measure, we find that higher levels of short-term debt are associated with relatively lower investment in good-growth-opportunities sectors. Our results point towards the existence of misallocation of investment coming from reliance on short-term debt, which helps mitigate the debt overhang problem for highly indebted firms, but does not necessarily lead firms to invest in higher-growth opportunities sectors.

6.3 Credit market distress

A third potential source of investment misallocation stems from the deterioration of credit market conditions during a crisis. It is widely understood that credit supply is procyclical in nature: economic booms are characterized by excessive credit growth, while during downturns insufficient credit is provided to the economy. In particular, during a banking crisis, when asset prices fall and banks start deleveraging, banks are more likely to deny credit to profitable projects. In this section, we test for the existence of a differential impact of banking crises on investment efficiency. Our goal is to assess the role of the crisis in affecting firm investment, depending on the firms' level of indebtedness and growth opportunities.

Economic theory predicts two possible sources of misallocation during a banking crisis. On the one hand, firms might lose profitable opportunities because the positive-NPV projects they

are willing to fund cannot survive until banks recover and provide the required level of credit. On the other hand, banks in a crisis could engage in zombie lending, whereby forbearance of non-performing loans enables banks to defer losses and to keep refinancing low productivity projects at the expense of good growth opportunities projects (Peek and Rosengren, 2005; Caballero et al., 2008; Koetter et al., 2017; Schivardi et al., 2017).

In Table 10, we augment our benchmark specification to account for the role of systemic banking crises. We estimate Model (4) whereby our main Model (1) now includes a variable that captures whether the country is currently in a systemic banking crisis, in interaction with our measures of debt overhang and of growth opportunities. We also include all other variables from Model (1), as well as all double interactions. The main coefficient of interest is the one on the triple interaction, which measures the difference in investment during a banking crisis, between high-debt and low-debt firms operating in sectors facing better growth opportunities industries, relative to sectors facing worse growth opportunities.

Table 10 reports the estimates from this modification of our main test. In column (1), we only include the double interaction between debt and the banking crisis, abstracting from the effect of growth opportunities. We find that indebted firms invest less during systemic banking crises, confirming that agency problems at firms and at banks interact to depress firms' investment.

Column (2) reports results for our specification of interest with the triple interaction. We find that, during a banking crisis, firms facing good global growth opportunities invest less than firms with the same level of debt facing low growth opportunities. Our results thus confirm the hypothesis about the existence of misallocation of investment during a banking crisis, whereby firms with higher levels of debt invest less, with the effect being even more prominent for those facing good growth opportunities.

Our analysis so far is prone to the criticism that we have not accounted for the effect of

concurrent macroeconomic factors affecting aggregate demand. In particular, one of the most influential hypotheses for the decline in aggregate investment after the global financial crisis rests on the proposition that aggregate demand collapsed due to substantial shocks that led economic agents to increase savings, reducing the corporate propensity to invest.[9] SMEs in Europe routinely report "finding customers" as the most severe problem they face in such a business environment (ECB, 2017). Aggregate demand likely declines more during systemic banking crises, casting doubt over the validity of our prior estimates.

To account for this possibility, we enrich our specification with standard empirical proxies that should capture demand properties of the business cycles. In particular, we add to our main empirical model interactions between the firm-specific debt-to-assets ratio with the country-specific GDP growth, the country-specific unemployment rate, and the country-specific yield on 10-year domestic sovereign bonds. In column (3) of Table 10, we include a horse race with all interaction variables which we call "macro factors" (coefficients on macroeconomic variables are not reported for brevity). Our main result on the triple interaction between debt, growth opportunities and the banking crisis dummy largely survives this 'horse race' specification.

While Table 10 provides evidence that the positive effect of higher debt on investment allocation is reversed during banking crises, the precise channel whereby intensified agency problems during systemic banking crises affect investment allocation remains unclear. One possibility is that credit constrained firms invest less during banking crises – because they have fewer tangible assets, a result related to the intuition of Almeida and Campello (2007) – and this effect is stronger in sectors facing better growth opportunities as these are also associated with higher investment risk. Another possibility is that banks are reluctant to recognize credit losses as this would reduce their regulatory capital cushion. This incentive is even higher during times when raising capital is more expensive, such as systemic banking crises. As firms with

[9]Larry Summers at the IMF 14th Annual Research Conference In Honor of Stanley Fisher, International Monetary Fund, 8 November 2013.

worse prospects are more likely to default, banks are more likely to keep lending to them at the expense of firms facing better investment prospects, a phenomenon know as "zombie lending" (Caballero et al., 2008; Koetter et al., 2017; Schivardi et al., 2017). The two possibilities are not mutually exclusive, and while the channels they capture are distinct, both could be subsumed in the debt-overhang mechanism central to this paper.

