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SOVEREIGN RISK AND BANK LENDING: EVIDENCE FROM 1999 TURKISH EARTHQUAKE

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ABSTRACT

We investigate the effect of sovereign risk on credit supply, using August 1999 Earthquake as an exogenous shock leading to an increase in Turkey's default risk. Using data on universe of banks between 1997-2012, we show that, banks with higher ex-ante exposures to government bonds suffered a bigger shock to their networth and decreased lending more ex-post. Tracing the impact of an exogenous increase in the sovereign spread to credit supply, the average bank decreases its credit supply by 1.6 percentage points which corresponds to 55 percent of the actual decline in aggregate loan provision in the aftermath of the shock.

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Sovereign governments mostly borrow from domestic residents (Aguiar and Amador (2013), Tomz and Wright (2013), and Reinhart and Rogoff (2009)). By lending to their own sovereigns, domestic financial institutions expose themselves to sovereign risk. As sovereign default risk increases and sovereign ratings get downgraded, the net worth of banks who hold sovereign debt goes down (Gennaioli, Martin, and Rossi (2014b), Holmstrom and Tirole (1993)). Such an increase in sovereign risk constitutes a direct balance sheet shock to the banks who hold sovereign debt and reduces the eligibility of sovereign bonds as collateral to secure funding. Sovereign risk can also increase endogenously due to weak banks. Governments can backstop the financial system as a lender of last resort, and recapitalize banks post financial crises. Such bailouts can increase sovereign risk (Acharya and Schnabl (2014)). Both channels can underline the well known fact of the coincidence of sovereign crises and banking crises (Reinhart and Rogoff (2009)).

This "diabolic loop" between sovereign and bank credit risk was at the center of the 2009–2012 sovereign debt crisis in the periphery of the euro area. In Greece, Ireland, Italy, Portugal, and Spain, the deterioration of sovereign creditworthiness reduced the value of banks' holdings of domestic sovereign debt. Bank and sovereign CDS spreads started to move together. The presumed solvency of domestic banks was reduced, which directly impacted their lending activity. The resulting bank distress increased the chances that banks would have to be bailed out by their own government, which increased sovereign distress even further. Everyone agrees on the policy urgency for the break-up of this vicious circle or doom loop/diabolic loop.[1]

To this date, there has been no *causal* empirical evidence on this mechanism, where an exogenous shock to banks' balance sheet due to heightened sovereign risk resulting in lower liquidity provision by banks to the private sector. The difficulty in obtaining this evidence lies in three peculiarities of these bank-sovereign doom loop episodes. First and foremost, the shock to the bank balance sheets is never exogenous and mostly anticipated, given the fact that these events unfold together in the midst of a sovereign debt crisis. If

[1]See Farhi and Tirole (2016); Brunnermeier, Garicano, Lane, and Pagano (2015).

banks cause the increase in sovereign risk or banks anticipate a government default, then they can actively manage their balance sheet by buying/selling government bonds and hence we cannot deduce the effect of government bonds on the balance sheet on lending when the value of such bonds go down. Second, the value of the existing government bonds may not change on the bank balance sheet even sovereign ratings go down, if banks are recording all assets at the book value. In this case, the shock to the bank balance sheet may not be observed in the data. Bank will change its behavior in terms of private sector lending given the lower market value of bonds, but the change in the value of the bonds may not be observed on the balance sheet. The econometrician will erroneously attribute this change in lending to another factor or simply conclude that there is no effect of increased sovereign risk on lending through banks' holdings of government bonds. And last but not least, if the troubles in the banking sector and/or increased sovereign risk lead to a recession and increased uncertainty, the demand for credit by private sector will go down. Since we observe in the data the equilibrium loan provision, the decline in loans can simply be due to this recessionary environment rather than the deterioration in bank balance sheets.

This paper investigates the link between government bonds, banks and credit market disruptions using a natural experiment that solves the aforementioned identification issues. Our experiment allows us to investigate the link from government bond holdings to banks' balance sheet health and then to credit supply to real sector. Specifically, we investigate the effect of government debt on banks' performance and credit provision, using administrative portfolio data for the universe of banks in Turkey between 1997–2012. We use the 1999 Marmara Earthquake as an unanticipated exogenous fiscal shock that led to fiscal distress. The earthquake provides us with a fiscal shock that affects the sovereign risk. There was no banking crisis prior or in the immediate aftermath of the earthquake, during our window for the event analysis.

