Debt or Demand: Which Holds Investment Back? Evidence from an Investment Tax Credit

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Abstract

We study how debt frictions and demand affect corporate investment using administrative data from a large temporary investment tax credit in Portugal. We obtain exogenous variation in demand for exporting firms from product-destination-level changes in foreign demand. We proxy debt frictions by an index of different debt-earnings ratios. We find that debt has a strong, non-linear effect on the likelihood that a firm invests in response to the tax credit. Firms in the lower two quartiles of our debt-earnings index have roughly equal predicted take-up probabilities. For firms in the third quartile predicted take-up drops by 50% while firms in the worst debt-earnings quartile have a predicted take-up rate close to zero. We show that the effect of demand is mediated by the size of a firm's debt burden. While demand has a strong positive effect for the bottom debt quartiles, demand ceases to affect take-up in the highest debt quartile. These results highlight that the distribution of debt, rather than the absolute stock of debt, matters for understanding post-crisis investment dynamics.

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1 Introduction

Corporate investment in the periphery of the Eurozone has suffered a prolonged decline since 2008 which further intensified in the aftermath of the European sovereign debt crisis. Two competing explanations of this decline have been put forward: the lack of product demand and the large stock of corporate debt. The first explanation holds that a negative demand outlook limits firm investment. The second explanation argues that a large debt stock inhibits the ability of firms to finance investment as interest payments reduce available cash flow, tightens collateral constraints impeding access to external financing, and reduces incentives to invest as debt rather than equity holders pocket the proceeds from investing.

This paper contributes two insights to this debate. Studying a large, temporary investment tax credit in Portugal, we first show that the relationship between a firm's debt burden and the likelihood that a firm invests in response to the tax credit is negative but non-linear. Below a certain 'kink point', the negative relationship between debt and the likelihood that a firm uses the tax credit is moderate. However, once a firm crosses over this kink point of indebtedness, a larger debt burden is associated with a sharp decrease in the likelihood that a firm invests in response to the tax credit. Second, the effect of demand is mediated by the size of a firm's debt burden. We find that there is a positive relationship between demand for a firm's product and the likelihood that the firm invests in response to the tax credit. However, demand ceases to have a significant effect on tax credit take-up for the tail of highly indebted firms.

Our results are consistent with theories of debt overhang, which predict that beyond a certain level of leverage firm owners will forgo profitable investment projects because the proceeds from these projects accrue to the firm's debt holders rather than to owners (Myers (1977)). This characterization of firm control rights applies to the vast majority of Portuguese firms, which are privately owned, are frequently managed by those owners, and finance investment with bank debt. Our results hence suggest that the distribution of debt across firms, rather than the absolute stock of debt, matters for correctly quantifying the adverse consequences of high corporate sector debt. Moreover, our results provide a potential explanation why a pick-up in demand conditions will have limited success in speeding up the post-crisis recovery in the absence of a concurrent reduction in corporate debt.

We study the 2014 extraordinary investment tax credit in Portugal (*Credito Fiscal Extraordinario ao Investimento* - CFEI). Since this large and temporary tax credit gave firms a strong incentive to invest in the second half of 2013, it provides an ideal setting to better understand the factors that hold back corporate investment. Firms received a 20%

tax credit on all investment undertaken between June and December 2013. The benefit was large, being equivalent to a reduction of the effective corporate income tax rate from 25% to 7.5%. The investment tax credit was universal, applying to all firms, sectors, and types of investment (including replacement investment). It was granted automatically based on 2013 tax returns. Firms were allowed to defer the tax benefit for up five years in cases when the tax credit exceeded the 2013 tax bill.

Our main empirical specification is an instrumental linear probability model that predicts each firm's take-up of the investment tax credit. We obtain firm-level data on the take-up of the tax credit from the Portuguese Tax Authority. Our main explanatory variables are the log change in firm-level sales, which we instrument with a measure of foreign demand constructed from customs data, and a measure of a firm's debt burden. For the latter, we construct an index that combines three commonly used debt-earning ratios. To allow for a non-linear effect of debt, we divide firms into four quartiles based on our debt-earnings index. We include interaction terms between the debt quartiles and the demand measure to study the interaction between debt and demand. We include a wide range of controls that potentially affect firms' investment decisions: estimated default risk, indicators for solvency and negative equity, past investment spending, productivity, liquidity measures, and industry/region/main lender fixed effects.

We use customs data to construct a demand instrument for exporting firms following Berman et al. (2015). This measure exploits exogenous variation in demand from product-destination level changes in foreign demand. We first calculate the share of each product-destination pair in a firm's export portfolio prior to the tax credit. We then calculate how much an export destination imported of a given good from countries other than Portugal in the year of the tax credit based on global import data. We combine the (time-invariant) firm-level shares with the change in foreign demand to obtain a firm-level measure of the change in product demand. We use this instrument to predict the log change firm-level sales in the sample of exporters. As a robustness test, we use an additional instrument which is based on the fraction of Portuguese firms in an industry that report low product demand as a major investment limitation in a bi-annual survey.

We combine this variation in demand with a measure of a firm's debt burden. Given that exogenous variation in debt is notoriously hard to come by, we proxy indebtedness by an index of three commonly used debt-earnings ratios. The ratios are debt/EBITDA, interest payments/EBITDA, and debt/cash flow. Debt-to-earnings ratios capture the ability of a firm to service its debt burden and capture two types of debt frictions that can generate under-investment: debt overhang and net worth based borrowing constraints. Unlike debt overhang, which reduces the attractiveness of new investment to firm owners, net worth based financial constraints limit the ability of highly indebted firms to finance

investment they would like to undertake. A high debt-earnings ratios identifies firms for which financial constraints are likely to bind. The cash flow of highly indebted firms is absorbed by debt payments leaving little free cash flow for investment. However, their low net worth means that they cannot easily finance investment with debt as banks are reluctant to lend to low net worth firms.

We present the following two main results. First, there is a kink in the relationship between indebtedness and the take-up of the tax credit. Firms in the lower two quartiles of the debt-earnings index have roughly equal predicted take-up probabilities. In contrast, predicted take-up drops by 50% for firms in the third quartile while firms in the worst debt-earnings quartile have a predicted take-up rate close to zero. Second, the effect of demand is mediated by a firm's debt burden. For firms in the lowest debt-earnings quartile, demand has a highly significant positive effect with a 10% increase in sales (instrumented by foreign demand) leading to a 9 p.p. higher take-up probability. In contrast, demand ceases to have a significant impact on take-up for firms in the worst debt-earnings quartile. OLS attenuates the effects of demand by a factor of three, highlighting the importance of using exogenous variation in demand. We find similar results when predicting the amount of invested conditional on a firm using the tax credit. Because the sample shrinks significantly in this intensive margin specification, we obtain less precise estimates.

This paper relates to a large literature on the determinants of corporate investment. Our findings are consistent with theories of debt overhang. The basic insight that a large debt burden inhibits investment when firm owners have control rights goes back to Myers (1977). Lamont (1995) shows that debt overhang is most likely to bite in adverse macroeconomic conditions. Empirical corporate finance research has provided evidence for a debt-overhang driven negative relationship between debt and investment (Hennessy (2004), Giroud et al. (2012)). We provide evidence that the relationship between debt and investment is not only negative but non-linear, consistent with the predictions of debt overhang models.

Our findings are also consistent with a growing literature on financial constraints limiting corporate investment. Financial constraints also generate a negative relationship between debt and investment. If firms face net worth based borrowing constraints, any negative shock to the value of their collateral limits the ability of firms to borrow (Bernanke (1983), Bernanke et al. (1996), Moore and Kiyotaki (1997)). Given that Portuguese firms are heavily bank-dependent for their external financing needs, financial constraints are likely relevant for many Portuguese firms. We leave the challenge of disentangling debt overhang from the effect of financial constraints for future work.

We contribute to the debate on the determinants of sluggish investment dynamics in

the aftermath the 2008 financial crisis. Kahle and Stulz (2013) argue that demand factors are more important than firm-level balance sheet constraints. Similarly, Bloom (2009) and Bloom et al. (2014) highlight the importance of uncertainty, in particular an uncertain demand outlook, in dampening firm investment.[1] In contrast, Giroud and Mueller (2017) provide evidence that firm balance sheets can account for a significant fraction of job losses in the US post-2008. Kalemli-Ozcan et al. (2015) use pan-European firm-level data to show that higher debt levels are associated with lower investment post-crisis. Mian and Sufi (2011) and Mian and Sufi (2014) argue that household debt overhang has been an important factor dragging down household consumption in the US post-2008.

We provide evidence that these different explanations are not mutually exclusive but interact in important ways. An improved demand outlook may have little effect if a large debt burden constrains firms from responding. For example, Arellano et al. (2016) show that a higher level of uncertainty affects highly indebted firms more as their ability to insure against the risk is more limited. More generally, our results highlight the limitations of investment panel regressions in which a measure of indebtedness enters linearly, which fail to instrument for demand and that omit an interaction of debt and demand. Any of these omissions would lead to an underestimate of the negative effect of debt on investment spending

This paper is organized as follows: Section 1 provides details on the investment tax credit. Section 2 discusses the data sources and presents our empirical strategy. Section 3 provides results and section 4 concludes.

