Corporate Indebtedness and Investment: Micro Evidence of an Inverted U-Shape

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Abstract

This study investigates the link between corporate indebtedness and investment by utilizing a novel firm-level data, which contains the universe of all incorporated manufacturing firms in Turkey over the last decade. The results of the panel regression model with multi-dimensional fixed effects provide significant evidence of an inverted-U relationship between indebtedness and investment, indicating that leverage increases investment up to a certain level, and after that further increase in leverage has an adverse impact on investment. This non-monotonic relationship is evident for all firm size groups. Conspicuously, the indebtedness level that becomes an impediment to investment is significantly lower for SMEs than large firms, which is in support of the arguments that small firms are more likely to be affected by debt overhang. Results also reveal that firms holding more cash can sustain higher level of debts without hurting investment activity. This is also the case for high capital-intensive firms and exporters. Findings of this paper highlight the importance of policies to make equity financing more attractive, incentivise the uptake and provision of equity capital from private investors, and deepen the capital markets.

Keywords: *Corporate debt; firm investment; cash policy; SMEs, debt overhang*

JEL classifications: *C23, D22, E22, G31, G32*

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Non-technical Summary

The theory of capital structure and its impact on investment activity has been a core issue in financial literature since the pioneer seminal work of Modigliani and Miller (1958). Hence, extensive empirical research has been carried out on this issue, especially in the years following the 2007-2009 global financial crisis. During this period, corporate indebtedness has globally increased and the consequences of this large build–up of debt on investments have attracted vast attention on both academic and policy-making fronts. Despite its importance of the issue, the empirical evidence on the corporate indebtedness and investment linkage is very limited for emerging countries, which can be attributed to data availability. To expand upon this small literature, this study investigates the issue in detail by utilizing a confidential and comprehensive firm-level data, which contains the universe of all incorporated manufacturing firms in Turkey over the last decade.

The results of the panel regression model with multi-dimensional fixed effects reveal that ignoring the non-monotonic relation between corporate debt and investment would lead to biased estimates. The estimations provide significant evidence of an inverted U-shaped relationship between leverage and investment, indicating that leverage increases investment up to a certain level, and beyond which leverage has an adverse impact on investment. This suggests that corporates with moderate leverage ratios potentially make use of unused borrowing capacities to engage in additional investments, while excessive indebtedness seems to become an impediment to investment growth. This non-monotonic relationship is evident for all firm size groups. The results show that the indebtedness level that becomes an impediment to investment activity is significantly lower for SMEs than large firms. This points out their lower borrowing capacity and tolerance to elevated debt relative to large firms.

Another important result is that firms that holding more cash can sustain higher level of debts without hurting investment activity. This reveals the importance of cash holdings in mitigating the adverse effect of high leverage on investment, which is consistent with the literature that lends support to the precautionary motive of corporate cash holdings. Moreover, I also document significant evidence that export orientation and capital intensity can attenuate the dampening effect of high leverage on corporate investment.

The findings of this study highlight the importance of regulations in preventing corporates from excessive indebtedness levels that are likely to become an impediment to investment

growth. During the Covid-19 pandemic, although the liquidity injections provided by policy makers in the form of loan guarantees and new lines of credit have been crucial for corporates to cope with liquidity shortages, the resulting increase in corporate leverage has further increased the concerns regarding the corporate investment prospects (OECD, 2021; Ebeke et al., 2021). As in many emerging countries, in Turkey bank lending is the dominant source of external finance for privately held firms and alternates to external debt is quite limited, especially for SMEs (e.g., there are only around four hundred firms listed on BIST and 70.85% of them are large firms). In that sense, the findings of this paper emphasize policies that make equity financing more attractive (e.g., allowance for corporate equity), incentivise the uptake and provision of equity capital from private investors and deepen the capital markets.

1. Introduction

The theory of capital structure and its impact on investment activity has been a core issue in financial literature since the pioneer seminal work of Modigliani and Miller (1958). Hence, extensive empirical research has been carried out on this issue, especially in the years following the 2007-2009 global financial crisis. During this period, corporate indebtedness has increased substantially in emerging countries due to low interest rates and easy access to credit. Accordingly, the negative consequences of this large build–up of debt on investments and sustainable economic growth have attracted vast attention on both academic and policy-making fronts. Despite the importance of the issue, the majority of previous empirical work focused on developed countries, and only a small number of studies (e.g., Magud and Sosa, 2015; Das and Tulin 2017; and Borensztein and Ye, 2021) have examined the impact of corporate indebtedness on investment in emerging countries, which can be attributed to a lack of data availability.

This paper aims to expand upon this small literature by analyzing the case of Turkey, one of the largest emerging economies. Examining the issue in detail with a comprehensive dataset is especially important for emerging economies. Thus, one of the important contributions of the paper is to provide further evidence to shed light on corporate indebtedness and investment linkage by utilizing a confidential and comprehensive firm-level dataset, which contains the universe of all incorporated manufacturing firms in Turkey.

In the first place, the results of the panel regression model with multi-dimensional fixed effects reveal that ignoring the non-monotonic relation between corporate debt and investment would lead to biased estimates. The estimations provide significant evidence of an inverted U-shaped relationship between leverage and investment, indicating that leverage increases investment up to a certain level, and beyond which leverage has an adverse impact on investment. This suggests that corporates with moderate leverage ratios potentially make use of unused borrowing capacities to engage in additional investments, while excessive indebtedness seems to become an impediment to investment growth.