In Table 11, we take these possibilities to the test by replacing, at a time, the variable $Debt/Assets$ with the proxy for credit constraints from EIBIS and with the proxy for distressed firms. We introduce both variables in levels, in double interactions with $BankingCrisis$ and with PE, respectively, as well as in a triple interaction with $BankingCrisis$ and PE. We are interested in the coefficient on the triple interaction which would tell us whether a particular firm is relatively more likely to reduce investment during banking crisis if it faces better exogenous growth opportunities. We find that distressed firms invest substantially less on average (columns (1) and (2)), a result reminiscent of the debt overhang effect we unveiled so far. However, such firms reduce investments less if they face better growth opportunities, suggesting that this class of firms responds to investment opportunities as well. The negative investment effect is also less pronounced during banking crises, another standard effect form the literature whereby banks are likely to evergreen loans to such firms instead of recognize the credit losses, weakening the incentives for firms to shut down some of the investment projects. Crucially, the coefficient on the triple interaction strongly suggests that distressed firms reduce investments more if they face better growth opportunities. We find the same effect for credit constrained firms as well (columns (3) and (4)). The results confirm that during times of systemic financial stress, a high degree of debt overhang may be proxying for other firm characteristics that can lead to credit misallocation, such as constrained access to finance and inability to service loan repayments.

7 Conclusions

Corporate investment in Europe was one of the biggest casualties of the twin financial and sovereign debt crisis, as investment by non-financial corporations dramatically dropped after the start of the crisis, and its recovery has been sluggish throughout the last decade. A number of explanations for this collapse in investment have been put forth, with debt overhang at the firm level indicated as one of the main culprits for this collapse (e.g., Kalemli-Özcan et al. (2015)). In this paper, we address the still open question whether debt overhang has reduced investment only through a level effect or through a composition effect as well, by shifting the allocation of investment away from good growth opportunities. To that end, we use data on 8.5 million firms in 22 countries, taking advantage of comprehensive information on firm investment and debt, as well as on standard controls for size and profitability. We augment these data with information on the global time-varying price-to-earnings ratio in the sector where each firms is operating, arguing that these capture global growth opportunities that are exogenous to individual firms' conditions.

Our main findings are twofold. First, we find that while debt overhang reduces firm investment, this effect is less pronounced for firms operating in sectors facing good global growth opportunities. The latter finding is consistent with a disciplining role as in Grossman and Hart (1982), and it is inconsistent with an underinvestment problem coupled with a reduction in investment efficiency as in Myers (1977). The main result of the paper is confirmed in specifications controlling for time-varying firm-specific factors, for firm fixed effects, and for country-sector-time fixed effects. Second, we also find that the positive effect of debt overhang on investment allocation declines at excessive levels of debt, as well as if debt is dominated by short maturities, and it is reversed during systemic banking crises. This second set of results is consistent with a number of theories on investment misallocation due to agency problems at firms and at banks, such as Jensen and Meckling (1976) and Diamond and He (2014).

Our findings contribute to the debate on why business investment levels in Europe remained substantially below their pre-crisis peak for so long after the global financial crisis. As such, they may offer a guidance on what the most efficient tools are for preventing such an investment decline in the future. While our results do not negate other concurrent mechanisms, such as weak demand, sovereign stress, or macroeconomic uncertainty, they point to various properties of firm-specific debt characteristics as an important determinant of lower overall investment. The main result emerging from our analysis is that high levels of corporate debt do not only have a negative average impact on investment, but that they are particularly detrimental to investment in low-growth-opportunity sectors. Our findings thus speak to the importance of regulatory tools and prudential supervision in curtailing credit booms that allow firms to become excessively leveraged.

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Table 1: **Orbis coverage.** This table summarizes the average coverage of our Orbis data set with respect to Eurostat SBS for selected NACE 2 sections (see Table 2). We compare the period 2008-2013 due to data availability issues in SBS data by sector. For Greece we take the OECD Structural and Demographic Business Statistics for selected ISIC Rev. 4 equivalents of NACE 2 sections, as the country is not represented in the Eurostat tables. Source: Orbis database, Eurostat Business demography by size class (from 2004 onwards, NACE Rev. 2), OECD Business statistics by employment size class.