2 Background: 2013 Investment Tax Credit

In this section we provide details on the 2014 extraordinary investment tax credit (*Crédito Fiscal Extraordinário ao Investimento* - CFEI) in Portugal. The CFEI tax credit was announced by the Portuguese government in May 2013 with the aim to stimulate corporate investment that had been slow to recover following the 2011 financial crisis in Portugal. The tax credit provided firms with an automatic 20% tax rebate on all investment spending undertaken between June and December 2013. The tax credit was designed to be as general as possible in order to avoid falling under EU state aid restrictions, which apply to other fiscal incentives in Portugal. These rules restrict state aid to particular disadvantaged regions and industries. In contrast, the CFEI applied to all sectors, regions, and type of investment expenditures. Importantly, it applied not only to new investment projects but also to existing investment projects and replacement investment.

[1] We abstract from the role of uncertainty in our analysis due to the difficulty of constructing reliable measures of firm-level idiosyncratic risk.

The tax credit was large. Firms received a tax credit worth 20% of investment expenditures between the 1st of June and the 31st of December 2013, limited to 70% of the total tax bill and with a maximum eligible investment expenditure of EUR 20M per firm. The benefit was equivalent to a reduction of the effective corporate income tax rate from 25% to approximately 7.5%. The tax credit could be deferred for up to five years when a firm's 2013 corporate income tax bill was too low to take full advantage of the CFEI benefit. The data show that most of the tax credit was disbursed in 2013, with 2014 deferred credits being less than a third of the 2013 tax credits claimed. The gross tax credits paid out under CFEI amounted to EUR 233 M, 2.37% of total capital expenditure (CAPEX) spending in 2013.

Take-up, measured as the fraction of firms receiving a tax credit, was very low with only about 4% of eligible firms claiming the tax credit. Manufacturing firms dominated the use of the investment tax credit but services, which usually do not qualify for any type of investment tax benefits, also made use of the tax credit. Take-up differs substantially across firm size: 24.74% of large and 23.81% medium firms used the tax credit, while 8% and less than 1% of small and micro firms used the tax credit.[2]

Aggregate investment increased in the year of the tax credit. According to firm balance sheet data, total CAPEX in 2013 increased by 6.15% relative to 2012. Similarly, national accounts data from INE (National Statistics Office) registered 8.11% growth in gross fixed capital formation (GFCF) in 2013 after four consecutive years of negative investment growth.[3] While some of this increase may be due to the investment tax credit, estimating the causal effect of the investment tax credit on aggregate investment is beyond the scope of this paper.

The tax credit imposed no additional administrative burden on firms. The tax credit was automatically applied based on the investment spending indicated on a firm's tax return. The tax credit was widely advertised following the announcement in May 2013. It is hence unlikely that either lack of knowledge or administrative costs would have prevented firms from making use of the investment tax credit. While the credit only applied to investment conducted between June and December, some flexibility was allowed for firms who had already begun implementing investment projects in the first semester of 2013.

In comparison to the existing investment tax benefit programs, CFEI was larger in gross payments and applied to a much wider range of firms and industries. These dif-

[2]Figure 3 in the Appendix shows the use of tax credits in 2013 disaggregated by industry and size.

[3]Note that the concepts of capital expenditure and GFCF are differ slightly in what they include as investment spending, which yields the difference in numbers. Additionally, many firms with positive investment do not report the cash flow statement where our measure of capex is located, so the capex measure covers a smaller pool of firms

ferences reflect that the existing investment tax benefits apply only to investment in structurally disadvantaged regions, such as Northern Portugal, or to investment in specific industries such as agriculture.[4] Figure 1 in the Appendix shows that CFEI, in aggregate terms, paid out more than the three main alternative investment tax credits combined. Moreover, the number of firms benefiting from the CFEI was 6-times higher than the number of firms using an existing tax credit. Table 1 in the Appendix shows that there is little overlap in use suggesting that the CFEI was successful in targeting firms that were not already benefiting from an existing program.

3 Data and Empirical Strategy

In this section we describe our data and empirical strategy. We combine administrative tax data and firm census data to estimate the effect of debt frictions and demand on (a) take-up rates of the investment tax credit, and (b) the amount invested. We instrument for product demand using variation in foreign demand for exporting firms following Berman et al. (2015).

3.1 Data

We collect data on firm-level tax credit use provided online by the Portuguese Tax Authority. The data cover tax benefits received in 2013 and 2014. Given that firms could defer the benefit for up to five years if their tax bill was low, it is possible that we do not capture every single firm that used the tax credit. However, the data show that the 2014 benefits were already only a small fraction of benefits disbursed in 2013. Hence it is likely that most firms at least received some of the benefit in either 2013 or 2014 allowing us to accurately estimate the effect on take-up rates.

We combine the tax data with proprietary data from the Bank of Portugal. We obtain information on the universe of corporate lending relationships from the credit register (*Central de Responsabilidades de Credito* or CRC) which contains monthly information on every loan in Portugal that exceeds EUR 50. We merge the credit register with balance sheet and other financial variables for non-financial firms. The data comes from the Simplified Corporate Information (*Informacao Empresarial Simplificada* or IES), an annual, mandatory firm census.

[4]There are a variety of investment tax benefits, of which three make up the majority of the claims. One is a contractual program with a 10 year period for big investment projects in strategic economic sectors subject to a formal approval process. The other two programs consist of automatic tax deductions either under the investment fiscal support regime designed for specific industries and regions on the one hand or research and development projects on the other hand. All three programs have similar eligibility criteria, falling under the European Union (EU) state aid regulation which restricts aid to certain industries (such as agriculture), regions (preferences for poorer areas), and types of investment.

Our final dataset covers 286,775 non-financial Portuguese firms in an unbalanced panel from 2010 to 2014, with a total of 986,141 firm-years. We only include firms that have data in both the credit register and firm census for our sample period. We drop observations with any of the following characteristics: negative assets or liabilities, missing sales, age greater than 250, and missing industry classification. All variables are scaled by total assets or liabilities and winsorized at the 2% level. For most of our analysis we restrict the period to 2012, for which we have observations for 199,767 firms holding around 365 billion euros in assets. In many specifications, we focus on the sample of 8,874 exporting firms, defined as any firm with positive export value. In 2012, 3,629 firms were exporters, approximately 1.8% of the 2012 sample.

Table 2 in the Appendix provides descriptive statistics for our sample of firms by take-up of the investment tax credit. We find that firms using the investment tax credit tend to be larger (in terms of total assets and number of employees) and older than the average firm. They have more trade debt and less bank and debt owned to government institutions (e.g. social security debt)[5] and perform better in terms of cash flow and equity. Nonetheless, they pay a comparable amount of income tax as a fraction of total assets and earn an equivalent amount of sales.

Firms that accessed the investment tax credit on average have lower credit risk. None of the firms using CFEI were insolvent in 2012 nor did they suffer a default episode that year.[6] Firms that use the tax credit have slightly more outstanding performing credit but little to no overdue credit. Both groups of firms have on average 20% sales growth from 2011 to 2012. The change in fixed assets, calculated net of depreciation, is less volatile in the group of firms that take up the tax credit. Capital expenditure is also fairly similar across groups, making up $4-5\%$ of total assets. We also find that firms that use the investment tax credit have slightly lower TFP.[7]

3.2 Measuring Firm-level Debt Burden

We measure debt frictions by a firm's capacity to serve its debt burden. We prefer debt-earnings measure over leverage ratios such as debt/equity or debt/assets. The large variation in the structure of liabilities and assets across firm size and industry makes

[5]This debt predominantly takes the form of unpaid social security or income tax obligations. This debt is senior to all other debt obligations and cannot take a haircut.

[6]A firm is insolvent if it has an open process in bankruptcy court or has been liquidated. Default is defined as any incident of at least three months of overdue credit, where the overdue credit accounts for at least 5% of the loan volume (with a minimum of 50 Euros) with that lender. We follow the methodology described in Antunes et al. (2016) to estimate default risk.

[7]We estimate TFP following the Olley and Pakes (1996) three step regression procedure which allows for endogeneity of some of the inputs, selection (due to firms exiting the market), and long-lasting unobserved differences across firms.

such measures less comparable than debt-earnings ratios. Similarly, simple definition of negative equity that are frequently employed in household research are not valid for firms with complex balance sheets. Moreover, negative equity is usually defined in market values while the regulatory balance sheet information only provides book values.

Instead, we combine information from three commonly used debt-earnings ratios into a single index. Debt-to-earnings ratios capture two types of debt frictions that generate under-investment: debt overhang and net worth based borrowing constraints. Debt overhang describes a situation in which the firm's managers forgo positive net-present value (NPV) investment projects because the surplus from these projects accrues to a firm's debt holders rather than its equity holders who have control rights (Myers (1977)). Debt overhang is highly relevant in Portugal where the vast majority of firms are privately owned, often run by their owner, and heavily reliant on bank debt.

The second debt friction are financial constraints that limit firms' ability to raise sufficient external financing to finance positive NPV projects when firms are highly indebted. Such net worth based financial constraints are now a standard ingredient in macro-finance models. Unlike debt overhang, which reduces the attractiveness of new investment to firm owners, net worth based financial constraints limit the ability of highly indebted firms to finance investment they would like to undertake. Debt-earnings ratios capture when such financial constraints are likely to bind. The cash flow of highly indebtedness firms is absorbed by debt payments leaving little free cash flow for investment. However, their low net worth means that they cannot easily finance investment out of debt as banks are reluctant to lend to low net worth firms.