I further analyze the non-linear relationship by splitting the full sample into low and high-indebted firms where the turning point of leverage calculated from the baseline estimations is used as the threshold. Results show that the association between leverage and investment is significantly positive for low-indebted firms while it is negative for high-indebted firms

which account for a non-negligible portion (30 percent) of the firms in the sample. This is prima facie that excessive debt levels depress investment activity. In addition, the linkage seems to be steeper for high-indebted firms. On average, a 10 percentage increase in leverage reduces investment by 3 percent for high-indebted firms, while it corresponds a 2 percent increase in investment for low-indebted firms.

I next investigate the heterogeneous effects across firms in detail. First, in order to assess the potential differential impact of firm size, I re-estimate the empirical model for micro-sized, small, medium-sized and large firms, separately. Results show that the inverted U-shaped relationship between investment and leverage exists for all firm size groups. However, the results show that the turning point gets higher with firm size. The indebtedness level that becomes an impediment to investment activity is significantly lower for Small and Medium-Sized Enterprises (SMEs). This points out their lower borrowing capacity and tolerance to elevated debt relative to large firms.

I next analyze whether corporate cash holdings matter. Results reveal that the cash holdings have an important role in mitigating the adverse effect of high leverage on investment. In other words, firms that holding more cash can sustain higher level of debts without adversely affecting investment activity. I further examine the possible differential impact of capital intensity. Results provide significant evidence that high capital-intensive firms can attenuate the dampening effect of high leverage on corporate investment pointing up the role of tangibility in mitigating the constraints on borrowing. Moreover, results show that the inverted U-shaped relationship exists significantly for both exporters and non-exporters. However, the tolerance to elevated debt is higher for exporters, which is consistent with the arguments that the export orientation contributes to firms' credit access.

My results contribute to several strands of the literature. First, this paper adds to the literature on the link between capital structure and investment decisions. Existing literature provide mixed evidence and there is no consensus on the impact of leverage on investment. The capital structure theory itself provides ambiguous predictions. On the one hand, tax advantages (Modigliani and Miller, 1963) and agency costs reduction between shareholders and managers provided by external debt (Ross, 1977; Grossman and Hart, 1982) are argued to have positive impacts on investment. In the same vein, Grossman and Hart (1982) argue that the external debt can discipline firm managers who would otherwise waste resources

on perks. On the other hand, Myers (1977) argues that high levels of indebtedness engages underinvestment problem since the benefits from additional investment accrue largely to existing debt holders rather than shareholders, which is referred to as debt overhang in the literature. Higher interest expenses and lower available funds due to high leverage are likely to forego some positive-NPV projects, resulting in underinvestment. The reconciliation of these theoretical arguments is underpinning my finding that ignoring a non-linear leverage-investment linkage would lead to biased estimates. Besides, my findings support the existing empirical literature that reports significant evidence of underinvestment resulting from debt overhang (e.g., Lang et al., 1996; Kalemli-Özcan et al., 2019; Cevik and Miryugin, 2020; Borensztein and Ye, 2021).

In particular, my study adds to the empirical literature on the non-monotonic relationship between leverage and investment (e.g., Jäger, 2003; Goretti and Souto, 2013; and Gebauer et al 2018) while expanding upon the small empirical literature focusing emerging economies. Magud and Sosa (2015), for instance show that private investment is negatively associated with corporate indebtedness using a cross section of large public firms in emerging countries. In the same vein, using a dataset of 10,974 Indian firms, Das and Tulin (2017) report the similar negative relationship. Recently, Borensztein and Ye (2021) provide significant evidence in support of the negative impact of high corporate indebtedness on investment for a set of firms in emerging and developing economies. However, one of the main drawbacks of these studies is the lack of representativeness of their samples. Unlike these studies, this study contributes to the empirical literature on emerging markets by using a comprehensive dataset rather than using only public/subset of firms.

Finally, this study contributes to the corporate cash holdings literature. Financial frictions leads corporates to have precautionary cash holdings, which play an important role in affecting other corporate financial and real activities. Precautionary cash holdings can buffer against these frictions and mitigate the underinvestment problem (Stiglitz and Weiss, 1981; Opler et al., 1999). Harford et al. (2014) also show that refinancing risk can be alleviated by cash holdings, which prevent the firms from forgoing valuable growth opportunities.

On the other hand, downside of excessive liquidity, such as agency costs associated with excessive cash holdings is well documented in the literature (e.g., Jensen, 1986, Harford, 1999; Pinkowitz et al., 2006; Dittmar and Mahrt-Smith 2007). Contrary to these arguments,

I document the role of cash holdings in mitigating the dampening effect of high leverage on investment, which lends support to the precautionary motive for corporate cash holdings.

The paper proceeds as follows. Section 2 provides details of the data used in the paper and introduces the empirical framework. Section 3 presents empirical results including heterogeneous effects across firms. Section 4 discusses a series of additional robustness checks. Section 5 concludes the paper.