Using a differences-in-differences methodology, we find that banks' with higher exposures to government debt before the earthquake suffered a bigger shock to their net worth and decreased lending more than the banks with lower exposures. Our estimates will be identified from the double difference, i.e., the difference in lending after the earthquake between banks with low and high exposures to government debt before the earthquake. It is not possible that banks accumulate or run down government debt in expectation of the earthquake and hence the unanticipated nature of the shock helps us to rule out moral hazard and/or risk shifting stories in expectation of a default.

Our identification strategy relies on the size and the unanticipated nature of the fiscal shock. In terms of the size of the fiscal shock, the Marmara earthquake is very significant. On August 17, 1999 a big earthquake (at a Richter Scale of 7.6) hit industrial heartland of Turkey, composed of cities such as Kocaeli, Sakarya, Duzce, Bolu, Yalova, Eskisehir, Bursa and Istanbul. The region's population share in country total is 25 percent and GDP share is 50 percent. Total cost of the disaster is estimated to be 20 billion USD, which is 11 percent of GDP as of 2000.[2] To put this event in context, the ratio of damaged buildings (including key industrial/chemical factories) is 4 times higher than 1995 Kobe earthquake and 12 times higher than 1994 Northridge earthquake. The Marmara Earthquake is listed in top ten in the U.S. NGDS Significant Earthquakes database on all earthquakes recorded in history.[3]

We start by showing the increased sovereign risk as a result of the earthquake. The spreads on government bonds go up and maturity gets shorter, indicating an increase in default risk. The government bonds decline in value and constitute a negative shock to banks' balance sheets; more so for the banks with high ex-ante exposure to sovereign debt. To establish the mechanism from the reduced value of government bonds to a negative bank balance sheet shock, we proceed as follows. Bank balance sheets are at book value and hence the decline in the value of government bonds will not be measured by the existing government bond holdings that are not marked to market. To remedy this problem, we make use of the accounting practices of the Turkish banking system during that period, that is recording any loss from any asset in a separate line item called "valuation". We show that

[2]See Akgiray and Erdik (2004) and National Geophysical Data Center, NOAA. doi:10.7289/V5TD9V7K.

[3]National Geophysical Data Center / World Data Service (NGDC/WDS): Significant Earthquake Database. National Geophysical Data Center, NOAA. doi:10.7289/V5TD9V7K provided in National Oceanic and Athmospheric Administration available at http://www.ngdc.noaa.gov.

banks with higher ex-ante exposure enter a loss into this item relative to the banks with lower ex-ante exposure to such government bonds after the earthquake. Since we separately condition on the loss in the value of assets due to non performing loans, this shows a direct negative shock to the net worth of the bank as a result of high exposure to government bond market.

Our results are statistically and economically significant. Our estimates imply that, a bank that holds 75 percent of its assets in government bonds decreases credit provision 2 percent during regular times (a normal time crowding out effect) and 6 percent during earthquake relative to respective means. We measure credit provision by stock of loans to assets so these are sizeable affects (mean loans to asset ratio is 30 percent). The actual decline in loan provision is 3 percentage points during the earthquake period. A bank with mean bond holdings (20 percent of its assets) will decrease loan supply by 1.6 percentage points and hence our estimates can explant 55 percent of the actual decline in credit provision from July to October 1999, on average.

Our estimates trace the impact of a 100 basis point increase in sovereign spreads, which was the observed increase during the earthquake period, on banks' credit supply. Although this is not a big increase and pales in comparison to the observed increases in spreads during the actual emerging market sovereign debt crises, such as the Turkish one of 2001–2002, we believe this is still a useful exercise to provide an *exogenous* lower bound on the effect of default risk on credit provision. Altavilla, Pagano, and Simonelli (2015), shows that a 100-basis-points rise in government yields in periphery countries during the summer of 2010 is associated with a 9 percent decrease in the lending of the bank who holds the median level of sovereign bonds. Our estimates are comparable to theirs.