Our debt-earnings index is constructed as follows. We rank firms from least to most indebted, allowing for ties, according to each of the following three ratios: debt/EBITDA, cash flow/debt, interest paid/EBITDA. We then divide firms into quartiles according to their ranks. We assign each of the quartiles a point value (1st quartile=1, 2nd quartile=2, etc). Finally we rank the firms by their combined points and again divide them into quartiles. Firms in the first quartile of our debt overhang proxy have a small debt burden, while firms in the fourth quartile have a severe debt burden. Figure 1 shows the quartile cut-offs for the debt-earnings ratios. Table 3 in the Appendix shows the number of firms in each quartile by use of the investment tax credit.

Quartiles are attractive for three reasons. First, the quartiles allow the impact of debt frictions to increase in a non-linear fashion with the severity of the friction. Second, this approach also allows us to deal with the possible discontinuity that arises from some firms reporting negative EBITDA. Negative EBITDA values make it difficult to interpret a continuous debt/EBITDA measure. In this case negative EBITDA firms would be ranked at the bottom even though they will face a more severe squeeze from their debt

Figure 1: Distribution of Debt-Earnings Ratios

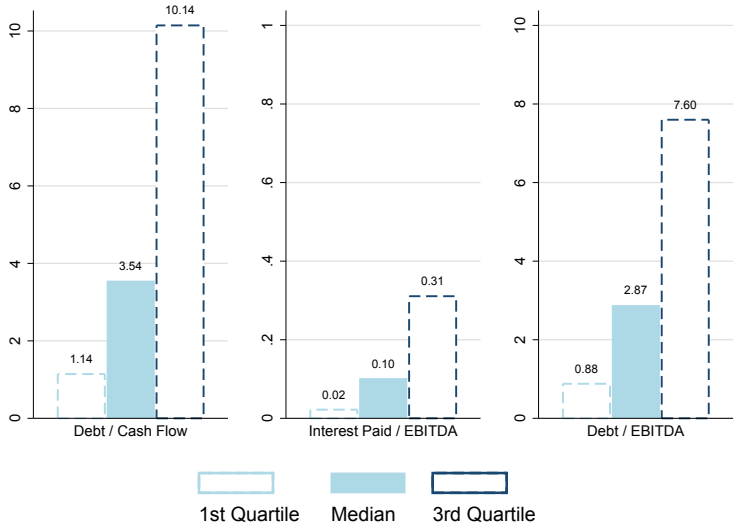


Figure 1 shows the quartile cut-offs for the the debt-earnings ratios used to construct our debt index. All numbers are for Portuguese non-financial firms in 2012. For ease of exposition, we show debt/cash flow even though we use cash flow/debt in the construction of the index. The values are shown in absolute value due to the discontinuity caused by negative EBITDA.
Source: Portuguese firm census, own calculations

burden than firms with positive EBITDA and the same amount of debt. To address this issue, we shift firms with negative EBITDA (but positive debt) to the right of the distribution, above firms with positive debt and positive EBITDA. We chose this approach over simply dropping the negative EBITDA observations because these firms represent a third of our sample. Third, we prefer the relative ranking of firms given that the choice of an absolute threshold is somewhat arbitrary. For example, a debt/EBIDTA level of five, which is considered a red flag by credit analysts, corresponds to the 65th percentile in our sample in 2012 and hence would include a larger number of firms in the highest debt group.

3.3 Measuring Product Demand

We use an instrumental variable approach to isolate plausibly exogenous variation in firm sales. Our main instrument is the change in foreign demand for exporting firms. As a robustness test, we also rely on investment survey data that directly asks for the role of product demand in limiting investment.

Exporter Demand We construct an instrument for foreign demand based on non-Portuguese imports to Portuguese export destinations from product-level customs data. We proceed in two steps to construct instruments for foreign and domestic demand fol-

lowing Berman et al. (2015). We first calculate time-invariant weights for each export product-destination pair in a firm's export portfolio over the years 2005-2011 based on detailed customs data. We then use global import data to calculate how much an export destination imported of a given good from countries other than Portugal. This value is our measure of the export destination's demand for a given product. Hence all time-variation in the demand instrument comes from changes in the country-level imports, not the firm-level weights.

We can then construct our firm-level instrument for foreign demand as follows:

$$\text{Foreign Demand}_{it} = \sum_{jp} \omega_{ijp} M_{jp,t} \tag{1}$$

where ω_{ijp} is the average share of each product p (defined at the HS-6 level) and destination j in firm i's exports over the period (time invariant weights) and $M_{jp,t}$ is the total value of imports for product p and destination j (not including Portugal) in year t.

We can also use a similar approach to construct an instrument for domestic demand.

$$\text{Domestic Demand}_{it} = \sum_{p} \omega_{ip} M_{p,t}^{PT} \tag{2}$$

where ω_{ip} is the average share of each product p in firm i's exports over the period and $M_{p,t}^{PT}$ is the total values of Portuguese imports for product p in year t.

Our baseline version focuses on the firm's core product, which is the HS-4 product with the highest average export value over the period. As a robustness check, we consider all products of a given firm. For the core product measure, ω_{ij}^{core} are the weights of destination j in firm i's core product exports. That is,

$$\text{Core Foreign Demand}_{it} = \sum_{j} \omega_{ij}^{core} M_{j,t}^{core}$$

The equivalent measure for domestic demand is simply the aggregate imports of the core product for each firm.

To construct firm-level weights, we use data from the Portuguese customs agency (*Comercio Internacional*) from 2005-2013. The data provides the export value (price times quantity) of each product (HS6-level) to each destinations at the annual level. The data provides tax identifiers for each firm and hence allows us to match the customs data to the firm-level census and credit register. We can match 28,329 across datasets. We match the firm-level Portuguese customs data to BACI, an International Trade Database, to construct the changing import values for each product. BACI provides data on import

values disaggregated by country and product (HS6-level). Figure 5 in the Appendix shows the a time series of the demand measures compared with actual export and sales values. While the scales are very different, the aggregated constructed measures largely follow the aggregate trends. In 2013, around a quarter of firms received a negative foreign demand shock (defined as a greater than 5% decrease in our demand measures) while around twelve percent had negative domestic demand growth.

Industry Level Survey Responses We use micro data from a biannual investment outlook survey conducted by the Portuguese National Statistics Office to construct a measure of whether firms perceive poor sales to be a major investment limitation.

Figure 2: Survey Responses: Limitations to Investment

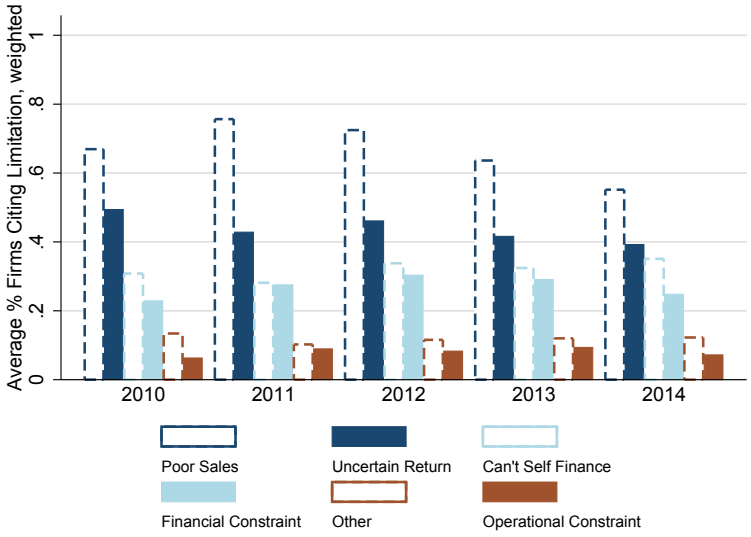


Figure 2 shows the fraction e of firms citing each of the main investment limitations across years. Averages are weighted by sample weights described in the text. For ease of exposition, some limitations are combined. "High interest rate", "poor access to bank credit", and "poor access to capital markets" are all considered financial constraints. "Low production capacity" and "can't find qualified personnel" are considered operational constraints. The remaining limitations are left as presented in the survey.
Source: Portuguese firm census, own calculations

The survey has a sample of approximately 3,500 firms each year. The survey samples from firms with more than 4 workers and annual sales of at least 125,000 Euros according to two stratification variables: industry group and number of workers.[8] Firms with more than 200 workers are exhaustively sampled. Because firms with more than 200 workers are very different from the firms with less than 200 workers, which make the bulk of firms in Portugal, we run our results separately for the two groups.

[8]The survey follows a methodology that is uniform across participating European Union countries. Specifically, the National Statistics Office classifies firms by industry at the 2-digit level except for manufacturing firms where they use 3 digit industry codes. They exclude agriculture and some professional service firms. Additionally, they classify firms into four employment groups: firms with less than 50 employees, with between 50-249 employees, between 250 and 499, and more than 500 employees.

We focus on the following set of questions about limitations to investment: (1) "was investment limited by some factor"; (2) "which factors presented limitations" (selected from a list); (3) "which factor was the most severe limitation". Firms answer these questions twice a year, in April and October, for different reference periods: the current year, the previous year (in April), or the next year (in October). We use the most recent firm response available. Figure 2 summarizes firm responses to the list of limitations. Poor sales outlook or low demand is always the most cited limitation, with uncertain returns and financing constraints the next most cited.