Country	Orbis coverage
AT	16%
BE	50%
BG	38%
DE	18%
DK	42%
EE	61%
ES	18%
FI	36%
FR	28%
GB	41%
HR	52%
HU	35%
IE	24%
IT	16%
LU	23%
LV	60%
NL	23%
PT	28%
RO	73%
SE	33%
SI	40%
SK	22%
CY	1%
CZ	8%
GR	5%
LT	5%
MT	4%
PL	3%
Average (excl. CY, CZ, GR, LT, MT, PL)	35%

Table 2: **Number of firms in Orbis data set.** This table presents the number of firms in each country and in each year in Orbis.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT	25,113	43,628	52,986	57,096	58,549	55,821	57,294	63,350	63,629	63,348
BE	189,154	194,728	202,423	210,231	218,409	224,930	230,440	236,875	241,902	241,224
BG	26,213	24,147	37,573	48,871	33,957	35,122	38,424	156,777	189,708	188,710
DE	55,736	287,443	452,854	466,021	482,664	490,012	487,141	491,603	351,963	271,260
DK	52,590	53,513	58,901	64,079	67,146	67,861	68,215	69,018	68,935	70,028
EE	22,857	25,799	30,139	35,284	39,112	32,252	34,386	37,199	40,104	41,069
ES	482,958	500,935	529,520	473,572	509,162	514,835	495,893	489,575	480,542	416,188
FI	56,716	58,400	57,836	69,876	80,408	83,051	85,684	87,672	83,735	80,902
FR	567,121	591,707	621,855	653,492	685,627	698,096	715,873	723,513	721,009	666,397
GB	568,194	591,598	606,180	623,011	637,971	649,875	672,657	706,134	746,959	793,687
HR	48,207	52,165	57,090	59,492	64,416	71,613	71,035	69,325	73,806	66,776
HU	147,229	157,619	50,583	100,788	104,052	161,669	159,937	158,727	173,713	180,160
IE	22,915	25,793	29,647	33,444	36,419	38,009	39,506	41,474	43,611	44,320
IT	337,770	347,053	368,824	533,410	558,450	565,993	579,232	584,098	572,818	549,429
LU	1,238	2,306	3,129	3,564	4,397	5,573	5,592	5,349	5,137	4,191
LV	6,535	7,029	9,449	10,437	5,897	5,417	49,980	60,381	64,999	69,272
NL	114,259	143,111	171,506	182,928	192,641	197,398	200,813	204,491	205,473	198,691
PT	68,179	206,610	201,282	204,299	203,030	204,055	194,158	185,246	181,451	178,098
RO	280,102	320,991	308,780	408,710	370,531	332,231	338,796	366,991	396,556	457,073
SE	133,632	137,550	142,223	148,991	156,616	165,279	175,298	193,942	212,457	225,587
SI	9,103	9,808	10,762	10,547	9,884	11,119	63,490	67,955	67,057	61,111
SK	8,822	18,109	24,539	28,258	28,256	72,389	82,451	92,227	101,174	99,387

Table 3: **Summary statistics.** This table presents summary statistics for the main variables used in the analysis. *Investment/Capital* is constructed as the ratio of the change in fixed tangible assets over the stock of fixed tangible assets in the previous year; *Intangible Inv./Intang. Cap* is constructed in an analogous way, using the stock of intangible assets; *Total Debt/Assets* is the ratio of total short-term, other current liabilities, and long-term debt to total assets; *Short term Debt/Total Debt* is the ratio of all current liabilities with maturity below one year to *Total Debt* (sum of loans, creditors, other current liabilities); *Cash Flows/Assets* is the ratio of cash flows to total assets; *Sales/Assets* is the ratio of sales to total assets; *Log(Assets)* is the logarithm of total assets; *Price/Earnings ratio* is the sector-level price-to-earnings ratio; *Price/Cash Earnings ratio* is computed using cash earnings; *US sales growth* is the yearly growth of US sales at the sector level; *Banking crisis* is a country-level dummy equal to one if the country is experiencing a banking crisis in a particular year, according to Laeven and Valencia (2012); *Index of financial constraints* is an indicator variable denoting firms that are dissatisfied with the amount of finance obtained. *BoE index* is an indicator variable denoting firms that have recorded negative profits for three consecutive years.

