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Uncertainty, macroprudential policies and corporate leverage: Firm-level evidence

Ibrahim Yarba [a,*], Z. Nuray Güner [b]

[a] Central Bank of the Republic of Turkey, Structural Economic Research Department, Turkey
[b] Department of Business Administration, Middle East Technical University, Turkey

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ABSTRACT

This paper investigates the impact of macroprudential policies and uncertainty of economic environment on corporate leverage dynamics over the last decade. This is the first study to investigate the impact of macroprudential policies and uncertainty on leverage dynamics of Turkish non-financial firms using firm-level data. We argue in this paper that persistence of uncertainty should be a more appropriate factor affecting credit dynamics rather than uncertainty. In that sense, we construct a measure of uncertainty by using principal component analysis and a measure of persistence of uncertainty for Turkey. Results from the dynamic panel models with a large set of control variables, provide significant evidence in support of the argument that leverage decisions are affected from the persistence of uncertainty rather than the uncertainty itself. Moreover, both the share of the financial debt in total liabilities and the leverage of Turkish non-financial firms decrease significantly when uncertainty increases persistently and when macroprudential policy tools are tightened. Most strikingly, this is the case only for Small and Medium-Sized Enterprises but not for large firms.

1. Introduction

In recent years, domestic and geopolitical uncertainties have played vital roles in emerging countries. Accordingly, macroprudential policies (MPPs) have been extensively used by these countries to increase the financial stability by improving the resilience of the financial system to adverse shocks. However, the impact of MPPs and uncertainty on corporate leverage dynamics has rarely been discussed in the literature. Evidence is much more limited for emerging economies and there is no consensus on the effectiveness of such policies. In order to provide further evidence to shed some light on this issue for emerging markets, we aim to analyse the impact of MPPs and uncertainty on corporate financial debt in Turkey, one of the most important transition economies by utilizing a confidential and unique firm-level data over the last decade. This study is the first to explore the issue by using firm-level data.

Economic activity is shaped by the decisions of economic agents, namely government, households, financial intermediaries and firms. These agents have to take actions in an uncertain environment due to the nature of decision-making process. In that sense, uncertainty is expected to have an important impact on decisions of agents and hence, the whole economy.

First, uncertainty is expected to have a negative impact on information asymmetry between borrowers and lenders. Furthermore, the probability of bankruptcy increases with uncertainty. As a result, banks tend to delay lending to firms during times of uncertainty and this decline in bank lending to firms slows down the business expansion (Greenwald and Stiglitz, 1990). Prior empirical

* Corresponding author.
E-mail addresses: ibrahim.yarba@tcmb.gov.tr (I. Yarba), nurayg@metu.edu.tr (Z.N. Güner).

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research has examined the impact of uncertainty on Initial Public Offering (IPO) activities, required return on future cash flows, asset prices and investment decisions.[1] However, there has been little emphasis on the impact of uncertainty on corporate leverage dynamics and there is no study analysing this issue for Turkish non-financial firms even though both domestic and geopolitical uncertainties have played vital roles in Turkey.

To investigate the issue, we construct a measure of uncertainty for Turkey by using Principal Component Analysis. In addition, we argue that decision-making process of both borrowers and creditors, hence the leverage dynamics depend on the nature of uncertainty, whether it is short-lived or not. It is reasonable to expect economic agents to get used to uncertainties in a country such as Turkey, where they confront both domestic and geopolitical uncertainties frequently. Thus, we argue that persistence of uncertainty should be a more appropriate factor to take into account when analysing leverage dynamics than the uncertainty itself. In order to test the validity of this argument, we construct an index for persistence of uncertainty as well.

On the other hand, in recent years macroprudential policies (MPPs) have been extensively used by both developed and developing countries. In particular, after the global financial crisis of 2008–2009, regulators and central bank governors all around the world agreed on the importance of macroprudential policies for both domestic and global financial stability. As an example, central bank governors and finance ministers of the Group of Twenty (G20) agreed to cooperate more on MPP framework in October 2010.

MPP framework is considered as an essential tool by policy makers to mitigate the adverse impact of shocks and systematic risks of the financial system, which can induce severe negative consequences for real economic activity. These policies are aimed to increase financial stability by increasing the resilience of the financial intermediaries to adverse shocks by building buffers and reducing procyclical feedback between credit and asset prices, and containing unsustainable increases in leverage and volatile funding (IMF, 2013).

Turkey, as one of the most important transition economies, has been using macroprudential policies increasingly and explicitly since 2011. Accordingly, the Central Bank of Turkey (CBRT) modified its inflation targeting framework by incorporating financial stability as a complementary objective by the end of 2010. Besides, Financial Stability Committee was founded in 2011 to respond to financial risks more effectively (Please see Kara (2016) for the details of the implementation of MPPs in Turkey).

In accordance with the importance of the issue, a growing literature has explored the impact of MPPs across countries on credit growth.[2] The results of these studies provide significant evidence on the negative impact of MPPs on credit growth. However, they mainly focused on aggregate credit growth using data mostly from advanced countries. Conversely, we utilize a comprehensive and confidential firm-level data to analyse the impact of MPPs on corporate leverage dynamics in a major developing country, Turkey.

Policymakers face a complex challenge in an uncertain economic environment, and as shown in existing theoretical research (e.g., Bahaj and Foulis, 2016; Brainard, 1967), uncertainty is an important dimension in the effectiveness of policymaking process. It may diminish the potency of the impact of macroprudential policies on credit dynamics. In that sense, another novel aspect of this study is to combine MPPs, uncertainty and persistence of uncertainty in the same model and analyse the simultaneous impact of all these important factors on corporate financial debt.