Although we use an exogenous fiscal shock, there are still other threats to identification. It can be the case that banks who hold more government securities on their balance sheets were affected from earthquake more since, by coincidence, they lend in the earthquake region more, for example. This is not plausible in our case, given the extent of the region affected by the earthquake, where every bank in our data set has a big presence in terms of lending.

Being the industrial and financial heartland of Turkey, the headquarters of all but 4 banks were located in the Marmara Region, where the remaining were the state-owned banks with headquarters located in Ankara. Of course, it can still be the case that the customers of the banks with high exposure to government debt pre-earthquake, reduce their demand for credit more post-earthquake. Given the lack of a recession in the region and also countrywide, we feel that this is not likely. In fact investment demand must increase in the earthquake region given the higher expected return on the destroyed capital stock.

In order to make sure that our results are not driven by a time varying bank specific demand effect, where banks with higher exposure to government holdings also face with lower demand in the aftermath of the earthquake for unobserved reasons, we proceed with two more analysis: First one is the use of foreign banks. For foreign banks we have their lending in Turkey and also outside of Turkey and we show that as a result of a balance sheet shock via holdings of Turkish bonds, these banks reduce their lending outside of Turkey. The estimated coefficient is very similar to our benchmark coefficient, which provides more support for the size of our balance sheet shock. Second analysis relies on data from the loan officer surveys. The benefit of these surveys is that we can find out changes to bank specific customer demand. The caveat is that these are undertaken after our earthquake period. So we will assume the information also applies to our period. From each bank we have the surveys on customer demand for every quarter, where the survey reports the changes in customer demand. We show that these reported changes move slowly from quarter to quarter and our bank level loan data is monthly. As a result we can account for the slow moving bank specific demand for each bank by bank-quarter fixed effects. This is a very restrictive specification but nevertheless we obtain a similar estimate when we undertook this analysis.

Finally, the exposure to government debt is not random. There is an extensive literature on the reasons of holding one's own government's debt. In general government bonds are the main source of liquidity and high quality collateral for banks.[4] Hence, sovereign debt is like

[4] Holmstrom and Tirole (1993).

any other assets with risk-return features and comove with other asset holdings. Though, government debt is also open to regulatory arbitrage and excessive leverage given the risk free nature of it.[5] A corollary to this is the theory of financial repression/moral suasion. When there are government policies that require banks and other financial intermediaries to hold more government bonds, and if these policies change over time, then they will affect the time variation in government bond holdings of banks. In fact, Chari, Dovis, and Kehoe (2016), shows that financial repression can be optimal if governments cannot commit to repay their debt. These authors show that the government finds it optimal to force banks to hold government debt during times in which its fiscal needs are unusually high. Their argument can explain the increase in government bond holdings of Turkish banks during a series of external shocks in 1990s (e.g. Russian crisis) that led to an increase in the fiscal need of Turkish government. This is exactly why we use the unanticipated fiscal shock (earthquake) to identify the balance sheet effect during an era of financial repression since government cannot undertake "additional" financial repression anticipating its' future fiscal need via the earthquake. Our identification centers on a tight window of two months following the earthquake and falls short of using the whole quarter since then there is enough time that government can put extra pressure on banks.

There might also be unobserved bank characteristics that are correlated with bond holdings and these unobserved characteristics might affect bank performance upon the realization of any fiscal shock even the shock is unanticipated. To the extent that such characteristics are not varying over time, such as being a state owned bank or a small poorly capitalized bank, our bank-fixed effects framework will absorb them.[6] The time-varying characteristics,

[5]See Broner Fernando and Ventura (2010) and Acharya and Steffen (2015). Using data from Bankscope on emerging market banks and defaults, Gennaioli, Martin, and Rossi (2014a) find support for government bonds providing liquidity, while Acharya and Steffen (2015) show support for a carry trade behavior of banks of different sovereigns in the European context. Angelini, Grande, and Panetta (2014) argue that, in the case of Italy, there was no build up in advance or during the period where spreads have risen on Italian bonds. There has been a growing literature on repatriation of public debt back home with heightened sovereign risk, meaning banks holding their own sovereign's debt (bank home-bias), in the light of the recent European crisis. See Brutti and Sauré (2013).