Variable	Obs	Mean	Std. Dev.	Min	Max	Median
Investment/Capital	32,921,958	0.34	2.27	-1.00	17.69	-0.12
Intang. Inv/Intang. Cap.	13,583,883	0.57	5.09	-1.00	44.23	-0.14
Total Debt/Assets	29,595,936	0.76	0.80	0.00	6.37	0.66
Short term Debt/Total Debt	29,186,239	0.84	0.26	0.02	1.00	1.00
Cash Flows/Assets	28,266,862	0.05	0.31	-1.61	0.99	0.06
Sales/Assets	24,998,164	1.82	1.89	0.00	12.13	1.37
Log(Assets)	44,701,224	11.93	2.14	5.65	17.27	12.13
Price/Earnings ratio	44,701,224	17.82	3.81	8.71	45.09	17.48
Price/Cash Earnings ratio	44,701,224	8.78	2.11	3.67	18.65	8.19
US sales growth	44,651,085	0.08	0.13	-0.31	1.67	0.07
Banking Crisis dummy	37,577,703	0.49	0.50	0.00	1.00	0.00
Index of fin. constraints	11,903,925	0.06	0.24	0.00	1.00	0.00
BoE index	16,772,843	0.13	0.33	0.00	1.00	0.00

Table 4: **Debt overhang and investment efficiency: Baseline results.** This table presents estimates of the effect of the debt in level and in its interaction with growth opportunities. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in tangible fixed assets (investment) over the stock of tangible fixed assets in the previous period (capital). Debt is measured as the ratio of total long term debt and current liabilities over total assets. *PE* is the global price-to-earnings ratio of the sector in which a firm is operating. All other variables are described in the note to Table 3. All regressions include fixed effects as specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) Investment/Capital	(2) Investment/Capital	(3) Investment/Capital
Debt/Assets x PE	0.0087***	0.0088***	0.0090***
	(0.0005)	(0.0005)	(0.0005)
Debt/Assets	-0.3690***	-0.3790***	-0.3828***
	(0.0088)	(0.0089)	(0.0090)
Cash Flows/Assets	0.4316***	0.3670***	0.3668***
	(0.0049)	(0.0049)	(0.0049)
Sales/Assets	0.0533***	0.0408***	0.0400***
	(0.0012)	(0.0013)	(0.0013)
log(Assets)	-0.7556***	-0.7378***	-0.7393***
	(0.0029)	(0.0029)	(0.0029)
PE	0.0034***		
	(0.0004)		
Firm FE	Yes	Yes	Yes
Country x Year FE	No	Yes	No
Sector x Year FE	No	Yes	No
Country x Sector X Year FE	No	No	Yes
Observations	14,975,770	14,975,767	14,975,583
R^2	0.2198	0.2227	0.2231

Table 5: **Alternative measures of growth opportunities.** This table presents the baseline specification from Table 4 column (3) but for alternative measures of growth opportunities. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in tangible fixed assets (investment) over the stock of tangible fixed assets in the previous period (capital). Debt is measured as the ratio of total long term debt and current liabilities over total assets. *PE* is the global price-to-earnings ratio of the sector in which a firm is operating. *US sales* is the average sales growth of US firms in the respective industry-year. *PC* is the price-to-cash-earnings ratio adjusted for capital changes. All other variables are described in the note to Table 3. All regressions include fixed effects as specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) Investment/Capital	(2) Investment/Capital	(3) Investment/Capital	(4) Investment/Capital
Debt/Assets x log(PE)	0.1543***			
	(0.0086)			
Debt/Assets x PE (country)		0.0000***		
		(0.0000)		
Debt/Assets x US sales			0.2099***	
			(0.0160)	
Debt/Assets x PC				0.0121***
				(0.0011)
Debt/Assets	-0.6642***	-0.2500***	-0.2398***	-0.3272***
	(0.0246)	(0.0036)	(0.0033)	(0.0096)
Cash Flows/Assets	0.3664***	0.3386***	0.3648***	0.3652***
	(0.0049)	(0.0054)	(0.0050)	(0.0049)
Sales/Assets	0.0399***	0.0234***	0.0400***	0.0401***
	(0.0013)	(0.0014)	(0.0013)	(0.0013)
log(Assets)	-0.7393***	-0.7240***	-0.7392***	-0.7391***
	(0.0029)	(0.0033)	(0.0029)	(0.0029)
Firm FE	Yes	Yes	Yes	Yes
Country x Sector x Year FE	Yes	Yes	Yes	Yes
Observations	14,975,583	12,281,914	14,965,139	14,975,583
R^2	0.2231	0.2231	0.2230	0.2230