In order to assess the issue, we utilize dynamic panel models with a large set of control variables. Besides, we re-estimate the models for Small and Medium-Sized Enterprises (SMEs) and large firms separately to examine whether the impact of these variables on firm financial debt changes depending on firm size.[3]

First, results provide significant evidence in support of the argument that persistence of uncertainty is a more appropriate factor in determining the corporate leverage, a firm's total debt to total assets ratio, rather than uncertainty. Besides, results show that for Turkish non-financial firms, corporate leverage is adversely affected when uncertainty is increasing persistently and when macroprudential policy is tightened during the sample period. More importantly, we do find that this is the case for SMEs but not for the large firms.

Moreover, for robustness, we re-estimate the model by taking ratio of financial debt to total liabilities, share of financial debt in total liabilities of firms, as the dependent variable instead of corporate leverage. Results are consistent with those obtained when the dependent variable is the ratio of financial debt to total assets.

The remainder of this paper is organized as follows. The dataset and methodology are explained in Section 2. Results are reported in Section 3. Finally, concluding remarks are presented in Section 4.

2. Data and methodology

2.1. Variables

This section explains measurements of macroprudential policy, uncertainty and persistence of uncertainty indices and other variables used in the empirical analyses of this study.

2.1.1. Uncertainty

Due to the fact that uncertainty is not observable, a true measure of uncertainty does not exist. In that sense, researchers have used various proxies to measure uncertainty. Bloom (2009) uses implied volatility (VXO index) constructed by the Chicago Board of Option Exchange. Bachmann et al. (2013) create a proxy for business level uncertainty based on the cross-sectional dispersion of survey-based forecasts from the Business Outlook Survey and IFO Business Climate Survey for the U.S. and Germany, respectively. Bekaert et al. (2013) take the variance risk premium decomposed from the VIX as the uncertainty measure and Jurado et al. (2015) use the common variation of the unforecastable component of the future value of a large number of variables in econometric models.

Recently, a growing literature has focused on news-based measures of economic uncertainty. The well-known index, Economic Policy Uncertainty Index created by Baker et al. (2016) has been commonly used in the literature in recent years. By using a computer based search, Baker et al. (2016) construct Economic Policy Uncertainty Index by quantifying frequencies of newspaper articles, which simultaneously contain terms having to do with economic policy, economy and uncertainty. Using the same

[1] See, for example, Bernanke (1983), Bloom et al. (2007), Czarnitzki and Toole (2011), Brogaard and Detzel (2012), Julio and Yook (2012), Colak et al. (2013), Pastor and Veronesi (2013), Wang et al. (2014), Bloom (2009, 2014), Ghosal and Ye (2015), Chen et al. (2016), Gulen and Ion (2016), Wang et al. (2017), Bhattacharya et al. (2017), and Sahinoz and Cosar (2018).

[2] See, for example, Brunnermeier et al. (2009), Lim et al. (2011), Ostry et al. (2012), Tovar et al. (2012), Claessens et al. (2013), Galati and Moessner (2013, 2014), Freixas et al. (2015), Bruno et al. (2015), Claessens (2015), Cerutti et al. (2016, 2017), Erdem et al. (2017) and Fendoğlu (2017).

[3] For robustness, we use two different approaches for size classification, namely net sale criterion, and the European and Turkish official criterion based on number of employees.

methodology, they have developed indices as proxies for economic policy uncertainty for the major economies and some emerging countries including China, Brazil, Chile, Korea, Russia and India.

However, in Turkey there exist only a few newspapers that have online searchable archives for the sample period of this study. An index created as a proxy for uncertainty based on articles in only a few newspapers might lead to biased results. Therefore, we generate an index of uncertainty (UNCI) for Turkey by using financial variables related with uncertainty. One can argue that creating an uncertainty index using only financial variables may not be appropriate for measuring the general economic environment uncertainty. However, a recent study by Caldara et al. (2016) show that the financial channel is the key in the transmission of uncertainty shocks. This finding provides significant support for the UNCI created in this study.

Besides, Stock and Watson (2012) explicitly point out the significant positive and high correlation between economic uncertainty proxies and credit spreads. They come to a conclusion that these two indicators seem to be identifying the same shocks. Furthermore, Caldara et al. (2016) find that volatility in financial markets, a widely used proxy for macroeconomic uncertainty, has significant association with credit spreads. In addition, bond premiums are considered as a measure of financial market strain (Gilchrist and Zakrajsek, 2012). Moreover, it is well known that in Turkey volatility in the exchange rate market is an important indicator for financial markets, and it is highly correlated with the confidence levels of both consumers and the real sector.

Given these findings in the literature, in this study Credit Default Spread (CDS), spreads in bond market and implied volatilities of foreign exchange market are considered in creating a proxy for uncertainty in Turkey. For CDS, 5 Year Credit Default Spread in USD for Turkey which has the highest trading volume; for bond market spread, the commonly used Emerging Market Bond Index spread (EMBI) for Turkey; for implied volatilities in FX market, 1 month and 1 year implied volatilities of both USD/TL and EUR/TL are used. All data is obtained from Bloomberg on a daily basis to increase the sample size over 2005–2017 period.

Principal Component Analysis (PCA) is employed to create a single daily uncertainty index. Based on the results of PCA one single factor is extracted. The eigenvalue of this factor is 5.055, and the factor explains 84.25% of variance of all the variables, which is relatively high. It is worthwhile to note that implied volatilities of foreign exchange market are the highest loading variables to the extracted factor. The firm level data of this study is annual, thus for each year, the average of daily UNCI values are calculated in order to convert daily data into annual data.