For each group, we collapse the firm-level survey data to the 2-digit industry level and take the average response in each industry as our measure for the impact of low demand on investment. That is, for each industry-year we calculate

$$\text{Low Demand}_{nt} = \frac{\sum_{nt} \mathbb{1}_{it}(\text{low demand})}{N_{nt}} \tag{3}$$

where $\mathbb{1}$(low demand) is an indicator of whether a firm cited low product demand as a limitation and N_{nt} is the number of sampled firms in that industry. To correct for sampling bias, we calculate weights, θ_{nt}, equal to the percentage of firms in each stratum (as defined by the 2-digit industry codes and employment groups) in the population relative to the survey sample. We define the population as the group of firms reporting to firm census. That is,

$$\theta_{nt} = \frac{n_{st}/N_t}{s_{st}/S_t} \tag{4}$$

where n_{st} and s_{st} are the number of firms in each stratum in the population and survey, respectively. N_t is the total number of firms observed in IES each year while S_t is the total number of firms surveyed each year.

Table 5 in the Appendix provides descriptive statistics on the resulting measure. We have 64 industries with an average of 80 firms. On average 73% firms in an industry cite poor sales as a major limitation to investment, with twenty industries having all sampled firms cite poor demand outlook. The lowest proportion occurs in sewage (12 firms sampled) and veterinarians (3 firms sampled) with no firms citing poor sales as a major outlook. In Figure 3 we show that this industry measure is highly correlated with sales growth. The impact of these limitations also varies substantially with size: 70.8% of micro firms cite poor sales as a limitation compared with 57.9% of large firms.

3.4 Empirical Strategy

We use the following instrumental variable linear probability model model to estimate the effect of debt frictions and demand on take-up of the 2013 investment tax credit.

$$\begin{aligned} Pr(\text{take up})_i = &\beta^{\text{demand}} \log \hat{S}_i + \sum_{j=1}^{3} \beta_j^{\text{debt}} \text{quartile}_i^j + \\ &\sum_{j=1}^{3} \beta_j^{\text{interact}} \text{quartile}_i^j \times \log \hat{S}_i + \gamma X_i + u_i \end{aligned} \tag{5}$$

where i indexes firms and j debt quartiles.

The dependent variable is a dummy that is one if the firm has received a tax credit in either 2013 or 2014. The main explanatory variables are demand and debt burden. $\hat{S}_i$ is the predicted firm sales based on the following first stage:

$$\log \hat{\text{S}}_i = \hat{\alpha}^z Z_i + \sum_{j=1}^{3} \hat{\alpha}_j^{\text{debt}} \text{quartile}_i^j + \hat{\theta} X_i \tag{6}$$

where Z_i denotes the instrument (foreign demand or industry share citing low demand). We include the same controls as in the second-stage regression.

We allow for a non-linear effect of debt-earnings ratios by including the upper three quartiles of the combined debt-earnings index (the first quartile is the omitted category). Firms in the fourth quartile have the worst debt-earnings ratios and face the highest debt burden. We also include an interaction term between the quartiles and predicted firm sales. This allows the effect of demand to depend non-linearly on the debt-earnings ratios.

Controls, X_i, include 2012 levels and growth rates so that $X_{ijdb} = \{X_{ijdb,t-1}, \Delta X_{ijdb,t-1}\}$. We control for credit default risk, computed following the methodology in Antunes et al. (2016), indicators for insolvency, past default, and negative equity. We also control for past investment trends by including fixed assets growth, TFP, and cash levels. Finally, we include a dummy variable indicating whether a firm paid income tax in 2012 and the level of other investment tax benefits received. Where possible we include firm size category, industry, district, and banking group fixed effects. The banking group fixed effects are defined as the banking group of the main lender of each firm (the bank with the largest share of the firm's loan balance).[9] We include district fixed effects to absorb

[9]We use group level fixed effects rather than bank level fixed effects in order to reduce the number of categories. Our dataset covers 17 banking groups and almost 100 main lenders, so while we may lose

geographic variation in investment. The firm size classification follows EU criteria which are based on total assets, number of employees, and the amount of sales.[10]

The identification assumption is that our instrument is correlated with firm-level sales only through only its effect on demand for the firm's product.

Intensive Margin We also estimate the effect of demand and debt frictions on the amount of invested conditional on a firm using the tax credit. The instrumental variable specification is as follows:

$$\begin{aligned}\log \text{CAPEX}_i = &\beta^{\text{demand}} \log \hat{S}_i + \sum_{j=1}^{3} \beta_j^{\text{debt}} \text{quartile}_i^j + \\ &\sum_{j=1}^{3} \beta_j^{\text{interact}} \text{quartile}_i^j \times \log \hat{S}_i + \gamma X_i + \epsilon_i\end{aligned} \tag{7}$$

where i and j index firms and debt quartiles. The dependent variable is log investment spending (CAPEX) and we condition on the sample of firms using the extraordinary tax credit. The explanatory variables as in specification 6.

4 Results

We find large and significant effects of both product demand and debt burden on the take-up of the investment credit as well as the amount invested. The debt-earnings index has a non-linear effect on investment, with the negative effect being concentrated in the most indebted quartile. The effect of demand is mediated by the effect of debt, with the positive effect disappearing for the most indebted quartile.

4.1 First stage regression

The first-stage regression suggests that the foreign demand instrument is strongly correlated with firm sales. Table 6 presents the correlation of each the instruments with log sales in the cross-section of firms in 2012.[11] A one standard deviation increase in export demand leads to an 6% increase in sales. The survey-based instrument, which we use for

some heterogeneity in using the bank groups, the bank level main lender leaves the regression with much fewer observations.

[10]Specifically: micro firms have less than 10 employees and total assets or sales below 2M Euros; small firms have less than 50 employees and total assets or sales below 10M Euros; medium firms have less than 250 employees and total assets below 43M or sales below 50M; and large firms have more than 250 employees or total assets above 43M and sales above 50M.

[11]The instruments have been normalized to have unit variance and we include all controls from the second stage.

Figure 3: First Stage for demand instruments

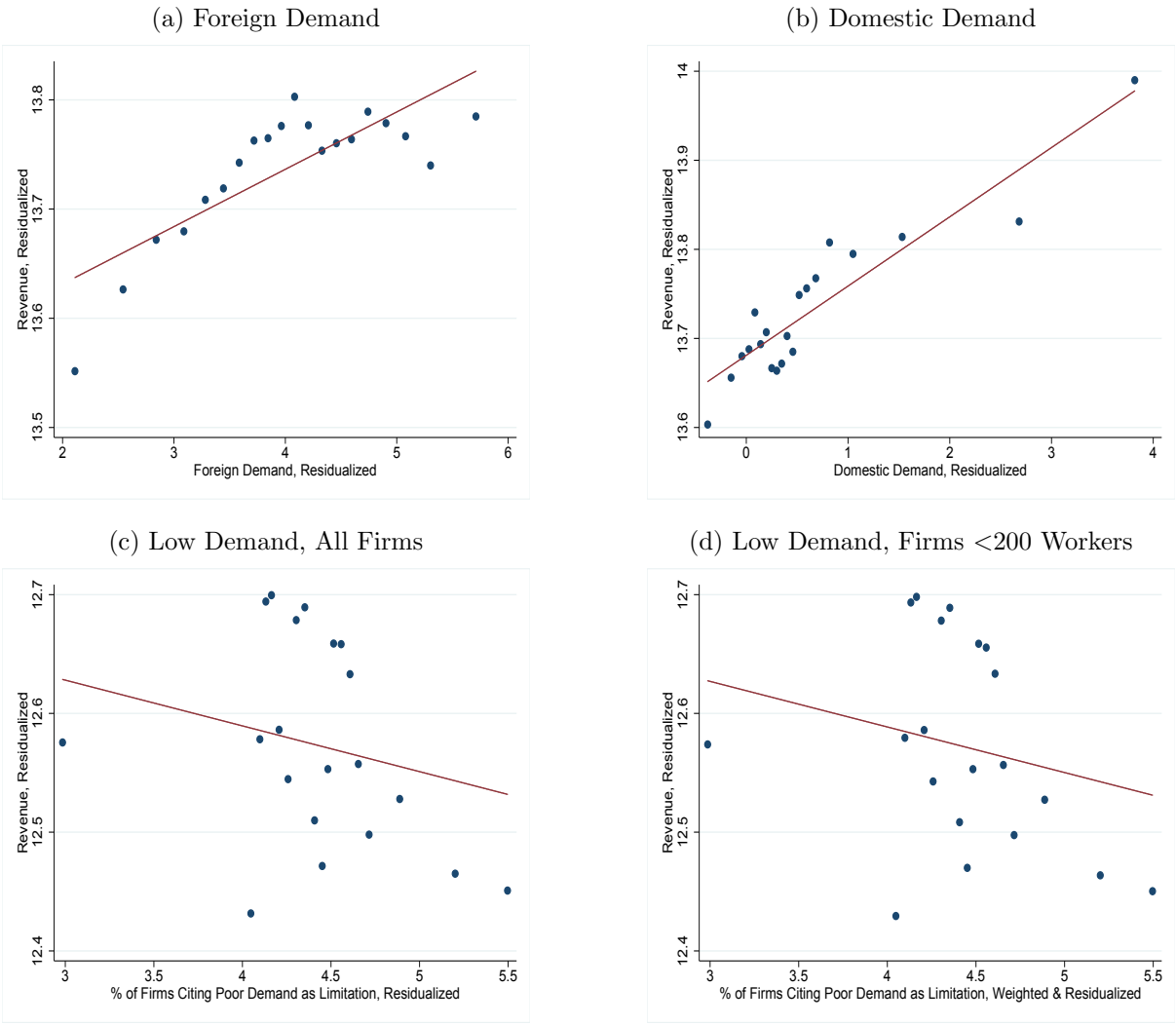
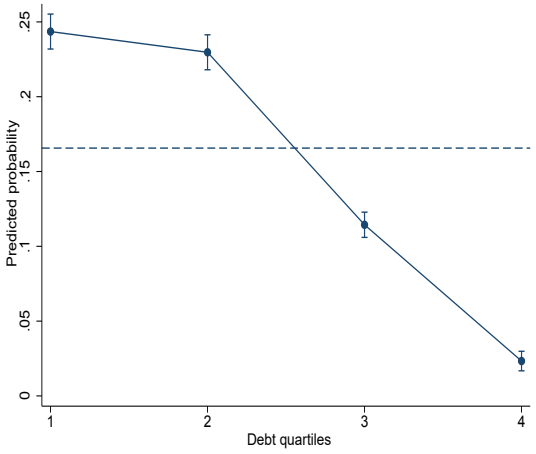