2. Data and Empirical Methodology

The confidential firm-level data utilized in this study is the Revenue Administration dataset provided by the Central Bank of the Republic of Turkey (CBRT). This unique database includes the universe of incorporated manufacturing firms in Turkey. It consists annual balance sheets and income statements prepared according to Tax Procedure Law of Turkey over the 2009-2019 period. I also use the Credit Register database of the Banks Association of Turkey that provides detailed information on all firm-level loans. I further linked the dataset to firm-level annual employment data collected by the Social Security Institute, which allows us to obtain information about firm size.

Table 1 Summary statistics

	Full sample			SMEs			Large firms		
	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.	Mean	Median	Std. Dev.
Investment	0.108	0.000	0.265	0.107	0.000	0.266	0.138	0.061	0.221
Leverage	0.607	0.640	0.304	0.608	0.641	0.305	0.570	0.588	0.253
Size	14.263	14.202	1.820	14.179	14.157	1.739	18.239	18.689	0.823
Cash flow	-0.003	0.004	0.107	-0.003	0.004	0.107	-0.012	-0.016	0.117
Growth	0.150	0.017	0.739	0.152	0.015	0.745	0.080	0.050	0.357
Maturity	0.116	0.000	0.219	0.113	0.000	0.218	0.245	0.201	0.227
Age	2.295	2.485	0.754	2.284	2.485	0.751	2.830	2.996	0.674
N		780,323			764,026			16,297	

This table presents summary statistics on all relevant variables used in the empirical analysis over the 2009-2019 period. Investment rate is the annual percentage change in plant, machinery and equipment; leverage is the ratio of total debt to total assets, where total debt is the sum of long-term debt, loans, credit, and other current liabilities; firm size is log of total assets in Turkish Lira deflated by GDP deflator; cash flow is the ratio of earnings before interest, tax and depreciation to total assets, growth is the percentage change of annual net sales; maturity is the share of long-term debt in total debt and firm age is log of the number of years since founding. A firm is classified as an SME if its number of employees is less than 250, and large otherwise.

Following the common practice, I drop firm-year observations with inconsistent data such as observations with negative debt, fixed assets, employment or total assets. I also winsorize

all firm-level variables used in the study at the 1st percentile in each tail to minimize the possible influence of extreme outliers. The end-result is an unbalanced panel data with 1,010,465 firm-year observations over the period from 2009 to 2019. Table 1 presents summary statistics on all relevant variables used in the empirical tests.

In order to investigate the relationship between firm indebtedness and investment, I use the model builds on the standard investment model, similar to those used in Lang et al. (1996), Badertscher et al. (2013) and Zubair et al. (2020). I estimate the following econometric specification with multi-dimensional fixed effects:

$$Y_{i,t} = \beta_0 + \beta_1 \, x \, Lev_{i,t-1} + \beta_2 \, x \; Lev^2_{i,t-1} + \sum_k \gamma_k \Omega_{k,i,t-1} + \mu_i + \delta_{s,t} + \vartheta_{r,t} + \varepsilon_{i,t} \quad (1)$$

where subscripts i, and t denote firm and year, respectively. Following the literature, the outcome of interest Y_{it}, investment rate is measured as the annual percentage change in plant, machinery and equipment, while the variable of interest, corporate leverage (Lev_{it}) is computed as the ratio of total debt to total assets. Total debt is measured as the sum of long-term debt, loans, credit, and other current liabilities. For robustness, I also focus on alternative measurements for both investment and leverage. The details are discussed in Section 4. Ω stands for the control variables commonly used in the literature, including firm size (log of total assets) and cash flow (the ratio of earnings before interest, tax and depreciation scaled by total assets), and firm age (log of the number of years since founding). In addition, sales growth (percentage change of annual net sales) is used to control for growth opportunities since market-based proxies such as Tobin's q are not available for privately held firms. I further control for maturity structure of corporate debt (the share of long-term debt in total debt) to control for possible rollover risk where long-term debt is the outstanding debt that has a maturity equal to or longer to one year.

Any variation in investment across firms can be driven by time invariant (unobserved) differences. Thus, I include firm fixed effects (μ_i) in the model to control for any unobservable firm specific and time-invariant heterogeneity, which is essential in panel estimations. The specification further controls for province x year ($\vartheta_{r,t}$)and sector x year ($\delta_{s,t}$) fixed effects to control for any possible omitted and time variant region and industry factors (e.g., technology or demand shocks). The main coefficients of interest are β_1 and β_2, the parameters of leverage and its squared term, respectively. If the association between

corporate leverage and investment is indeed inverted U-shaped as proposed in the study, we expect $\beta_1 > 0$ and $\beta_2 < 0$.