2.1.2. Persistence of uncertainty

We argue that reactions of economic agents to uncertainty may depend on the nature of it. If it is perceived as short-lived, future perspective of firms or creditors, which has an important effect on leverage dynamics, may not change. In that sense, we argue that the nature of the uncertainty, whether it is persistent or not, seems to be an appropriate factor that could be taken into account in financial debt decisions of firms. To this aim, we adopt the methodology used by Herrera et al. (2011) and Davis and Haltiwanger (1992) in order to measure the persistence of uncertainty. The process is as follows:

$$P\_UNCI_t = \begin{cases} \alpha \, x\min\left\{1, \max\left(0, \dfrac{\text{percentage change in UNCI between } t \text{ and } t-2}{\text{percentage change in UNCI between } t-1 \text{ and } t-2}\right)\right\}, & \text{if } \Delta UNCI_t \; X \; \Delta UNCI_{t-1} > 0 \\ \beta \, x \, max\left\{-1, \min\left(0, \dfrac{\text{percentage change in UNCI between } t \text{ and } t-2}{\text{percentage change in UNCI between } t-1 \text{ and } t-2}\right)\right\}, & \text{otherwise} \end{cases}$$

P_UNCI_t denotes the persistence of uncertainty index *(UNCI)* and $\Delta UNCI_t$ *is* the percentage change in *UNCI* between *t* and *t–1* where α is *-1* if $\Delta UNCI_t < 0$ and *1* otherwise, and β is *-1* if $\Delta UNCI_t > 0$ and *1* otherwise. P_UNCI_{it} takes on the values in the interval of $[-1, 1]$. Successive increases (decreases) in uncertainty at *t–1* and *t* is considered to be persistent increases (decreases) in uncertainty. P_UNCI_t gets closer to *1 (-1)* when increase (decrease) in uncertainty at time *t* is higher relative to increase (decrease) at time *t–1*. On the other hand, if uncertainty does not increase (decrease) in two successive periods, it takes the value of *0* which can be interpreted as no persistence. However, even though uncertainty decreases (increases) at time *t –1*, if the increase (decrease) at time *t* is relatively high that uncertainty level at time *t* gets above the level at time *t–2*, then P_UNCI_t does not get the value of *0*, but it gets closer to *1 (-1)* depending on the magnitude of the increase (decrease) at time *t*.

Overall, P_UNCI_t takes the value of *0* when change in uncertainty at time *t* (increase or decrease) can be interpreted as not persistent but temporary. On the other hand, positive and negative persistence is increasing when P_UNCI_t gets closer to *1* and *-1*, respectively.

2.1.3. Macroprudential policies

One of the most challenging issues in assessing the performance of MPP framework is the lack of information due to the nature of policy implementation. It involves a wide range of tools implemented by various policy makers. However, in a recent study, Cerutti et al. (2016) compile a unique and detailed dataset of widely used MPP tools for 64 countries including Turkey over the period 2000–2014 on a quarterly basis. They also created an index, which reflects the direction of MPPs' usage (loosening or tightening) over time. Using a combination of primary and secondary sources, they collect information on commonly used MPP tools under five main categories: (i) capital buffers, (ii) loan-to-value (LTV) ratio limits, (iii) concentration limits, (iv) interbank exposure limits, and (v) reserve requirements. The primary information is provided directly by national authorities through the IMF or International Banking Research Network (IBRN). As primary sources, they use Global Macroprudential Policy Instruments (GMPI) which are compiled by IMF (2014) and available on national authorities' webpages. As secondary sources to complement the database, they use earlier dataset compiled by Reinhardt and Sowerbutts (2015), Akıncı and Olmstead-Rumsey (2015), Kuttner and Shim (2013), and Lim et al. (2011). After compiling this large and unique dataset, they construct an index for the direction of MPPs'usage for each country where *-1* stands for loosening, *0* stands for no change, and *1* stands for tightening in MPPs in a given quarter.

In this study, this index (MPI) is used as a proxy for MPP framework usage in Turkey and it is obtained from Cerutti et al.

Table 1
Variable definitions.

Variables	Definitions
Uncertainty Index	Explained in Section 2.1.1.
Persistence of Uncertainty Index	Explained in Section 2.1.2.
Macroprudential Policy Index	Index created by Cerutti et al. (2016) and authors' own calculations explained in Section 2.1.3.
Dependent Variables	
Firm leverage	Calculated as total financial debt divided by total assets
Share of financial debt in total liabilities	Calculated as total financial debt divided by total liabilities
Control Variables	
Firm Characteristics	
Profitability	Calculated as the operating income divided by total assets
Size	Calculated as the log of sales deflated by GDP deflator
Growth	Calculated as the difference in the net sales between current year and previous year divided by the net sales in previous year
Tangibility	Calculated as the total net plant, property and equipment divided by total assets
Business Risk	Calculated as the standard deviation of the ratio of operating income to total assets for the last three consecutive years
Industry Specific Factor	
Industry median leverage	Calculated as the median of related total leverage ratio of all the firms operating in the same industry as the firm, excluding the firm itself. Sector classification is based on economic activity classification, NACE Rev.2 which is released by EUROSTAT
Macroeconomic/Economic Environment Factors	
GDP growth	Calculated as the percentage change in annual real GDP
Inflation	Calculated as the difference in the Consumer Price Index between current year and previous year divided by the Consumer Price Index in previous year
Government Borrowing	Calculated as the government debt divided by GDP
Financial Development	Index created by Svirydzenka (2016) and extended by the authors.

The table reports the definitions of the dependent and the independent variables used in this study.

(2016). The firm level data of this study is on a yearly basis, thus for each year the average of quarterly MPI's are calculated in order to create an annual MPI series. However, this index does not exist for 2015. For that year, we obtained the information from related national authorities such as the CBRT, Banking Regulation and Supervision Agency (BRSA), and Capital Markets Board of Turkey (CMBT), and their related press releases and webpages. For robustness and to check the accuracy of own work, we also collected data for 2013 and 2014, and achieved the same results with Cerutti et al. (2016) for these years. This validated the process we used to calculate the MPI values for 2015.

2.1.4. Other variables in the models

Following Yarba and Guner (2019), a large set of firm specific, industry specific, macroeconomic and economic environment factors are included in the empirical models of this paper as control variables. Calculation and definition of these control variables are straightforward. Therefore, they are explained in Table 1.