Figure 3 shows a binned scatterplot of log(sales) and our demand instruments in 2012, after residualizing the controls described in 3.4. Instruments are normalized to have unit variance. Panel (a) and (b) show the trade instruments described in equations 1 and 2.
Source: Own calculations

robustness, enters with the opposite sign since we are measuring the fraction of firms in an industry that report being constrained by low demand. A standard deviation increase in the fraction of firms that cite demand as a major limitation to investment is associated with a decrease in sales of 2%. Figure 3 depicts the first stage correlations across all years (2010-2012), after residualizing on controls and year fixed effects. The instruments, along with the included controls, explain around 55-60% of variation in log sales. The F-statistics shown in Table 8 are between 57.1 and 74.2 is significantly above the Stock and Yogo (2005) criterion for 5% maximal relative bias.

Figure 4: Probability of Take-Up, By Debt-Earnings Quartile

(a) Exporting Firms



(b) All Firms

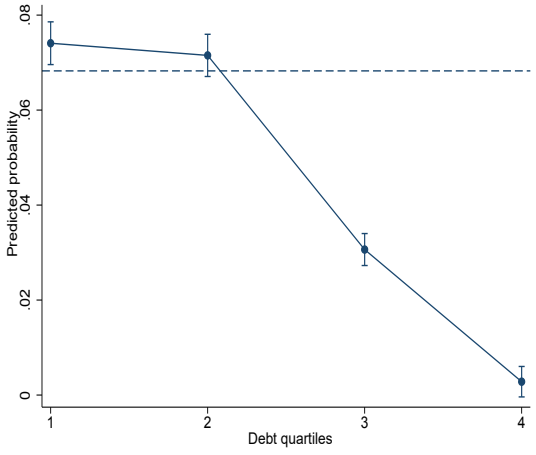
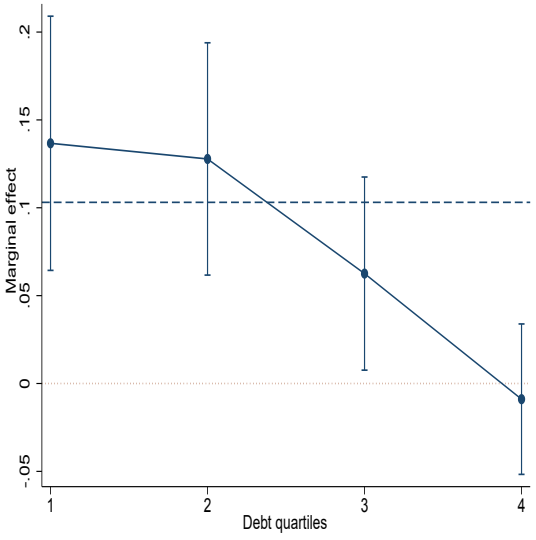


Figure 4 shows the predicted probability of tax credit take-up for the four debt quartiles. Panel (a) shows all exporting firms using the foreign demand measure as an instrument for demand and panel (b) shows results for all firms using the survey-based demand instrument. The dotted lines show the average predicted probabilities, which are 16.57% and 6.83% respectively.
Source: Own calculations

Figure 5: Marginal Effect of Demand on Take Up, By Debt-Earning Quartile

(a) Exporting Firms



(b) All Firms

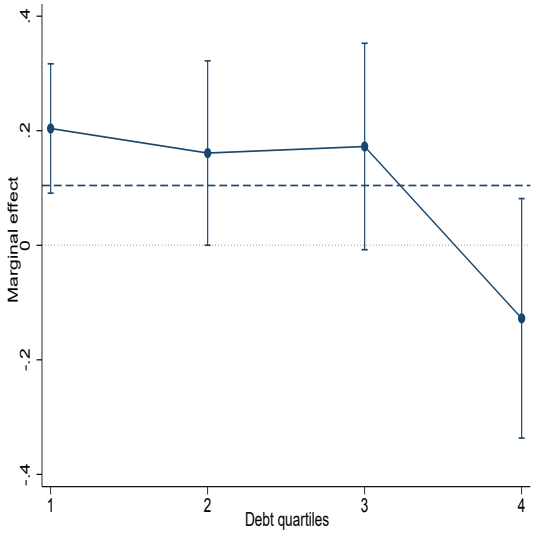


Figure 5 shows the marginal effect of the (instrumented) log sales by debt-earnings quartile. The blue dotted line shows the average marginal effect while the dashed line is at zero. Panel (a) uses the foreign demand instrument in the sample of exporting firms. Panel (b) shows results for the survey-based instrument in the full sample.
Source: Own calculations

4.2 Extensive Margin

We find that both product demand and debt burden are significant predictors of tax credit take-up. We find that predicted take-up drops across the debt quartiles. Firms in the lowest debt quartile have average take-up rates of around 20% while firms in the highest debt quartile have average take-up rates of close to 0 (see Figure 4). Importantly, this effect is non-linear. We also find that the effect of the debt-earnings ratios is attenuated in the OLS specification, in which we do not instrument for demand, by a factor of 3.

Demand positively affects take-up. A 10% increase in sales is associated with an 8 percentage points (pp) higher take-up across all firms. However, the impact of demand is mediated by the debt burden as shown in Figure 5. The marginal effect of an increase in sales declines in importance in the higher debt-quartiles. In the highest debt-earnings quartile, demand does not have a statistically significant impact.

Results from measuring demand based on the investment survey in the full sample of firms confirm the non-linear effects found in the sample of exporters. However the effects are smaller in magnitude due to the inclusion of smaller firms which have lower take-up rates than larger firms.

Table 1: Regression Result: Take Up of Tax Credit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	Ln(Revenue) instrumented using					
		Trade Measure	Trade Measure	Survey Limitations	Survey Limitations	All	Trade Measure
Sample	All firms	All firms	<200 employees	All firms	<200 employees	All firms	Positive EBITDA
Ln(sales)	2.897***	8.880***	10.008***	10.438***	10.310***	7.870***	10.747***
	[0.086]	[2.751]	[2.642]	[2.857]	[2.879]	[2.380]	[3.175]
2nd Debt Quartile	-0.804***	-1.197	-1.289	0.067	-0.074	-1.065	-0.938
	[0.280]	[0.922]	[0.939]	[3.243]	[3.133]	[1.085]	[0.891]
3rd Debt Quartile	-3.896***	-7.045***	-6.987***	-0.842	-0.854	-4.909***	-5.978***
	[0.243]	[0.863]	[0.868]	[1.614]	[1.556]	[0.935]	[0.966]
4th Debt Quartile	-3.947***	-12.359***	-12.140***	-12.639**	-12.645**	-8.465***	-9.823
	[0.226]	[1.182]	[1.193]	[6.262]	[5.995]	[1.178]	[9.372]
First stage F-statistic	-	57.13	56.49	74.22	74.03	12.12	56.25
Observations	82,173	15,152	14,738	74,701	74,112	14,853	12,584

Table 1 shows the marginal effects of demand and debt measures on the probability of a firm using the CFEI tax credit. The dependent variable is a dummy indicating whether or not a firm took up the tax credit in 2013 or 2014. Bank group, industry, firm size and district fixed effects are included in all regressions, as well as firm controls for solvency and past investment trends. Robust standard errors are in brackets. In the first column we show results from an OLS regression, which does not instrument for demand. The following columns show marginal effects for results instrumenting for log sales. Instruments normalized to have unit variance. Trade measure refers to the foreign demand based instrument described in the text. Survey Limitations refers to the share of firms that report demand as a major limitation to investment. Quartile variables are dummies indicating a firm is in the 2nd, 3rd, or 4th quartile of our debt-earning index. Effects should be read as the discrete change with respect to the base category, firms in the first quartile (that is, the least-burdened firms). The final column shows results for a sample of firms with strictly positive EBITDA.
* ($p < 0.05$), ** ($p < 0.01$), *** ($p < 0.001$)

4.3 Intensive Margin

The intensive margin broadly confirms the extensive margin results (see Table 2). The intensive margin results are estimated on a much smaller sample since we condition on firms that use the investment tax credit, which provides some challenges. As very few firms in the fourth quartile of the debt-earnings index use the tax credit, we combine the third and fourth quartile for the intensive margin analysis. Moreover, our demand instruments suffer from a weak instrument problem in the smaller sample making inference challenging.

We again find evidence of a non-linear effect of the debt-earnings index on investment. Moving from the lowest to the highest debt group implies a 17% decline in investment. We find that, as in the extensive margin, demand has a substantial and statistically significant impact on the amount invested. A 1% increase in predicted log sales leads to a 1.4% increase in investment spending. This effect is again attenuated in the OLS specification. There is some evidence that debt and demand interact in the OLS specification. However the IV estimates are too imprecisely estimated to be able to reject the null of a constant effect across the debt quartiles.