Table 6: **Robust sample.** This table presents the baseline specification from Table 4 column (3) but for: (1) a sample of companies present in the market for 10 consecutive years; (2) a sample of manufacturing companies only; (3) a sample of firms with fewer than 50 employees; (4) a sample of firms with between 50 and 250 employees; and (5) a sample of firms with more than 50 employees. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in tangible fixed assets (investment) over the stock of tangible fixed assets in the previous period (capital). Debt is measures as the ratio of total long term debt and current liabilities over total assets. *PE* is the global price-to-earnings ratio of the sector in which a firm is operating. All other variables are described in the note to Table 3. All regressions include fixed effects as specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) Investment/Capital	(2) Investment/Capital	(3) Investment/Capital	(4) Investment/Capital	(5) Investment/Capital
Debt/Assets x PE	0.0058***	0.0098***	0.0080***	0.0055***	-0.0066
	(0.0010)	(0.0005)	(0.0007)	(0.0013)	(0.0064)
Debt/Assets	-0.3509***	-0.3930***	-0.3481***	-0.1746***	0.0736
	(0.0203)	(0.0100)	(0.0134)	(0.0268)	(0.1392)
Cash Flows/Assets	0.3971***	0.3624***	0.4065***	0.4186***	-0.0401
	(0.0137)	(0.0053)	(0.0070)	(0.0161)	(0.0808)
Sales/Assets	0.0587***	0.0384***	0.0537***	-0.0307***	-0.1437***
	(0.0040)	(0.0013)	(0.0018)	(0.0036)	(0.0193)
log(Assets)	-0.7961***	-0.7308***	-0.8004***	-0.9425***	-1.8838***
	(0.0082)	(0.0031)	(0.0045)	(0.0087)	(0.0787)
Firm FE	Yes	Yes	Yes	Yes	Yes
Country x Sector x Year FE	Yes	Yes	Yes	Yes	Yes
Observations	2,420,017	12,555,499	7,114,603	2,857,034	128,848
R^2	0.1749	0.2290			

Table 7: **Alternative measure of firm performance.** This table presents the baseline specification from Table 4 column (3) but for different measures of firm performance. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in intangible fixed assets (intangible investment) over the stock of intangible fixed assets in the previous period in (1), and the firm's year-on-year sales growth in (2). Debt is measured as the ratio of total long term debt and current liabilities over total assets. *PE* is the global price-to-earnings ratio of the sector in which a firm is operating. All other variables are described in the note to Table 3. All regressions include fixed effects as specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)
	Intangible investment/Capital	Sales growth
Debt/Assets x PE	0.0105***	0.0049***
	(0.0017)	(0.0003)
Debt/Assets	-0.4844***	-0.0792***
	(0.0307)	(0.0065)
Cash Flows/Assets	0.1916***	-0.3582***
	(0.0156)	(0.0030)
Sales/Assets	0.0194***	-0.4319***
	(0.0039)	(0.0009)
log(Assets)	-0.7964***	-0.7329***
	(0.0096)	(0.0020)
Firm FE	Yes	Yes
Country x Sector x Year FE	Yes	Yes
Observations	8,444,873	15,822,990
R^2	0.2064	0.2076

Table 8: **Misallocation from excessive debt.** This table presents the baseline specification from Table 4 column (3) augmented with a squared term for debt, both in level and in its interaction with growth opportunities. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in tangible fixed assets (investment) over the stock of tangible fixed assets in the previous period (capital). Debt is measured as the ratio of total long term debt and current liabilities over total assets. *PE* is the global price-to-earnings ratio of the sector in which a firm is operating. All other variables are described in the note to Table 3. All regressions include fixed effects as specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)
	Inv/Capital	Inv/Capital	Inv/Capital
Debt/Assets x PE	0.0087***	0.0097***	0.0106***
	(0.0008)	(0.0008)	(0.0008)
Debt/Assets	-0.4221***	-0.5299***	-0.5462***
	(0.0156)	(0.0158)	(0.0160)
$(\text{Debt/Assets})^2$ x PE	0.0000	-0.0002	-0.0004*
	(0.0002)	(0.0002)	(0.0002)
$(\text{Debt/Assets})^2$	0.0109***	0.0317***	0.0349***
	(0.0036)	(0.0036)	(0.0037)
Cash Flows/Assets	0.4258***	0.3501***	0.3499***
	(0.0050)	(0.0050)	(0.0050)
Sales/Assets	0.0533***	0.0406***	0.0398***
	(0.0012)	(0.0013)	(0.0013)
log(Assets)	-0.7529***	-0.7298***	-0.7313***
	(0.0029)	(0.0030)	(0.0030)
PE	0.0036***		
	(0.0005)		
Firm FE	Yes	Yes	Yes
Country x Year FE	No	Yes	Absorbed
Sector x Year FE	No	Yes	Absorbed
Country x Sector x Year FE	No	No	Yes
Observations	14,975,770	14,975,767	14,975,583
R^2	0.2199	0.2228	0.2232