2.2. Data

We utilize a representative and a comprehensive database for Turkish non-financial firms over the period 2007–2015. This confidential firm-level data provided by the CBRT consists of annual balance sheets and income statements of Turkish non-financial firms prepared according to Tax Procedure Law of Turkey. The CBRT releases the aggregated reports by sectors and company sizes on its web site annually while the firm level data is not publicly available for confidentiality reasons.[4]

In contrast to most of the earlier studies, the dataset does not include only publicly traded non-financial firms, but also privately held firms. It is also well-diversified in terms of firm size; of the firms included in the dataset, 14.14% are micro-sized, 37.49% are small, 33.91% are medium, and 14.46% are large firms on average according to European Union classification scheme based on number of employees.[5] Moreover, SMEs included in our dataset account for 28.86% of total assets, 24.94% of owners' equity, and 27.39% of total net sales of all Turkish SMEs covered in the database of Republic of Turkey, Ministry of Science, Industry and Technology on average over the sample period. The same ratios for large firms included in the dataset utilized in this study are 54.14%, 56.30%, 48.15%, respectively.

Our sample includes about 12,943 firms each year on average, and each of these firms has at least 3 years of consecutive data. Following the common practice, we winsorized the data at each tail at 0.5% in order to minimize the possible effects of outliers. The end result is an unbalanced panel data with 116,484 firm-year observations.[6]

Table 2 reports descriptive statistics for the dependent and independent variables used in this study. Panel A of Table 2 reports the descriptive statistics for the full sample while Panels B and C report the descriptive statistics for SMEs and large firms, respectively. Based on net.

Sales criterion, firms are divided into quartiles by the value of their net sales, and a firm is classified as "large" if it is in the highest net sales quartile and an "SME" otherwise in this paper.[7] Financial debt to total assets ratio for the whole sample is on average 30.75% while the share of financial debt in total liabilities is 44.09%. On average, total leverage and firm riskiness of SMEs are higher than those of large firms. Moreover, firm growth rates have the largest

[4] Please see the CBRT's web site for detailed information on the database including data collection process (http://www.tcmb.gov.tr/wps/wcm/connect/tcmb+en/tcmb+en/main+menu/statistics/real+sector+statistics/company+accounts).

[5] Firms with 1–9 employees, 10–49 employees, 50–249 employees, and >250 employees are classified as micro, small, medium, and large-sized firms, respectively.

[6] Financial development index used in this study is obtained from Svirydzenka (2016). Remaining economic environment and macroeconomic variables are obtained from Electronic Data Delivery System (EDDS) of CBRT, Turkish Statistical Institute and Undersecretariat of Treasury of the Republic of Turkey.

[7] Descriptive statistics for SMEs and large firms determined based on number of employees are in line with those reported in Table 2. To conserve space, these results are not reported in the study. However, they are available from the authors upon request.

Table 2
Descriptive statistics.

Variable	Obs	Mean	Sd	1st Quartile	Median	3rd Quartile
Panel A: Full Sample						
Leverage: Financial Debt to Total Assets	116,484	30.75	24.91	8.71	28.15	47.34
Financial Debt to Total Liabilities	116,484	44.09	30.33	16.36	45.49	69.26
Profitability	116,484	4.72	12.39	0.40	4.35	9.20
Firm size	112,477	16.33	2.07	15.46	16.51	17.49
Firm growth	94,722	17.00	97.08	−5.79	12.77	32.10
Tangibility	116,484	27.78	24.58	7.50	21.17	41.78
Firm business risk	79,922	5.46	12.75	1.63	3.27	6.13
Industry median leverage	180	28.20	9.65	22.85	27.59	33.58
GDP growth	9	5.03	4.67	4.79	5.17	8.49
Inflation	9	8.04	1.56	6.53	8.17	8.81
Government leverage	9	35.89	5.04	32.00	37.00	38.00
Financial development	9	0.49	0.03	0.48	0.49	0.50
Uncertainty Index	9	0.01	0.76	−0.47	−0.04	0.21
Persistence of Uncertainty Index	9	0.02	0.73	−0.30	0.00	0.48
Macroprudential Policy Index	9	0.22	0.42	0.00	0.25	0.25
Panel B: SMEs						
Leverage: Financial Debt to Total Assets	87,366	31.45	25.62	8.72	28.76	48.42
Financial Debt to Total Liabilities	87,366	44.58	30.77	16.27	45.98	70.23
Profitability	87,366	3.85	12.69	−0.03	3.67	8.31
Firm size	83,359	15.58	1.82	15.05	16.03	16.70
Firm growth	68,209	14.63	108.16	−10.49	11.18	32.84
Tangibility	87,366	29.36	25.91	7.47	22.28	45.30
Firm business risk	56,783	5.73	14.65	1.56	3.21	6.20
Panel C: Large firms						
Leverage: Financial Debt to Total Assets	29,118	28.66	22.51	8.68	26.49	44.45
Financial Debt to Total Liabilities	29,118	42.65	28.91	16.63	43.88	66.53
Profitability	29,118	7.33	11.03	2.41	6.35	11.64
Firm size	29,118	18.48	0.91	17.79	18.23	18.92
Firm growth	26,513	23.09	59.36	2.64	15.58	30.89
Tangibility	29,118	23.06	19.30	7.57	18.72	33.57
Firm business risk	23,139	4.79	5.81	1.79	3.38	5.96

The sample consists of non-financial firms in the confidential database of the CBRT. The table reports the descriptive statistics for the dependent and the independent variables used in this study over the period 2007–2015. Panel A reports the descriptive statistics for the full sample, while Panels B and C report the descriptive statistics for SMEs and large firms, respectively. Definitions of variables are given in Table 1. Based on net sales criterion, firms are divided into quartiles by the value of their net sales, and a firm is classified as "large" if it is in the highest net sales quartile and an "SME" otherwise in this paper. All variables are expressed as percentages, with the exception of firm size, financial development and other indices.

variance for the full sample and the difference in the variance of firm growth is remarkable between SMEs and larger firms.