Table 2: Regression Results: Amount Invested

	(1)	(3)	(4)	(5)	(6)	(7)
	OLS	Ln(Revenue) instrumented using				
		Trade Measure	Trade Measure	Survey Limitations	Survey Limitations	All
Sample	All Firms	All Firms	<200 employees	All Firms	<200 employees	All Firms
Ln(sales)	0.891***	1.376**	1.179*	-1.480	-1.652	1.326*
	[0.037]	[0.680]	[0.642]	[3.724]	[4.083]	[0.691]
2nd Debt Quartile	0.033	0.043	0.065	-0.034	-0.029	0.034
	[0.052]	[0.080]	[0.084]	[0.127]	[0.129]	[0.113]
3rd & 4th Debt Quartile	-0.077	-0.227*	-0.176	0.591	0.595	-0.070
	[0.073]	[0.116]	[0.120]	[0.881]	[0.915]	[0.161]
First stage F-statistic		10.94	11.53	3.42	3.72	6.12
R-squared	0.537					
Observations	5,325	2,492	2,325	4,850	4,641	2,439

Table 2 shows the results for the intensive margin regression. The dependent variable is log(capex), with investment spending data supplemented by the tax credit amount if a firm did not report investment spending to the firm census. The regressions are run on the sample of firms who use CFEI tax credit. The third and fourth debt quartiles are combined into a single category here, as very few firms (55) in the fourth quartile use the tax credit. Bank group, industry, firm size and district fixed effects are included in all regressions, as well as firm controls for solvency and past investment trends. Robust standard errors are in brackets.
* ($p < 0.05$), ** ($p < 0.01$), *** ($p < 0.001$)

4.4 Discussion

Our results imply that two of the main explanations for the tepid investment post-crisis - a large private debt burden and low product demand - play an important role in the

investment decision of firms. A back-of-the-envelope calculation based on our baseline estimates suggests that if all firms had the same level of demand as the top ten firms in 2012 and 2013, average take-up would have been 11 percentage points higher. However, the impact of debt and demand are not independent. Even a strong pick-up in demand may not affect investment when firms are saddled with a high debt-burden, which is the care for a growing number of Portuguese firms. Moving all firms into the lowest (best) quartile of the debt-earnings index, would have led to an average take-up of 17% instead of 4%. Most of this jump is driven by the fact that moving firms out of the third and fourth debt quartiles has a large effect on take-up rates, reflecting the non-linear impact of debt. These results suggest that the distribution of indebtedness, rather than the absolute stock of debt, matters for correctly quantifying the adverse consequence of high corporate sector debt.

5 Conclusion

This paper provides evidence that the large stock of corporate debt plays an important role in explaining subdued investment in Europe since the 2008 financial crisis. We exploit a temporary investment tax credit in Portugal in 2013, which generated large incentives to invest in the second semester of 2013, to show that debt played two important roles in reducing firms' take-up of the tax credit. First, we find that the effect of a firm's debt burden is non-linear with the negative effect being most pronounced after a 'kink' point. As firms cross over this kink point, the negative effect of debt on corporate investment is shoots up. Second, the positive effect of demand on investment disappears when the firm has a high debt burden. This implies that the positive effects of an incipient recovery are limited as long as firms remain highly indebted. Both of these results are consistent with theories of debt overhang which predict that under-investment will kick in strongly once a firm crosses a critical debt point. Calibrating a debt overhang model based on our results is a fruitful avenue for future research. Our results also highlight the need for policies that directly address firms' excessive debt burden. For example, policies to improve the ability of firms to restructure existing debt can potentially have powerful positive effects on investment.

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A Tables and Figures

Table 1: Tax Credit Use in 2013

		2013 Extraordinary Tax Credit					
		All Firms			Exporters		
		Didn't Receive	Received	Total	Didn't Receive	Received	Total
Standard Tax Benefit Programs	Didn't Receive	180,914	7,196	188,110	18,433	2,554	20,987
		95.51	*3.80*	*99.31*	*84.64*	*11.73*	*96.37*
	Received	690	612	1,302	352	439	791
		0.36	*0.32*	*0.69*	*1.62*	*2.02*	*3.63*
	Total	181,604	7,808	189,412	18,785	2,993	21,778
		95.88	*4.12*	*100*	*86.26*	*13.74*	*100*

Table 1 shows the overlap between use of regular investment tax credits and CFEI in 2013, both in terms of the number of firms and the percentage of firms in 2013. The second half of the table shows the same statistics for exporting firms (defined as any firm with positive exports in 2013). There are 189,412 firms in the sample in 2013, of which 11.5% are exporters. 4.12% of firms overall and 13.74% of exporters used CFEI.

Source: Autoridade Tributária, IES

Table 2: Firm Characteristics by Use of Tax Credit

	No Tax Credit	Tax Credit	All	T-statistic
Credit Risk	0.05	0.02	0.05	128.74***
	0.05	*0.03*	*0.05*	
Bankruptcy indicator	0.05	0.00	0.04	103.13***
	0.21	*0.05*	*0.20*	
Default indicator	0.06	0.00	0.06	116.48***
	0.24	*0.06*	*0.24*	
Negative Capital indicator	0.24	0.02	0.23	186.26***
	0.43	*0.15*	*0.42*	
Revenue growth	0.19	0.20	0.19	-0.28
	12.85	*3.43*	*12.62*	
Growth in fixed assets	42.13	0.66	40.35	3.10***
	7462.49	*9.08*	*7300.80*	
Cash / Assets	0.23	0.21	0.23	14.91***
	0.27	*0.22*	*0.27*	
Log(TFP)	0.77	0.70	0.77	25.48***
	0.49	*0.33*	*0.48*	
Income Tax / Assets	0.01	0.02	0.01	-26.61***
	0.02	*0.02*	*0.02*	
Age	12.90	17.32	13.05	-45.31***
	12.01	*14.11*	*12.12*	
Log(Assets)	12.19	14.34	12.26	-193.78***
	1.62	*1.60*	*1.67*	
Employees	9.31	56.96	10.95	-22.76***
	91.70	*306.40*	*106.83*	
Trade Debt / Assets	0.37	0.43	0.37	-39.92***
	0.29	*0.24*	*0.29*	
Bank Debt / Assets	0.26	0.22	0.26	32.76***
	0.26	*0.18*	*0.26*	
Public Debt / Assets	0.12	0.08	0.11	58.42***
	0.18	*0.09*	*0.18*	
Cash Flow / Assets	-0.05	0.10	-0.04	-161.96***
	0.44	*0.10*	*0.43*	
Capital / Assets	0.03	0.38	0.04	-159.25***
	1.14	*0.24*	*1.12*	
Revenue / Assets	1.34	1.40	1.34	-8.05***
	1.49	*1.14*	*1.48*	

Table 2 shows means and standard deviations for 2010-2012 values of selected firm characteristics by use of the CFEI tax credit. The last column shows t-test for difference in means. Credit risk is defined as the probability of default following the methodology described in Antunes et al. (2016). Default is defined as any spell of at least three months of overdue credit, where the overdue credit accounts for at least 5% of the loan volume (with a minimum of 50 euros). A firm is defined as bankrupt if it has an open process in bankruptcy court or has been liquidated. The change in fixed assets is calculated net of depreciation. TFP is estimated following the Olley and Pakes (1996) three step regression procedure which allows for endogeneity of some of the inputs, selection (due to firm exit), and long-lasting unobserved differences across firms.

Source: IES, own calculations

Table 3: Tax Credit Use by Debt Quartile

	No Tax Credit	Tax Credit	All
First Quartile	53,849	3,283	57,132
	29.91%	*1.82%*	*1.82%*
Second Quartile	30,816	2,384	33,200
	17.12%	*1.32%*	*18.44%*
Third Quartile	46,377	1,335	47,712
	25.76%	*0.74%*	*26.50%*
Fourth Quartile	41,796	180	41,976
	23.22%	*0.10%*	*23.32%*
Total	172,838	7,182	180,020
	96.01%	*3.99%*	*100.00%*

Table 3 shows the number of firms in each quartile of the debt-earnings index, whose construction is described in 3.2, by use of the CFEI tax credit. In italics is the frequency of each group in the total firms in 2012.
Source: Autoridade Tributária, IES, own calculations

Table 4: Firm Characteristics by Debt-Earnings Quartile

	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	Overall
ROA	11.12%	7.58%	-4.76%	-32.11%	-3.64%
	77.13	*46.74*	*63.50*	*106.37*	*81.75*
TFP	2.76	2.52	2.38	2.05	2.45
	2.98	*14.64*	*3.04*	*3.33*	*7.21*
Labor Productivity	110408.73	110825.81	110531.77	68948.51	99864.35
	1221027.42	*1789435.92*	*685618.06*	*1282192.42*	*1312482.43*
Credit Risk	2.43%	3.66%	6.11%	9.07%	5.03%
	2.27	*2.93*	*4.25*	*5.86*	*4.63*

Table 4 shows means and standard deviations for selected firm characteristics by debt-earnings quartile (2010-2012). ROA is calculated as EBITDA over assets and labor productivity is revenue divided by the number of employees. Credit risk is defined as the probability of default following the methodology described in Antunes et al. (2016). TFP is estimated following the Olley and Pakes (1996) three step regression procedure which allows for endogeneity of some of the inputs, selection (due to firm exit), and long-lasting unobserved differences across firms.
source: IES, own calculations