Table 9: **Misallocation from the maturity composition of debt.** This table presents the baseline specification from Table 4 column (3) augmented with the share of short term debt out of total debt, both in level and in its interaction with growth opportunities. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in tangible fixed assets (investment) over the stock of tangible fixed assets in the previous period (capital). Debt is measured as the ratio of total long term debt and current liabilities over total assets. *PE* is the global price-to-earnings ratio of the sector in which a firm is operating. All other variables are described in the note to Table 3. All regressions include fixed effects as specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)
	Inv/Capital	Inv/Capital	Inv/Capital
Debt/Assets x PE	0.0079***	0.0088***	0.0090***
	(0.0005)	(0.0005)	(0.0005)
Debt/Assets	-0.3021***	-0.3272***	-0.3310***
	(0.0089)	(0.0090)	(0.0090)
Short Term Debt/Debt x PE	-0.0200***	-0.0115***	-0.0121***
	(0.0007)	(0.0007)	(0.0008)
Short Term Debt/Debt	1.1723***	1.0075***	1.0175***
	(0.0137)	(0.0143)	(0.0150)
Cash Flows/Assets	0.4269***	0.3660***	0.3659***
	(0.0049)	(0.0049)	(0.0050)
Sales/Assets	0.0384***	0.0269***	0.0261***
	(0.0012)	(0.0013)	(0.0013)
log(Assets)	-0.7265***	-0.7105***	-0.7120***
	(0.0029)	(0.0029)	(0.0029)
PE	0.0199***		
	(0.0007)		
Firm FE	Yes	Yes	Yes
Country x Year FE	No	Yes	No
Sector x Year FE	No	Yes	No
Country x Sector x Year FE	No	No	Yes
Observations	14,947,301	14,947,301	14,947,119
R^2	0.2222	0.2249	0.2253

Table 10: **Misallocation during banking crisis.** This table presents the baseline specification from Table 4 column (3) augmented with a triple interaction between debt, growth opportunities, and a dummy equal to one if the country is experiencing a systemic banking crisis. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in tangible fixed assets (investment) over the stock of tangible fixed assets in the previous period (capital). Debt is measured as the ratio of total long term debt and current liabilities over total assets. *PE* is the global price-to-earnings ratio of the sector in which a firm is operating. All other variables are described in the note to Table 3. Column (3) includes interactions of *Debt/Assets x PE* with GDP growth, the unemployment rate, and sovereign bond yields. All regressions include fixed effects as specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) Investment/Capital	(2) Investment/Capital	(3) Investment/Capital
Debt/Assets x PE x Banking Crisis		-0.0058***	-0.0035***
		(0.0009)	(0.0011)
Debt/Assets x Banking Crisis	-0.1192***	-0.0064	-0.0147
	(0.0036)	(0.0175)	(0.0199)
Debt/Assets x PE		0.0068***	0.0035*
		(0.0007)	(0.0021)
Debt/Assets	-0.1545***	-0.2846***	-0.3644***
	(0.0040)	(0.0133)	(0.0398)
Firm-level controls	Yes	Yes	Yes
Macro controls	No	No	Yes
Firm FE	Yes	Yes	Yes
Country x Sector x Year FE	Yes	Yes	Yes
Observations	14,975,583	14,975,583	14,096,137
R^2	0.2232	0.2232	0.2114