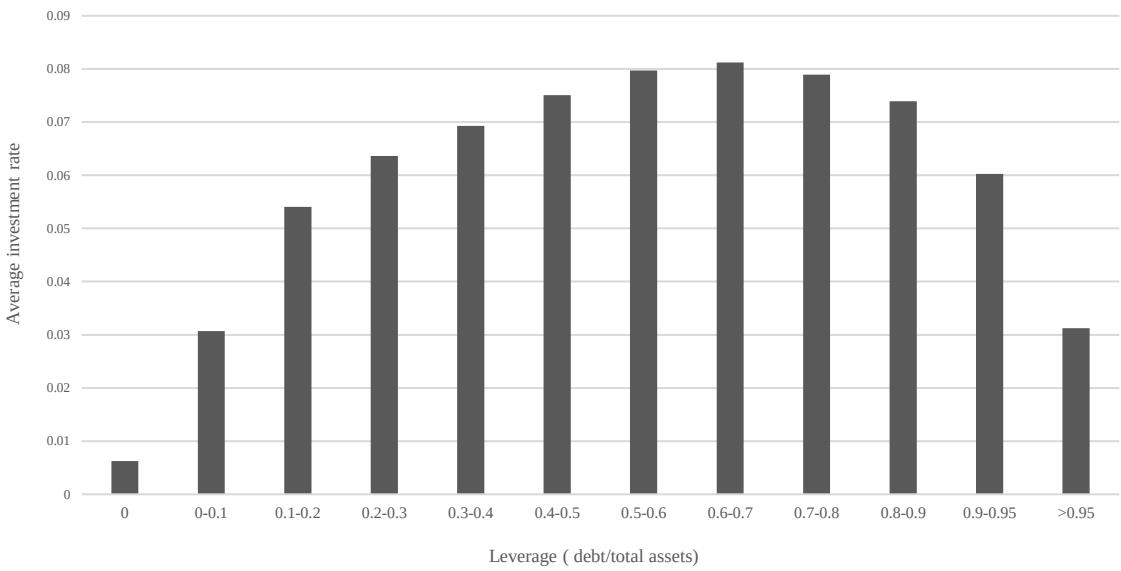
3. Empirical Results

2.1. Baseline specification

In order to motivate the analysis, I first present a plot of average investment rates by leverage ratios for the universe of manufacturing firms over the 2009-2019 period in Figure 1. On average, investment rates are increasing up to a certain level of leverage, and after that investment rates fall sharply. This suggests a concave relationship between investment rates and leverage.

Figure 1. Leverage and investment

This figure plots the average investment rate by leverage ratios for the universe of manufacturing firms over the 2009-2019 period. Investment rate is the annual percentage change in plant, machinery and equipment; leverage is the ratio of total debt to total assets, where total debt is the sum of long-term debt, loans, credit, and other current liabilities



To achieve formal evidence, I estimate the empirical model in equation 1. Table 2 presents the baseline results for the full sample. All regressions include firm fixed effects, which control for any time-invariant unobserved heterogeneity. In column 1, the coefficient on the leverage is positive and highly significant at 1% level, and that on the squared term of the leverage (leverage squared) is negative, which is also highly significant at 1% level. In columns 2 and 3, I incorporate industry-year and province-year fixed effects in the model in order to control any possible omitted province and industry factors (time variant

Table 2. Corporate indebtedness and investment: full sample

	Investment					
	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	0.01081***	0.01353***	0.01321***	0.05044***	0.04640***	0.04664***
	(0.00212)	(0.00212)	(0.00212)	(0.00594)	(0.00596)	(0.00596)
Leverage squared				-0.03484***	-0.02888***	-0.02937***
				(0.00491)	(0.00493)	(0.00493)
Size	-0.01295***	-0.00960***	-0.00934***	-0.01347***	-0.01013***	-0.00989***
	(0.00068)	(0.00069)	(0.00069)	(0.00069)	(0.00070)	(0.00070)
Cash flow	0.09652***	0.09653***	0.09633***	0.09282***	0.09357***	0.09333***
	(0.00372)	(0.00373)	(0.00373)	(0.00375)	(0.00376)	(0.00376)
Growth	0.00651***	0.00639***	0.00631***	0.00657***	0.00641***	0.00633***
	(0.00040)	(0.00040)	(0.00040)	(0.00040)	(0.00040)	(0.00040)
Maturity	-0.00181	-0.00002	0.00030	-0.00124	0.00045	0.00078
	(0.00248)	(0.00248)	(0.00248)	(0.00249)	(0.00248)	(0.00248)
Age	-0.03225***	-0.02459***	-0.02462***	-0.03160***	-0.02449***	-0.02451***
	(0.00107)	(0.00152)	(0.00153)	(0.00107)	(0.00152)	(0.00153)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector x year FE	No	Yes	Yes	No	Yes	Yes
Province x year FE	No	No	Yes	No	No	Yes
Observations	780,323	780,323	780,323	780,323	780,323	780,323
R-squared	0.289	0.292	0.293	0.289	0.292	0.293
Turning point	-	-	-	0.724	0.798	0.794

This table presents estimations of the empirical model in equation 1 for the full sample. Definitions of variables are given in the note for Table 1. Robust standard errors clustered at firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

unobservable region and industry factors). The results remain robust, which suggest an inverted U-shaped relationship between leverage and investment.[1]

The turning point for the leverage is approximately 79 percent, which is calculated from the coefficients on leverage and its squared term reported in column 3 of Table 2. It corresponds approximately to the seventh decile of the distribution. This indicates that 30 percent of firms over the sample period were operating above the turning point. The inverted U-shaped relationship between leverage and investment indicates that leverage increases investment up to a certain level, and after that further increase in leverage has an adverse impact on

[1] The correlation between control variables is 0.36 at most. Including all control variables to the model, the coefficient of leverage and its square term still (variables of interest) still remain similar and significant which implies there exists variation despite the possible collinearity between control variables and variable of interests. Moreover, in order to see the potential effect of multicollinearity between the control variables, I added them one by one to the model and find that the coefficients remains both quantitatively and qualitatively similar. To converse space, they are not reported but available upon request.

investment. In other words, corporates with moderate leverage ratios potentially make use of unused borrowing capacities to engage in additional investments, while excessive indebtedness seems to become an impediment to investment growth.