[6]Buch, Koetter, and Ohls (2013) show substantial heterogeneity in the sovereign bond holdings of German banks that can be explained by fixed bank characteristics (slow moving) such as being large and/or poorly capitalized.

such as cash holdings and interbank balances, we control for explicitly. We also show that the characteristics that determine government bond holdings do not have any differential affect on government bond holdings before and after the earthquake. This exercise shows that even banks with low capital ratios hold more government debt, they did not increase their holdings in anticipation of the earthquake or during earthquake, as expected given the unanticipated nature of the earthquake. As long as there are no systematic differential prior trends in our key outcome variables by high and low exposure banks pre-earthquake, our identification strategy will be valid. To verify this, we run placebo regressions with several fake earthquake dates, showing no prior trend difference in loan supply by high and low exposure banks.

We proceed as follows. Section I presents a brief review of the literature. Section II discusses the economic background of Turkey. Section III presents a conceptual framework. Section IV lays out the identification methodology. Section V presents the data. Section VI undertakes the empirical analysis and Section VII concludes.

I Related Literature

We contribute to the broad literature that relates the sovereign debt crises to private sector access to credit. Arteta and Hale (2008), for example, find evidence of a decline in foreign credit over the period between 1984 and 2004 for 30 emerging markets in the aftermath of a sovereign debt crisis that these countries experienced. Borensztein and Panizza (2009) finds that probability of a banking crisis conditional on a sovereign default is much higher then the unconditional probability, whereas probability of default conditional on banking crisis is only slightly higher. Reinhart and Rogoff (2009) finds the opposite result that banking crises are the most significant predictors of defaults.

Our paper is specifically on the transfer of fiscal stress to real sector via the financial sector. The existing literature focuses on the rise in sovereign spreads and/or actual defaults as the sovereign shock. An increase in sovereign spreads and the higher correlation between sovereign CDS spreads and bank CDS spreads can be driven by other factors, which also drive bank fragility. As sovereign bonds yields raise and sovereign ratings deteriorate, cost of borrowing increases for banks as the value of key collateral, i.e. the sovereign bonds, drops. If the initial rise in spreads is not exogenous, in terms of anticipation and correlation to bank fragility, it will be hard to disentangle transmission from sovereign bond markets to banks' balance sheet health and their ability to supply credit.

There are other papers that also focus on the balance sheet channel. Bofondi and Sette (2013) and Gennaioli, Martin, and Rossi (2014a). Both papers look at the effect of sovereign debt crises/defaults on lending to real sector. Bofondi and Sette (2013) interpret their finding on reduced credit supply as a "lender-of-last-resort" shock, since they do not find any differential results based on bank characteristics but rather they find a country effect. Gennaioli, Martin, and Rossi (2014a), on the other hand, find that banks who hold more government bonds during normal times for liquidity reasons cut lending more during defaults. Using data from a wide array of past emerging market sovereign defaults, Gennaioli, Martin, and Rossi (2014b) shows a negative relation between bank lending and holdings of sovereign bonds during default episodes.

In the European context, Popov and Van Horen (2015) and De Marco (2014) show that after the start of the euro area sovereign debt crisis, banks from non-stressed countries with sizeable exposures to stressed sovereign debt reduced their syndicated lending more than non-exposed banks. Acharya, Eisert, Eufinger, and Hirsch (2015) combine syndicated loan data with company-level data, to investigate the real effects of the loan supply contraction triggered by the sovereign crisis. These studies in general uses limited EBA stress test data for banks' sovereign exposures. Altavilla, Pagano, and Simonelli (2015), uses confidential ECB monthly exposure data for a longer time span and also finds a sizeable balance sheet effect for banks who were exposed more to sovereign risk.