Table 5: Descriptive Statistics of Investment Survey, Selected Industries

	Sampled Firms all years	Sampled Firms, 2012	Average Workers	Average Sales (M Euros)	Mean Investment (M Euros)	% Demand any year	% Demand 2012
Sale & repair of motor vehicles	120	39	183.55	195.95	0.83	83.87%	95.65%
Food & beverage	146	52	496	164.63	0.70	88.06%	92.59%
Mining & quarrying	46	16	56.15	82.11	0.10	92.00%	90.91%
Construction	202	58	177.45	125.83	0.33	82.24%	88.57%
Publishing	84	28	159	300.99	0.26	75.00%	85.71%
Electricity & Gas	9	3	433.67	90.12	34.35	11.11%	33.33%
Water supply	74	27	317.30	300.44	42.04	20.69%	25.00%
Mining of metal ores	77	27	189.16	80.80	3.52	11.90%	18.75%
Sewage	39	14	83.29	93.55	9.39	4.00%	0.00%
Veterinarians	9	3	16.17	238.56	0.05	0.00%	0.00%

Table 5 shows descriptive statistics from the investment survey for the five industries most affected by low demand in 2012 and the five industries least affected. Industry is defined at the two-digit level and industries with fewer than three firms surveyed are dropped from the sample. Averages were calculated as a simple average across surveyed firms in the period 2010-2012. The last two columns show the fraction of firms that mention demand as a limitation in any year and in 2012 respectively.
Source: INE, own calculations

Table 6: First Stage Results

Foreign Demand	6.335***	6.420***			7.108***	7.114***
	[0.664]	[0.673]			[0.836]	[0.837]
Domestic Demand	8.712***	9.243***			10.327***	10.353***
	[0.547]	[0.574]			[0.697]	[0.698]
% Firms Citing Poor Sales			1.971***	1.985***	5.048***	5.142***
			[0.559]	[0.560]	[1.379]	[1.390]
2nd Debt Quartile	-4.181***	-4.347***	1.29	1.284	-5.767***	-5.803***
	[1.611]	[1.653]	[1.075]	[1.075]	[2.175]	[2.178]
3rd Debt Quartile	-8.394***	-9.075***	2.770**	2.763**	-8.506***	-8.566***
	[1.774]	[1.826]	[1.099]	[1.100]	[2.303]	[2.307]
4th Debt Quartile	-28.123***	-29.473***	-4.758***	-4.763***	-25.350***	-25.388***
	[2.700]	[2.774]	[1.348]	[1.348]	[3.491]	[3.497]
R-squared	0.621	0.611	0.549	0.549	0.571	0.570
Observations	15,152	14,738	74,701	74,112	14,853	14,464
Sample	All Firms	<200 employees	All Firms	<200 employees	All Firms	<200 employees

Table 6 shows results from an OLS regression where the dependent variable is ln(revenue), winsorized at the fifth percentile. The demand instruments have been normalized to have unit variance. Columns (1), (3), and (5) show results from the sample of all firms while the remaining columns restrict the sample to firms with fewer than 200 employees. All instruments were winsorized at the fifth percentile and normalized to have unit variance. Foreign Demand is a sum of imports weighted by the intensity with which a given firms trades products to each destination. Domestic demand is a corollary, as the sum of Portuguese imports weighted by the intensity with which each firm trades those products.

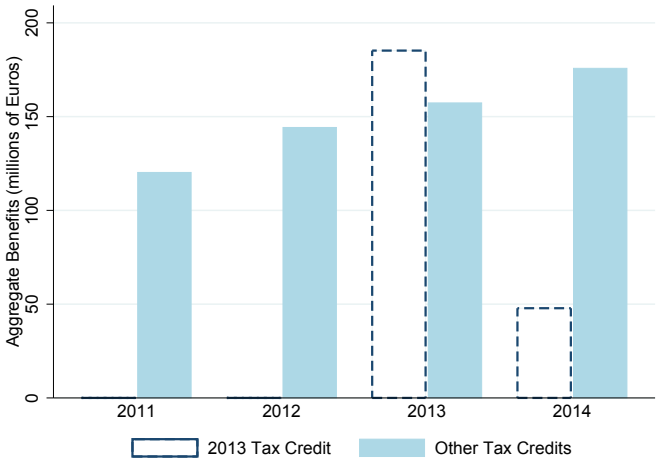


Figure 1: Aggregate Use of Investment Tax Credits

Figure 1 compares the gross benefits received by firms annually from the three main investment tax benefits programs provided by the Portuguese government and the 2013 CFEI tax credit. The 2013 CFEI payout was larger than the three alternative programs combined. CFEI tax claims can be deferred until 2017 if firms did not pay sufficient income tax in 2013 to reap the entire benefit of their investment in the second semester of 2013. Credit claimed in 2014 due to deferred benefits totals about a third of the total payout in 2014.

Source: Autoridade Tributaria

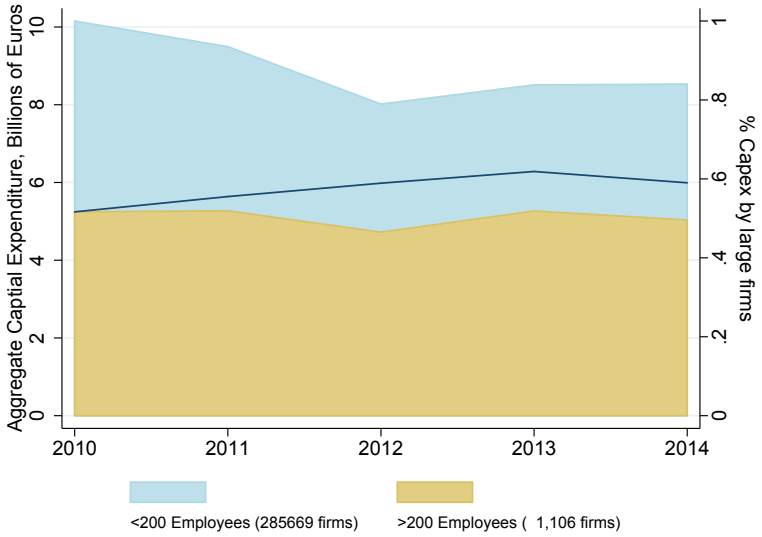
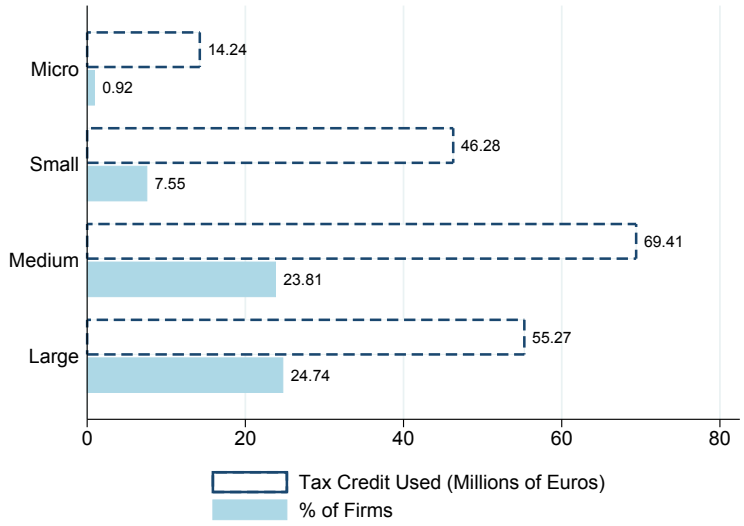


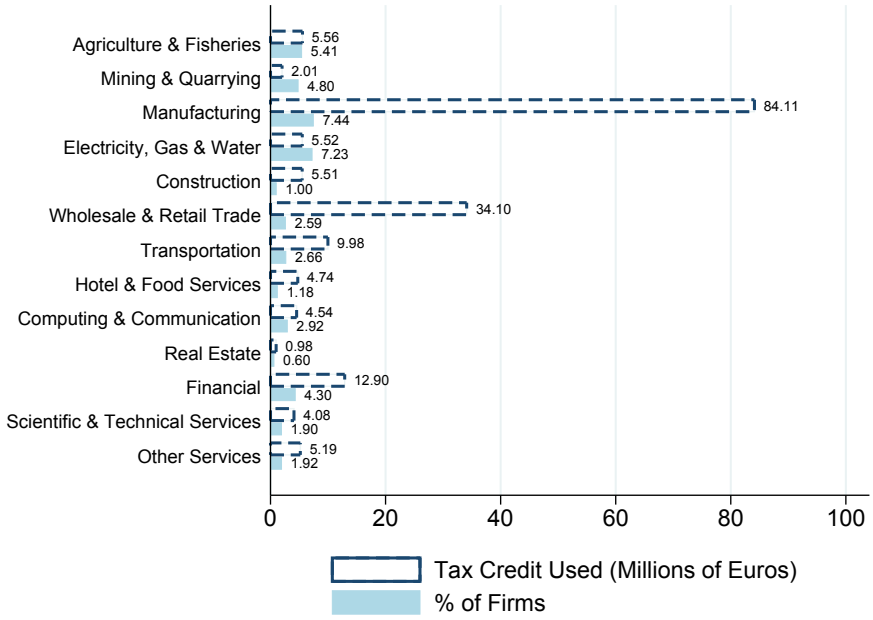
Figure 2: Capital Expenditure, by Number of Employees

Figure 2 shows, on the left hand scale, the total capital expenditure reported to Portuguese firm census each year as an approximation of aggregate investment. As many micro and small firms are not required to report CAPEX, this is the lower bound of investment expenditure. The light blue area on top shows how much investment spending was by firms with fewer than 200 employees (99.6% of the sample of firms). The sand area below shows investment spending by firms with more than 200 employees. To get a sense of the changing composition of investing firms, the navy line running across the graph, on the right hand scale, shows the percent of capital expenditure by large firms (with more than 200 employees), around 60% in 2013.