Table 11: **Misallocation during banking crisis: the role of financial distress.** This table presents the baseline specification from Table 4 column (3) augmented with a triple interaction between different measures of financial distress, growth opportunities, and a dummy equal to one if the country is experiencing a systemic banking crisis. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in tangible fixed assets (investment) over the stock of tangible fixed assets in the previous period (capital). *PE* is the global price-to-earnings ratio of the sector in which a firm is operating. *Fin. Constr.* is an indicator variable denoting firms that are dissatisfied with the amount of finance obtained. *Distressed firm* is an indicator variable denoting firms that have recorded negative profits for three consecutive years. All other variables are described in the note to Table 3. Columns (2) and (4) include interactions of *Distressed firm x PE* and of *Fin. Constr. x PE*, respectively, with GDP growth, the unemployment rate, and sovereign bond yields. All regressions include fixed effects as specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) Inv./Capital	(2) Inv./Capital	(3) Inv./Capital	(4) Inv./Capital
Distressed firm x PE x Banking Crisis	-0.0139***	-0.0190***		
	(0.0018)	(0.0024)		
Distressed firm x Banking Crisis	0.2122***	0.2658***		
	(0.0319)	(0.0421)		
Distressed firm x PE	0.0107***	0.0217***		
	(0.0014)	(0.0036)		
Distressed firm	-0.3005***	-0.5312***		
	(0.0255)	(0.0665)		
Fin. Constr. x PE x Banking Crisis			-0.0082**	-0.0111***
			(0.0032)	(0.0042)
Fin. Constr. x Banking Crisis			0.0069	0.0792
			(0.0587)	(0.0727)
Fin. Constr. x PE			0.0080***	0.0104
			(0.0025)	(0.0066)
Fin. Constr.			-0.1532***	-0.2277*
			(0.0463)	(0.1223)
Firm-level controls	Yes	Yes	Yes	Yes
Macro controls	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes
Country x Sector x Year FE	Yes	Yes	Yes	Yes
Observations	8,528,525	8,250,831	7,280,107	6,905,140
R^2	0.2262	0.2250	0.2317	0.2171

A Appendix Tables

Table A1: **Sectors and Price-to-Earnings ratios.** This table presents the list of sectors used in the analysis. The source is Thomson Reuters Datastream, P/E Equity Indices by Market.

Datastream mnemonic	Description	Average PE (2004-2013)
aersp	Aerospace & Defense	16.21
autmb	Automobiles & Parts	17.23
beves	Beverages	19.35
chmcl	Chemicals	17.30
cnstm	Construction & Materials	15.55
eltnc	Electronic & Electrical Equipment	21.04
fdrgr	Food & Drug Retailers	18.59
foods	Food Producers	17.79
fstpa	Forestry & Paper	21.23
gnind	General Industrials	15.34
gnret	General Retailers	18.96
hceqs	Health Care Equipment & Services	19.57
hhold	Household Goods & Home Construction	16.52
inden	Industrial Engineering	18.20
indmt	Industrial Metals & Mining	13.37
indtr	Industrial Transportation	16.34
leisg	Leisure Goods	26.37
media	Media	20.42
mning	Mining	17.01
persg	Personal Goods	21.60
pharm	Pharmaceuticals & Biotechnology	19.05
reits	Real Estate Investment Trusts	22.94
rlisv	Real Estate Investment & Services	14.91
sftcs	Software & Computer Services	21.85
supsv	Support Services	17.57
techd	Technology Hardware & Equipment	19.94
telfl	Fixed Line Telecommunications	14.66
telmb	Mobile Telecommunications	15.65
tobac	Tobacco	16.04
trles	Travel & Leisure	19.32

Table A2: **Debt overhang and investment efficiency: Accounting for regional effects.** This table presents estimates of the effect of the debt in level and in its interaction with growth opportunities. The sample period is between 2004 and 2013. The dependent variable is the ratio of the change in tangible fixed assets (investment) over the stock of tangible fixed assets in the previous period (capital). Debt is measured as the ratio of total long term debt and current liabilities over total assets. All other variables are described in the note to Table 2. All regressions include all firm-specific controls, as well as the fixed effects specified. Standard errors clustered at the firm level appear in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	(1) Investment/Capital
Debt/Assets x PE	0.0086***
	(0.0006)
Debt/Assets	-0.3682***
	(0.0106)
Cash Flows/Assets	0.3597***
	(0.0056)
Sales/Assets	0.0565***
	(0.0014)
log(Assets)	-0.6954***
	(0.0033)
Firm FE	Yes
Region x Sector x Year FE	Yes
Observations	10,842,629
R^2	0.2231

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