2.3. Methodology

In empirical studies of capital structure, firm heterogeneity and time invariant differences across firms are considered as essential to be controlled. Besides, based on the arguments in the literature regarding slow adjustment of firm leverage to the optimal leverage each period due to adjustment costs, a lag of the dependent variable must be incorporated in the model to control for the prior period's leverage (Flannery and Hankins, 2013). However, using lag of the dependent variable as an explanatory variable and firm fixed effects together introduces serious econometric biases. OLS ignores longitudinal structure of the data, thus in OLS, the coefficient estimates of the lag dependent variable is biased due to the correlation between the said lagged variable and error term (Nickell, 1981; Baltagi, 2008). On the other hand, even though fixed effect dynamic model captures the longitudinal structure of the data, it also produces biased estimations since it ignores correlation between the lagged dependent variable and error term (Nickell, 1981).

In order to overcome this bias, the first-difference generalized method of moments (GMM) estimator is introduced by Arellano and Bond (1991). They use a first difference transformation of the model to eliminate the fixed effects and then employs the second lag of dependent variable as a valid instrument for the first difference of lag dependent variable. They deal with the lack of efficiency problem of Anderson and Hsiao (1981, 1982) approach by employing longer lagged dependent variables as additional valid instruments. On the other hand, potential weakness of this approach revealed by Blundell and Bond (1998) and Arellano and Bover (1995) is that the lagged values of the dependent variable may provide inadequate information and may be poor instruments for the first differenced variables, especially if they are serially correlated. In that sense, Blundell and Bond (1998) introduce an alternative GMM system based on a two-equation system of regression both in first differences and in levels.

However, we prefer fixed effect dynamic panel model to Blundell and Bond (1998) and Arellano and Bond (1991) for three reasons. First, previous literature such as Judson and Owen (1999), and Flannery and Hankins (2013) show that the aforementioned bias of fixed effect dynamic panel is decreasing with the length of the panel data as the impact of an error term becomes relatively small in the average error. Second, the null hypothesis of no second order autocorrelation is rejected by the results of the Arellano − Bond test (AR(2)) for our sample. This violates the main assumption of Arellano and Bond (1991) and Blundell and Bond (1998), and makes it impossible to use the instrumental variables in estimating these models (Hahn et al., 2007; Baltagi, 2008). Third, Flannery and Hankins (2013) show that fixed effect dynamic panel model is one of the most accurate estimators of panel data with endogenous independent variables and second order serial correlation. They also show that fixed effect dynamic panel model should also be considered when there is an unbalanced panel data and when dependent variable is clustered.

The dynamic panel models employed in this study are given in equation (2) through 4.

$$Y_{it} = \alpha_0 + \alpha_1 x\, Y_{it-1} + \alpha_2\, x\, P\_UNCI_t + \sum_k \gamma_k F_{k,\,it-1} + \sum_l \beta_l I_{l,\,it} + \sum_m \delta_m EE_{m,\,it} + \sum_n \theta_n X_{n,\,it} + \mu_i + \varepsilon_{it} \quad (2)$$

$$Y_{it} = \alpha_0 + \alpha_1 x\, Y_{it-1} + \alpha_2\, x\, P\_UNCI_t + \alpha_3\, x\, UNCI_t + \sum_k \gamma_k F_{k,\,it-1} + \sum_l \beta_l I_{l,\,it} + \sum_m \delta_m EE_{m,\,it} + \sum_n \theta_n X_{n,\,it} + \mu_i + \varepsilon_{it} \quad (3)$$

$$Y_{it} = \alpha_0 + \alpha_1 x\, Y_{it-1} + \alpha_2\, x\, P\_UNCI_t + \alpha_3\, x\, UNCI_t + \alpha_4\, x\, MPI_t + \sum_k \gamma_k F_{k,\,it-1} + \sum_l \beta_l I_{l,\,it} + \sum_m \delta_m EE_{m,\,it} + \sum_n \theta_n X_{n,\,it} + \mu_i + \varepsilon_{it} \quad (4)$$

where Y_{it} denotes the dependent variable for firm i in year t. Two different dependent variables, namely, financial debt/total assets ratios – a measure of corporate leverage and financial debt/total liabilities – a measure of share of financial debt in total liabilities of a firm are defined. *UNCI*, *P_UNCI* and *MPI* are the variables of interest denoting uncertainty, persistence of uncertainty, and macroprudential policy indices, respectively. *F* is the vector of firm characteristics while *I* is the industry specific control variables. *EE* denotes the proxies for economic environment and *X* is the macroeconomic control variables mentioned in Table 1. μ_i is (unobservable) time invariant firm specific effect, and ε_{it} is the idiosyncratic error term.

3. Results

First, we estimate empirical dynamic panel models in equation (2) through 4 by using financial debt to total assets ratio as the dependent variable in order to investigate impacts of aforementioned factors on leverage of Turkish non-financial firms. Table 3 presents results of the estimations for the full sample.

There is a significantly negative association between persistence of uncertainty index and corporate leverage (columns 1 to 6). This suggests that corporate leverage is decreasing when uncertainty is persistently increasing. On the other hand, no significant relationship between uncertainty index and corporate leverage is observed after controlling for a large set of variables consisting of firm specific, industry specific and other related macroeconomic variables (columns 2, 3, 5 and 6). These relations are robust since the coefficient of *P_UNCI* remains negative and highly significant at 1% level while the coefficient of *UNCI* remains insignificant in alternative model specifications.[8] Hence, results provide significant support for the argument that the persistence of uncertainty is the more relevant factor affecting leverage decisions rather than the uncertainty itself. Besides, macroprudential policy index has also significant negative association with corporate leverage (columns 3 and 6). This indicates that leverage of Turkish non-financial firms is decreasing when macroprudential policy tools are tightened.