Results for control variables are mostly in line with expectations and previous related literature. All else equal, investment rate is decreasing with firm size indicating decreasing returns to scale in investment. Younger firms tend to invest more than older firms and firms with higher growth opportunities and cash flows tend to have higher investment rates confirming the positive impact of growth opportunities and cash flow on investment.

I further analyze the non-linear association by splitting the full sample into low and high-indebted firms where the turning point (0.79) is used as the threshold. The re-estimated results for these subsamples are reported in Table 3. If the relationship between investment and leverage is indeed inverted U-shaped, the relationship should be positive for low-indebted firms with the leverage below the turning point, while it should be negative for high-indebted firms with the leverage above the turning point.

Table 3. Low-indebted firms versus high-indebted firms

	Investment					
	Low-indebted			High-indebted		
	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	0.02340***	0.02480***	0.02459***	-0.04909***	-0.03974***	-0.03838***
	(0.00309)	(0.00313)	(0.00313)	(0.00942)	(0.00957)	(0.00961)
Size	-0.02035***	-0.01697***	-0.01659***	-0.01028***	-0.00762***	-0.00757***
	(0.00113)	(0.00121)	(0.00121)	(0.00113)	(0.00112)	(0.00112)
Cash flow	0.11367***	0.11526***	0.11525***	0.06706***	0.06697***	0.06713***
	(0.00486)	(0.00490)	(0.00490)	(0.00679)	(0.00681)	(0.00684)
Maturity	0.00084	0.00558***	0.00209	-0.00916	0.00521***	-0.00430
	(0.00283)	(0.00053)	(0.00283)	(0.00832)	(0.00069)	(0.00833)
Growth	0.00609***	0.00195	0.00548***	0.00535***	-0.00595	0.00502***
	(0.00053)	(0.00283)	(0.00053)	(0.00069)	(0.00832)	(0.00069)
Age	-0.02085***	-0.01609***	-0.01599***	-0.04049***	-0.03414***	-0.03368***
	(0.00147)	(0.00195)	(0.00196)	(0.00208)	(0.00307)	(0.00308)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector x year FE	No	Yes	Yes	No	Yes	Yes
Province x year FE	No	No	Yes	No	No	Yes
Observations	548,712	548,712	548,712	231,611	231,611	231,611
R-squared	0.315	0.318	0.320	0.435	0.437	0.441

This table presents the empirical panel model estimations for low and high-indebted firms where the turning point (0.79) is used as the threshold. Turning point is calculated from the coefficients on leverage and leverage squared reported in column 3 of Table 2. Definitions of variables are given in the note for Table 1. Robust standard errors clustered at firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

Results show that the coefficient of leverage is significantly positive for the former (column 3) while it is significantly negative for the latter (column 6). This further confirms the inverted U-shaped relationship between leverage and investment. Besides, the coefficient estimates suggest that the linkage seems to be steeper for high indebted firms. On average, a 10 percent increase in leverage increases investment rate by 2 percent for low indebted firms while it reduces investment by 3 percent for high indebted firms, which are economically significant and relevant, as well

3.2. SMEs versus large firms

Previous literature provides ample evidence that borrowing capacity and access to credit problem is more severe when firm size is smaller (e.g., Berger and Udell, 1992; Mutluer Kurul and Tiryaki, 2016; and Yarba and Güner, 2020a,b), and the continuation of the lending relationship is more valuable with larger firms (e.g., Khwaja and Mian, 2008; and Iyer et al., 2014). Thus, the negative impact of high leverage is expected to be less for larger firms.

In order to investigate the issue, I re-estimate the empirical model for micro-sized, small, medium-sized and large firms, where the number of employees of 10, 50, and 250 are used as thresholds.[2] The results are reported in Table 4. In all specifications, the coefficients are significantly positive and negative for leverage and its squared term, respectively. These suggest that inverted U-shaped relationship between investment and leverage exists for all firm size groups. Conspicuously, the results show that turning point gets higher with firm size. The indebtedness level that becomes an impediment to investment is significantly lower for SMEs than larger firms indicating SMEs' lower borrowing capacity and tolerance to higher debt relative to large firms. These findings are in support of the arguments in the literature that small firms are more likely to be affected by debt overhang since they tend to be informationally opaque and dependent on banks for their external financing (e.g., Kashyap et al., 1993,1994).

[2] I also used total assets as the threshold for large and small firms: i-those with total assets above/below the 50th percentile, ii- above/below the 75th percentile, ii) below 25th percentile/above 75th percentile. The re-estimated results for all alternatives are in line with those reported in Table 4. To converse space, they are not reported but available upon request.