Source: Portuguese firm-census, own calculations



(a) By EU Size Categories



(b) By Activity

Figure 3: Use of Investment Tax Credit by Size and Industry

Figure 3 compares the size of the tax credit in millions of Euros (navy blue bar) and the percent of firms in each category (light blue bar) who used the 2013 extraordinary tax credit, by firm size and industry. Manufacturing and retail firms dominate use of the tax credit in terms of volume, while manufacturing and utilities have the largest percentage of firms using CFEI. Size categories are based on number of workers, sales, and total assets.

Source: Autoridade Tributária, Portuguese firm census, own calculations

Figure 4: Debt-Earnings Ratios Over Time

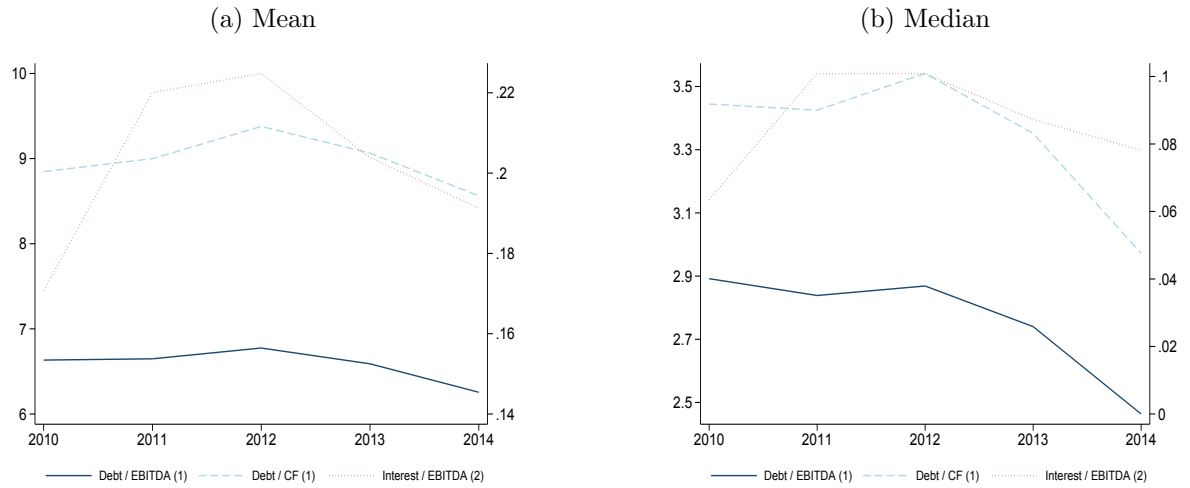


Figure 4 shows the mean and median value of the three debt-earnings ratios used for the debt quartiles over time. The values are shown in absolute value due to the discontinuity caused by negative EBITDA and are winsorized at the 95th percentile.
Source: Portuguese firm census, own calculations

Figure 5: Aggregate Sales and Demand Proxies

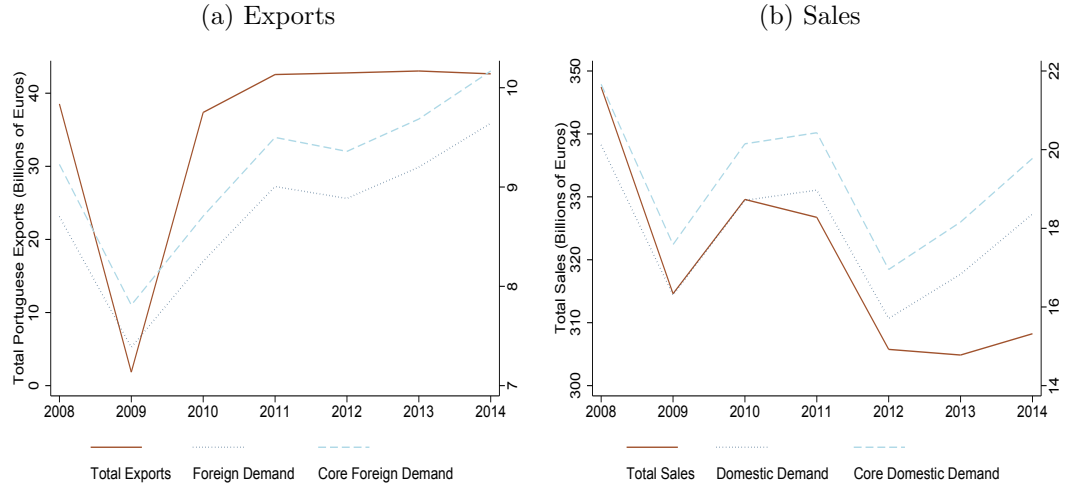
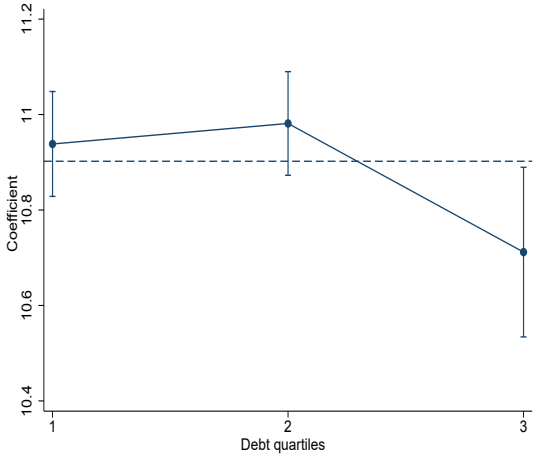


Figure 5 compares aggregate sales and exports (solid line) with our demand measures, whose construction is described in 3.3. We find that in both cases the aggregated measures (in the dotted and dashed lines) largely follow the trend of aggregate exports and turnover for foreign demand and domestic demand respectively.
Source: Portuguese firm census, Comercio Internacional

Figure 6: Predicted Investment By Debt-Earning Quartile (Intensive Margin)

(a) Trade Instrument



(b) OLS

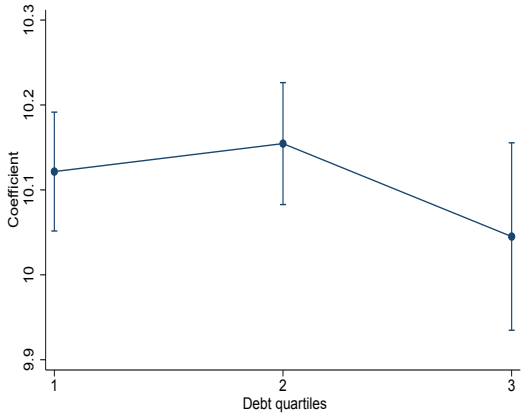
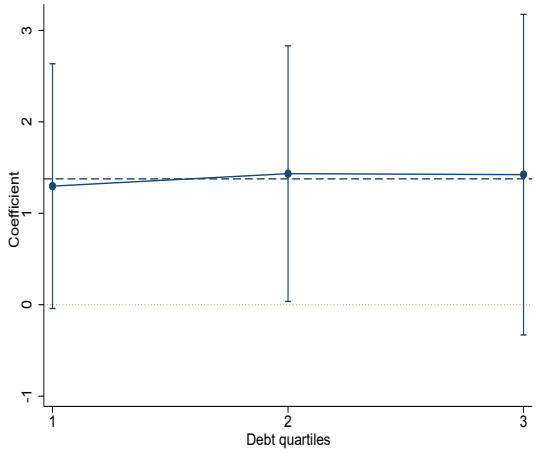


Figure 6 shows the predicted amount invested across the three debt quartile in the sample of firms that use the tax credit. We combine the third and fourth quartile due to the limited number of firms that use the investment tax credit in the higher debt quartiles. In panel (a) we show the sample of exporting firms using the foreign demand instrument. Panel (b) shows the results for OLS. The dotted line shows the average predicted investment.
Source: Own calculations.

Figure 7: Impact of Log Sales By Debt-Earning Quartile

(a) Trade Instrument



(b) OLS

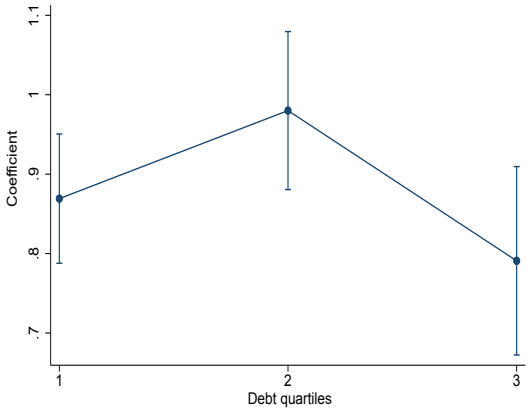


Figure 7 shows the impact of a 10% increase in predicted revenue on investment in the sample of firms that use the tax credit. We combine the third and fourth quartile due to the limited number of firms that use the investment tax credit in the higher debt quartiles. In panel (a) we show the sample of exporting firms using the foreign demand instrument. Panel (b) shows the results for OLS. The dotted line shows the average predicted investment, while the dashed line is zero.
Source: Own calculations.