We also incorporate *UNCIxSIZE*, *P_UNCIxSIZE* and *MPIxSIZE* terms to examine interactions between firm size and uncertainty, persistence of uncertainty and macroprudential policy, respectively. The coefficients of both interaction terms, *MPI* × *SIZE*.

And *P_UNCI* × *SIZE* are significant and positive (columns 4 to 6). These relationships remain robust when we also include year and industry x year fixed effects in the model in order to control time fixed effects and any possible omitted industry factors (time variant unobservable industry factors) (columns 7 to 15). These robust relations suggest that adverse impacts of both macroprudential policy and persistence of uncertainty are mitigated by increase in firm size.

For robustness, we re-estimate panel regressions for SMEs and large firms separately in order to examine whether there is any difference in impacts of macroprudential policy and persistence of uncertainty for firms in different size classifications. The net sales criterion is used to classify firms as SMEs and large firms.[9] Based on this criterion, firms are divided into quartiles by the value of their net sales, and a firm is classified as “large” if it is in the highest net sales quartile and an “SME” otherwise. Results are reported in Table 4.

Results reveal that macroprudential policy and persistence of uncertainty indices are significantly negatively associated with leverage of SMEs (columns 1, 2 and 3). However, results are significantly different for large firms. Relationships are not robust for neither *MPI* nor *P_UNCI* for large firms (columns 4, 5 and 6). These results are in line with those reported in Table 3. These suggest that leverage of only SMEs but not large firms decreases when uncertainty is increasing persistently and also when macroprudential policy is tightened during the sample period.

One can argue that the negative impact of macroprudential policy tightening and increase in the persistence of uncertainty on leverage of SMEs can be attributed to different trends in liabilities of SMEs and large firms over time. However, as seen in Fig. 1, which presents the time series of yearly aggregated assets to liabilities ratio for SMEs (blue line) and large firms (red line), there is not a systematic difference between the trends in this ratio of SMEs and large firms during the sample period analyzed in this paper.

To reconcile the similarity in trends of assets to liabilities ratio in Fig. 1 for SMEs and large firms, and asymmetric impacts of macroprudential policy and persistence of uncertainty on leverage (financial debt to total assets) of SMEs and large firms reported in Tables 3 and 4, we.

Re-estimate the models with financial debt to total liabilities ratio as the dependent variable instead of corporate leverage (financial debt to total assets ratio). This analysis enables us to assess the impact of macroprudential policy and persistence of uncertainty on the share of financial debt in total liabilities of firms. Estimations for full sample and firm size classifications based on net sales criterion are reported in Table 5.[10]

The blue line and the red line represent yearly aggregated assets to liabilities ratios of non-financial firms in CBRT database from 2007 to 2015 for SMEs and large firms, respectively. Firms are

[8] In order to identify whether variables of interest are significant or insignificant due to its interaction with size or not, we re-estimated all alternative model specifications using all combinations of uncertainty, persistence of uncertainty and macroprudential policy variables with and without interactions terms. Results show that the relationships are not due to their interactions with size. All alternative model specifications are not reported in the study due to space limitations, however, they are available from the authors upon request.

[9] For robustness, another classification scheme based on number of employees is also used. In this approach, a firm is classified as an “SME” if its number of employees is less than 250, and “large” otherwise. Since the results based on this classification scheme are in line with those based on net sales, they are not reported in the paper but available upon request from authors.

[10] Estimations for firm size classification based on number of employees are in line with those reported in Table 5. To conserve space, these results are not reported in the study. However, they are available from the authors upon request.

Table 3
Corporate leverage, macroprudential policies and uncertainty.

	Financial Debt/Total Assets														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Lag of Financial Debt/Total Assets	0.317***	0.317***	0.317***	0.316***	0.316***	0.317***	0.316***	0.316***	0.317***	0.310***	0.310***	0.311***	0.310***	0.310***	0.311***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
P_UNCI	−0.013***	−0.013***	−0.028***	−0.039***	−0.040***	−0.075***									
	(0.003)	(0.004)	(0.009)	(0.008)	(0.013)	(0.017)									
UNCI		−0.001	0.007		0.002	0.001									
		(0.004)	(0.006)		(0.014)	(0.016)									
MPI			−0.010*			−0.061***									
			(0.005)			(0.020)									
P_UNCI x Size				0.002***	0.002**	0.003***	0.002***	0.002**	0.003***	0.001***	0.001*	0.002***	0.001***	0.001*	0.002***
				(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
UNCI X Size					−0.000	0.000		−0.000	0.000		0.000	0.001		0.000	0.001
					(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)
MPI x Size						0.003***			0.003***			0.002**			0.002**
						(0.001)			(0.001)			(0.001)			(0.001)
Size	0.005***	0.005***	0.005***	0.006***	0.005***	0.005***	0.006***	0.006***	0.005***	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.159***	0.155***	0.344***	0.159***	0.156***	0.376***	0.073***	0.073***	0.070***	0.105***	0.105***	0.102***	0.105***	0.105***	0.102***
	(0.046)	(0.055)	(0.115)	(0.046)	(0.056)	(0.116)	(0.027)	(0.027)	(0.027)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Firms specific controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry specific controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Macroeconomic/economic environment controls	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
Year fixed effects	No	No	No	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes
Sector x year fixed effects	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52,076	52,076	52,076	52,076	52,076	52,076	52,076	52,076	52,076	52,076	52,076	52,076	52,076	52,076	52,076
R-squared	0.870	0.870	0.870	0.870	0.870	0.870	0.870	0.870	0.870	0.872	0.872	0.872	0.872	0.872	0.872