Table 4. SMEs versus large firms

	Investment				
	SMEs	Micro-Sized Firms	Small Firms	Medium-Sized Firms	Large Firms
	(1)	(2)	(3)	(4)	(5)
Leverage	0.04332***	0.01958***	0.04526***	0.10357***	0.22472***
	(0.00602)	(0.00678)	(0.01355)	(0.02689)	(0.04715)
Leverage squared	-0.02737***	-0.01361**	-0.02861**	-0.05498**	-0.11726***
	(0.00497)	(0.00555)	(0.01120)	(0.02228)	(0.04215)
Size	-0.00956***	-0.00262***	-0.02319***	-0.03598***	-0.05607***
	(0.00070)	(0.00078)	(0.00174)	(0.00400)	(0.00950)
Cash flow	0.08965***	0.03802***	0.15742***	0.22315***	0.25676***
	(0.00380)	(0.00431)	(0.00846)	(0.01513)	(0.02715)
Growth	0.00634***	0.00298***	0.01095***	0.01438***	0.00812
	(0.00041)	(0.00042)	(0.00107)	(0.00245)	(0.00582)
Maturity	-0.00017	0.00016	-0.00313	0.00815	0.01437
	(0.00253)	(0.00323)	(0.00474)	(0.00792)	(0.01414)
Age	-0.02313***	-0.00879***	-0.03730***	-0.05453***	-0.05502***
	(0.00155)	(0.00182)	(0.00339)	(0.00700)	(0.01327)
Firm FE	Yes	Yes	Yes	Yes	Yes
Sector x year FE	Yes	Yes	Yes	Yes	Yes
Province x year FE	Yes	Yes	Yes	Yes	Yes
Observations	763,266	413,805	272,002	78,219	16,297
R-squared	0.294	0.362	0.319	0.347	0.377
Turning point	0.791	0.719	0.791	0.942	0.958

This table presents estimations of the empirical model in equation 1 for micro-sized, small, medium-sized and large firms, where the number of employees of 10, 50, and 250 are used as thresholds. SMEs includes micro, small and medium firms. Definitions of variables are given in the note for Table 1. Robust standard errors clustered at firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

3.3. Do corporate cash holdings matter?

Since Keynes (1936), the literature provides extensive evidence that financial frictions leads corporates to have precautionary cash holdings, which play an important role in affecting other corporate financial and real activities. Financial frictions can induce credit rationing and aggravate refinancing risk, which can lead to higher cost of external financing. On the one hand, precautionary cash holdings can buffer against these frictions and mitigate the underinvestment problem (e.g., Stiglitz and Weiss, 1981; Opler et al., 1999). Harford et al. (2014) also show that refinancing risk can be alleviated by cash holdings, which prevent the firms to forgo valuable growth opportunities. On the other hand, downside of excessive liquidity, such as agency costs associated with excessive cash holdings is well documented in the literature (e.g, Jensen, 1986; Harford, 1999; Pinkowitz et al., 2006; Dittmar and Mahrt-Smith, 2007).

In order to assess whether cash holdings matter in leverage-investment linkage, I divide the sample into low- and high-cash holders. High-cash holders are the firms whose beginning-of-year cash holdings (measured as the ratio of cash and equivalents to total assets) are in the highest quartile of the sample distribution, and the rest is defined as low-cash holders.[3] The re-estimated results for these subgroups are presented in columns 1 and 2 of Table 5. The inverted U-shaped relationship between leverage and investment is evident for both subgroups. Interestingly, result reveal that the turning point is higher for more-cash holders. This indicates the role of cash holdings in mitigating the adverse effect of high leverage. In other words, firms that hold more cash can sustain higher level of debts without adversely affecting their investment activity, which is consistent with the literature that lends support to the precautionary motive of corporate cash holdings.

Table 5. Additional heterogeneous effects by cash holdings, export orientation and capital intensity

	Investment					
	Low-cash holdings	High-cash holdings	Low-capital intensity	High-capital intensity	Non-Exporters	Exporters
	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	0.03392***	0.03511***	0.03720***	0.05480***	0.03317***	0.07083***
	(0.00490)	(0.01138)	(0.00693)	(0.01307)	(0.00649)	(0.01638)
Leverage squared	-0.02382***	-0.01968**	-0.02690***	-0.03051***	-0.02146***	-0.03653***
	(0.00391)	(0.00991)	(0.00565)	(0.01132)	(0.00534)	(0.01375)
Size	-0.00319***	-0.00498***	-0.00805***	-0.02278***	-0.00844***	-0.02494***
	(0.00063)	(0.00126)	(0.00079)	(0.00210)	(0.00075)	(0.00210)
Cash flow	0.05220***	0.07747***	0.07451***	0.15657***	0.07174***	0.16877***
	(0.00325)	(0.00628)	(0.00434)	(0.00813)	(0.00413)	(0.00958)
Growth	0.00472***	0.00458***	0.00584***	0.00459***	0.00545***	0.00645***
	(0.00030)	(0.00083)	(0.00046)	(0.00090)	(0.00043)	(0.00121)
Maturity	0.00225	-0.01338**	0.00046	0.00418	-0.00294	0.00828
	(0.00198)	(0.00548)	(0.00316)	(0.00423)	(0.00284)	(0.00560)
Age	-0.01242***	-0.02507***	-0.02116***	-0.03958***	-0.02102***	-0.03648***
	(0.00128)	(0.00305)	(0.00174)	(0.00401)	(0.00171)	(0.00396)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector x year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province x year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	587,807	192,516	589,538	190,785	592,234	188,089
R-squared	0.325	0.472	0.336	0.351	0.317	0.364
Turning point	0.712	0.892	0.691	0.898	0.773	0.969

This table presents estimations of the empirical model in equation 1. Definitions of variables are given in the note for Table 1. Robust standard errors clustered at firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

[3] I also use above/below the median value and below 25th percentile/ above 75th percentile.as the thresholds for low and high cash holders. Since the results are in line with those reported in Table 5, they are not reported for the sake of brevity but available upon request.