The sample consists of non-financial firms in the confidential database of CBRT over the period 2007–2015. The table presents results from alternative model specifications of dynamic panel model in Eq. (4); $Y_{it} = \alpha_0 + \alpha_1 x\, Y_{it-1} + \alpha_2 x\, P\_UNCI_t + \alpha_3 x\, UNCI_t + \alpha_4 x\, MPI_t + \sum_k \gamma_k F_{k,\,it-1} + \sum_l \beta_l I_{l,\,it} + \sum_m \delta_m EE_{m,\,it} + \sum_n \theta_n X_{n,\,it} + \mu_i + \varepsilon_{it}$, where Y_{it} denotes corporate leverage (financial debt to total assets) of firm *i* in year *t; UNCI*, *P_UNCI* and *MPI* are the variables of interest denoting uncertainty, persistence of uncertainty, and macroprudential policy indices, respectively. Definitions of these variables are given in Section 2.1. Besides, *F* is the vector of firm characteristics while *I* is the industry specific control variables; *EE* denotes the proxies for economic environment and *X* is the macroeconomic control variables defined in Table 1. Robust standard errors clustered at firm level are reported in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Table 4
SMEs versus large firms.

	Financial Debt/Total Assets					
	SMEs			Large Firms		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag of Financial Debt/Total Assets	0.288***	0.288***	0.288***	0.345***	0.346***	0.346***
	(0.013)	(0.013)	(0.013)	(0.015)	(0.015)	(0.015)
UNCI		0.006	−0.012		0.021**	−0.026
		(0.008)	(0.027)		(0.009)	(0.040)
P_UNCI	−0.031***	−0.039***	−0.062**	0.001	−0.025*	−0.057
	(0.006)	(0.013)	(0.026)	(0.007)	(0.013)	(0.041)
MPI	−0.017***	−0.020***	−0.058*	0.012**	−0.000	−0.032
	(0.005)	(0.007)	(0.032)	(0.005)	(0.007)	(0.058)
UNCI X Size			0.001			0.002
			(0.002)			(0.002)
P_UNCI x Size			0.001			0.002
			(0.001)			(0.002)
MPI x Size			0.002			0.002
			(0.002)			(0.003)
Size	0.005***	0.005***	0.005***	0.008***	0.008***	0.008**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Constant	0.457***	0.550***	0.554***	−0.136	0.173	0.171
	(0.087)	(0.161)	(0.162)	(0.106)	(0.173)	(0.174)
Firms specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic/economic environment controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,697	34,697	34,697	17,379	17,379	17,379
R-squared	0.879	0.879	0.879	0.874	0.874	0.874

The sample consists of non-financial firms in the confidential database of CBRT over the period 2007–2015. The table presents results from alternative model specifications of dynamic panel model in Eq. (4): $Y_{it} = \alpha_0 + \alpha_1 x\, Y_{it-1} + \alpha_2 x\, P\_UNCI_t + \alpha_3 x\, UNCI_t + \alpha_4 x\, MPI_t + \sum \gamma_k F_{k,\,it-1} + \sum \beta_l I_{l,\,it} + \sum \delta_m EE_{m,\,it} + \sum \theta_n X_{n,\,it} + \mu_i + \varepsilon_{it}$, where Y_{it} denotes corporate leverage (financial debt to total assets) of firm *i* in year *t; UNCI*, *P_UNCI* and *MPI* are the variables of interest denoting uncertainty, persistence of uncertainty, and macroprudential policy indices, respectively. Definitions of these variables are given in Section 2.1. Besides, *F* is the vector of firm characteristics while *I* is the industry specific control variables; *EE* denotes the proxies for economic environment and *X* is the macroeconomic control variables defined in Table 1. Firms are divided into quartiles based on their net sales, and a firm is classified as "large" if it is in the highest net sales quartile and an "SME" otherwise. Robust standard errors clustered at firm level are reported in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

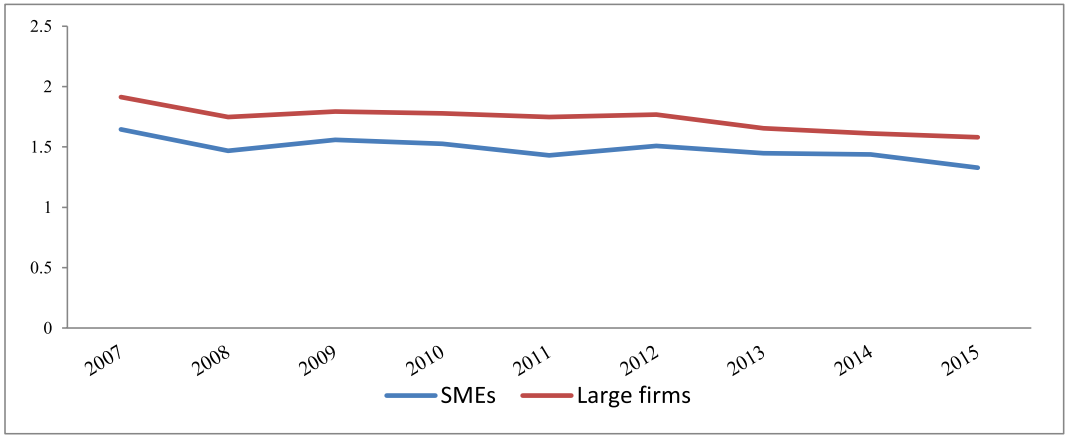

Fig. 1. Assets to liabilities ratio.

divided into quartiles based on their net sales, and a firm is classified as "large" if it is in the highest net sales quartile and an "SME" otherwise.

In column 1 of Table 5, we do find that macroprudential policy and persistence of uncertainty indices are negatively associated with the share of financial debt in total liabilities of all the firms included in the sample while the relationship is positive for interaction terms, *MPI* × *SIZE* and *P_UNCI* × *SIZE*. Furthermore, it is shown that these significant relationships are valid for SMEs (columns 3 and 4) but not for large firms (columns 5 and 6). These results are in line with those reported in Tables 3 and 4 These suggest that both financial leverage and financial debt to total liabilities ratios of SMEs but not large firms are decreasing with the tightening of macroprudential policy and the increase in uncertainty persistence.[11]

[11] Based on previous survey based research (e.g., Mutluer Kurul and Tiryaki, 2016), the negative relationship between leverage and uncertainty for SMEs can be argued as a supply side issue. However, the dataset does not allow us to examine the issue in detail, and we leave it for future research.