3.4. Additional heterogeneous effects by export orientation and capital intensity

In this section, I analyze the possible differential effects by export orientation and capital intensity. To this aim, I repeat the analysis for high and low capital-intensive firms, separately. A firm is classified as "high capital-intensive" if it is in the highest capital intensity quartile and "low capital-intensive", otherwise.[4] Following the literature, I measure capital intensity as the ratio of real tangible fixed assets to the number of employees. The re-estimated results reported in Table 5 show that the non-linearity in the leverage-investment link holds for both low and high capital-intensive subgroups (columns 3 and 4). However, the turning point is higher for the latter. This suggests that high capital-intensive firms can mitigate the adverse impact of high leverage. This finding is not surprising given that tangible fixed assets, are the most frequently requested collateral by Turkish financial institutions (Mutluer Kurul and Tiryaki, 2014), and in line with the literature (e.g., Yarba and Güner, 2020a, among others) that emphasizes the role of tangibility in mitigating the constraints on borrowing.

Moreover, in order to assess the potential differential impact of export orientation, I re-estimate the empirical model for exporters and non-exporters, separately. The results reported in Table 5 show that the inverted U-shaped relationship exists significantly for both exporters and non-exporters. However, the turning point is higher for the exporters. This suggests that the tolerance to elevated debt is higher for exporters than non-exporters, which is consistent with the literature that indicates export orientation contributes to firms' credit access (e.g., Muûls, 2015; Manole and Spatareanu, 2010, among others).

4. Additional robustness checks

In this section, a series of additional checks are performed to achieve further confirmation that the results are robust. In the previous results, firm leverage is measured as the ratio of total debt to total assets, where total debt is the sum of long term debt, credit, loans and other current liabilities. As a robustness check, I repeat the analysis using two alternative measurement of leverage: i) including all liabilities,[5] and ii): excluding all non-financial liabilities. The results are reported in columns 1 and 2 of Table 6, respectively. The non-

[4] The results using above/below the median value and below 25th percentile/ above 75th percentile.as the thresholds for low and high capital-intensity are similar. To converse space, they are not reported but available upon request.
[5] Other liabilities, which are neither trade debt nor financial debt are also included since Yarba (2021) argues that they are also used as an alternative financing channel by Turkish firms.

linearity in the debt-investment link is further confirmed for both alternative leverage measures. Similar to the baseline estimation, the calculated turning point corresponds to approximately 75th percentile of the distribution for both specifications.

As another check, I use alternative measurement of investment as the dependent variable instead of investment rate (the annual percentage change in plant, machinery and equipment): i- investment (annual change in plant, machinery and equipment) to net sales ratio ii- investment to total assets ratio. Re-estimated results reported in columns 3 and 4 of Table 6 are in line with those reported in Table 2.

I further address the possible bias that might be induced by foreign currency denominated corporate debt. To this aim, I repeat the analysis by excluding the firms holding foreign currency debt, which account for approximately 13% of firms in the sample. Results are reported in column 5 of Table 6. No bias due to foreign currency debt is evident in these results.

One criticism of the panel estimations is the possible endogeneity problem that may arise due to simultaneity of indebtedness and investment decisions. In the previous results, I use lags of regressors to deal with this concern. To address the issue further, following the literature (e.g., Coricelli et al., 2012 among others) I replace one-year lagged regressors used in the baseline estimation by two-year lagged values. The correlation between one-year and two-year lagged leverages is 0.8225 while the correlation between two-year lagged leverage and the residuals of the baseline model is -0.0044 indicating that current investment decisions are not affected by debt reported two years before the investment decisions.

I next conduct a more structural two-step approach. Following the literature on panel estimations, I first estimate the leverage using the standard estimation approach including related firm characteristics as explanatory variables. Specifically, following Rajan and Zingales (1995), Frank and Goyal (2009), and Yarba and Güner (2020a), these are firm size (log of assets), sales growth (percentage change of annual net sales), profitability (operating income/net sales), liquidity (cash and cash equivalents/total assets), tangibility (tangible fixed assets/total liabilities), and, firm age. I also incorporated firm, sector-year and province-year fixed effects into the estimation model to control for any time-invariant unobserved heterogeneity and any possible omitted time variant unobservable industry/region factors. The predicted value seems to be a suitable instrument candidate

since it is highly correlated with the leverage (0.8286) but nearly zero-correlated with the residuals of the baseline model (0.002).

Alternatively, I incorporate the lagged leverage as an additional explanatory variable to account for persistency in leverage, and predict by the Arellano and Bond (1991) two-step generalized method of moments (GMM) procedure using two-step robust errors. In order to reduce the number of observations dropped from the sample, the variables are transformed using forward deviations as in Arellano and Bover (1995). The predicted leverage from the GMM estimation also displays little correlation with the baseline model residuals (0.0071) while it is highly correlated with leverage (0.7702).

Table 6. Additional robustness checks

	Investment							
	Leverage: including all liabilities	Leverage: excluding all non-financial debt	Dependent variable: investment to net sales ratio	Dependent variable: investment to total assets ratio	Excluding FX debt holders	Leverage: two-years lagged	Leverage: fitted value	Leverage: fitted value (GMM)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Leverage	0.05549***	0.04063***	0.00192**	0.00527***	0.04215***	0.02054***	0.67178***	0.01648**
	(0.00614)	(0.01069)	(0.00097)	(0.00115)	(0.00609)	(0.00624)	(0.12710)	(0.00665)
Leverage squared	-0.03246***	-0.11076***	-0.00124***	-0.00333***	-0.02662***	-0.01091**	-0.42732***	-0.00973***
	(0.00483)	(0.02234)	(0.00041)	(0.00096)	(0.00503)	(0.00519)	(0.09705)	(0.00244)
Size	-0.01015***	-0.00858***	-0.00451***	-0.00498***	-0.00866***	-0.02119***	-0.05392***	-0.01375***
	(0.00071)	(0.00068)	(0.00022)	(0.00014)	(0.00071)	(0.00078)	(0.00281)	(0.00089)
Cash flow	0.09492***	0.08700***	0.01973***	0.01588***	0.07764***	0.06084***	0.26083***	0.09899***
	(0.00377)	(0.00358)	(0.00115)	(0.00078)	(0.00386)	(0.00393)	(0.01340)	(0.00435)
Growth	0.00625***	0.00657***	0.00052***	0.00064***	0.00570***	0.00387***	0.01408***	0.00715***
	(0.00040)	(0.00040)	(0.00012)	(0.00007)	(0.00041)	(0.00044)	(0.00184)	(0.00053)
Maturity	-0.00517**	-0.00153	0.00150**	-0.00038	0.00163	-0.00530**	-0.00976	-0.00483*
	(0.00242)	(0.00248)	(0.00070)	(0.00045)	(0.00271)	(0.00256)	(0.00882)	(0.00292)
Age	-0.02449***	-0.02502***	-0.00277***	-0.00230***	-0.02284***	-0.01762***	-0.11736***	-0.04500***
	(0.00153)	(0.00153)	(0.00036)	(0.00025)	(0.00159)	(0.00159)	(0.00761)	(0.00279)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province x year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	780,323	780,323	780,323	792,812	678,283	700,564	699,556	579,039
R-squared	0.293	0.293	0.285	0.29519	0.309	0.287	0.212	0.308
Turning point	0.855	0.183	0.774	0.791	0.792	0.941	0.786	0.847

This table presents estimations of the empirical model in equation 1. Definitions of variables are given in the note for Table 1. Robust standard errors clustered at firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

I next repeat the analysis by using two-year lagged leverage and predicted values instead of the actual leverage. The re-estimated results reported in Table 6 are in line with my baseline estimations reported in Table 2.[6] The inverted U-shaped relationship between leverage and investment is evident for all specifications.

As a final robustness check, I investigate whether any bias induced by firm entry or exit. To this aim, I re-estimated the model for the firms that have at least T years of consecutive data, where T ∈ [4, 11]. T= 3 corresponds to the sample of the baseline specification since lag of sales growth is used as an explanatory variable in the model. No bias due to entry and/or exit is evident in results.[7]

5. Conclusion

Corporate indebtedness has globally increased in the years preceding the 2007-2009 global financial crisis. The consequences of this large build–up of debt on investments have attracted vast attention on both academic and policy-making fronts. Despite its importance of the issue, the empirical evidence on the corporate indebtedness and investment linkage is very limited for emerging countries, which can be attributed to data availability. To expand upon this small literature, this study investigates the issue in detail by utilizing a confidential and comprehensive firm-level data, which contains the universe of all incorporated manufacturing firms in Turkey over the last decade.

In the first place, the results of the panel regression model with multi-dimensional fixed effects reveal that ignoring the non-monotonic relation between corporate debt and investment would lead biased estimates. I document significant evidence of an inverted U-relationship between leverage and investment, indicating that leverage increases investment rate only up to a certain level. This non-monotonic relationship is evident for all firm size groups. The results show that the indebtedness level that becomes an impediment to investment activity is significantly lower for SMEs than large firms, providing evidence in support of the arguments in the literature that small firms are more likely to be affected by debt overhang.

[6] The results for leverage estimations are not reported for the sake of brevity but available upon request.
[7] To conserve space, these results are not reported in the paper. However, they are available upon request.

Another important result is that firms that holding more cash can sustain higher level of debts without hurting investment activity. This reveals the importance of cash holdings in mitigating the adverse effect of high leverage on investment, which is consistent with the literature that lends support to the precautionary motive of corporate cash holdings. Moreover, I also document significant evidence that export orientation and capital intensity can attenuate the dampening effect of high leverage on corporate investment.

The findings of this study highlight the importance of regulations in preventing corporates from excessive indebtedness levels that are likely to become an impediment to investment growth. During the Covid-19 pandemic, although the liquidity injections provided by policy makers in the form of loan guarantees and new lines of credit have been crucial for corporates to cope with liquidity shortages, the resulting increase in corporate leverage has further increased the concerns regarding the corporate investment prospects (OECD, 2021; Ebeke et al., 2021). As in many emerging countries, in Turkey bank lending is the dominant source of external finance for privately held firms and alternates to external debt is quite limited, especially for SMEs (e.g., there are only around four hundred firms listed on BIST and 70.85% of them are large firms). In that sense, the findings of this paper emphasize policies that make equity financing more attractive (e.g., allowance for corporate equity), incentivise the uptake and provision of equity capital from private investors and deepen the capital markets.

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