Table 5
Corporate financial debt shares, macroprudential policies and uncertainty.

	Financial Debt/Total Liabilities					
	Full Sample		SMEs		Large Firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Lag of Financial Debt/Total Liabilities	0.246***	0.246***	0.215***	0.215***	0.294***	0.294***
	(0.009)	(0.009)	(0.011)	(0.011)	(0.014)	(0.014)
UNCI		0.057**		0.065		−0.049
		(0.023)		(0.040)		(0.059)
UNCI X Size		−0.003**		−0.003		0.004
		(0.001)		(0.002)		(0.003)
P_UNCI	−0.075***	−0.111***	−0.084***	−0.127***	−0.056	−0.053
	(0.018)	(0.023)	(0.029)	(0.037)	(0.053)	(0.062)
P_UNCI x Size	0.003***	0.004***	0.004**	0.005***	0.003	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.003)
MPI	−0.066***	−0.048*	−0.112***	−0.095**	0.011	−0.046
	(0.025)	(0.029)	(0.041)	(0.046)	(0.078)	(0.084)
MPI x Size	0.004***	0.003	0.007***	0.005*	−0.000	0.002
	(0.001)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)
Size	0.010***	0.009***	0.009***	0.008***	0.019***	0.019***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)
Constant	0.363***	0.587***	0.501***	0.791***	0.029	0.270
	(0.089)	(0.158)	(0.119)	(0.218)	(0.149)	(0.243)
Firms specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry specific controls	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic/economic environment controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52,076	52,076	34,697	34,697	17,379	17,379
R-squared	0.837	0.837	0.843	0.843	0.852	0.852

The sample consists of non-financial firms in the confidential database of CBRT over the period 2007–2015. The table presents results from alternative model specifications of dynamic panel model in Eq. (4); $Y_{it} = \alpha_0 + \alpha_1 x\, Y_{it-1} + \alpha_2 x\, P\_UNCI_t + \alpha_3 x\, UNCI_t + \alpha_4 x\, MPI_t + \sum \gamma_k F_{k,\,it-1} + \sum \beta_l I_{l,\,it} + \sum \delta_m EE_{m,\,it} + \sum \theta_n X_{n,\,it} + \mu_i + \varepsilon_{it}$, where Y_{it} denotes financial debt to total liabilities of firm i in year t; *UNCI*, *P_UNCI* and *MPI* are the variables of interest denoting uncertainty, persistence of uncertainty, and macroprudential policy indices, respectively. Definitions of these variables are given in Section 2.1. Besides, F is the vector of firm characteristics while I is the industry specific control variables; EE denotes the proxies for economic environment and X is the macroeconomic control variables defined in Table 1. Firms are divided into quartiles based on their net sales, and a firm is classified as "large" if it is in the highest net sales quartile and an "SME" otherwise. Robust standard errors clustered at firm level are reported in parentheses. Statistical significance at the 1%, 5%, and 10% levels is indicated by ***, **, and *, respectively.

Moreover, in order to examine whether any bias induced by firm entry or exit, we re-estimate all model specifications for the firms that have at least T years of consecutive data, where $T \in [4, 9]$. $T = 3$ corresponds to the original sample analyzed in this paper. In analyses not reported here, no bias due to entry and/or exit of firms is evident in results.[12]

4. Concluding remarks

Despite the importance of the issue, the impact of macroprudential policies and uncertainty on corporate leverage dynamics has rarely been discussed in the literature and evidence is much more limited for emerging economies. In order to provide further evidence to shed some light on this issue for emerging markets, we analyse the impact of MPPs and uncertainty on corporate leverage dynamics in Turkey, one of the most important transition economies by utilizing a confidential and unique firm-level data over the last decade. This study is the first to explore the issue by using firm-level data.

Besides, we argue in this paper that persistence of uncertainty should be a more appropriate factor affecting leverage decisions of firms rather than uncertainty itself. It is reasonable to expect economic agents to get used to uncertainties in a country such as Turkey since they face both domestic and geopolitical uncertainties frequently. In order to assess the validity of this argument we construct a measure of uncertainty and persistence of uncertainty for Turkey. Results from dynamic panel regressions with a large set of control variables in addition to the variables of interest, provide significant evidence in support of the argument that leverage dynamics are affected from the persistence of uncertainty rather than the uncertainty itself. In addition, results reveal that financial leverage ratio as well as the share of the financial debt in total liabilities of Turkish non-financial firms decrease when uncertainty increases persistently and when macroprudential policy tools are tightened by regulators during the sample period. Most strikingly, this is the case only for SMEs but not for large firms.

Findings of this study also provide support for the findings of previous research regarding the financial constraints on SMEs, which limits their potential in the economy. Mutluer Kurul and Tiryaki (2016) report that the credit constraint problem is more severe when firm size is smaller in Turkey by using Business Environment and Enterprise Performance Survey, jointly conducted by the European Bank for Reconstruction and Development and the World Bank. Moreover, Şeker and Correa (2010) point out the smaller growth rate of SMEs in Turkey compared to Central Asia and Eastern Europe and highlight their unrealized potentials in Turkish economy. Results of this study highlight the importance of designing appropriate macroprudential policies and the necessity to broaden the range of external financing instruments available to SMEs as alternatives to the straight bank debt, which help SMEs realize their full potential in the country, and enable them to continue to play their crucial role in investment, employment and

[12] To conserve space, these results are not reported in the paper. However, they are available from the authors upon request.

innovation.

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