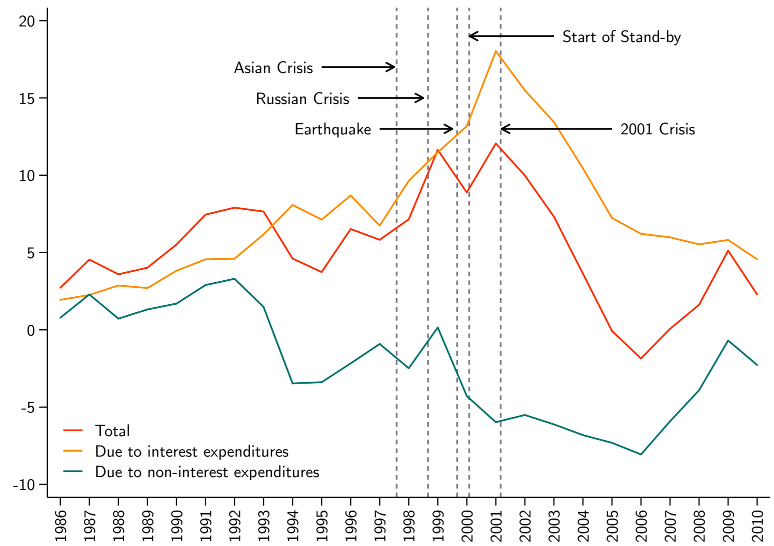
Our paper is different from all the above papers, not only because we have regulatory filings of banks' sovereign exposure data for a long period of time for Turkey, but mainly because we have an exogenous increase in sovereign risk, where all of the empirical papers in the literature undertakes their analysis in the middle of the sovereign debt crisis. Hence our paper provides causal evidence on the balance sheet channel and shows that the mechanism goes through balance sheet health to explain how banks with higher exposures to government debt reduce their credit supply during times of fiscal stress.

II Country Background

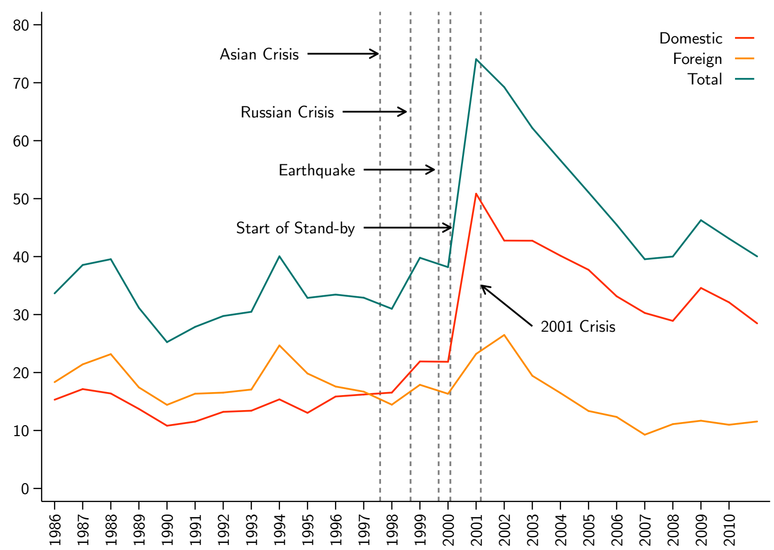
A series of events in 1990s, such as Asian Crises and Russian Crises, led to an increase in public sector borrowing requirement in Turkey. Figure 1(a) plots the public sector borrowing requirement which is akin to consolidated budget deficit. In the light of growing interest liabilities, primary budget records a surplus as an attempt to keep fiscal situation sustainable. As shown in Figure 1(b), domestic debt was the culprit for high debt/GDP ratio during this period, while external debt was more manageable.

While Asian Crisis in 1997Q3 constituted the first shock to Turkish banks that borrow internationally, the major shock was observed in 1998Q3 when Russia devalued its currency and defaulted on its debt. During this period, the banking sector's portfolios gradually shifted towards the domestic government debt. The changes in the government's financing needs and the increase in the return on holding government debt made the domestic government debt instruments attractive for the banking sector. As a result, Turkish banking sector's government bond and bill holdings as a ratio of total credit extended to non-financial sector doubled within two years, as shown in Figure 2 that plots this ratio for the average bank.

Figure 3 plots the share of government securities in bank's total assets for the average bank and for the aggregate, where the aggregate behavior is driven by the large banks. It is clear that there is no significant difference between large banks and small banks until the 2001 crisis, where in the eve of this crisis, both increased their exposure—large banks much more so—to government debt, consistent with moral hazard stories as in Acharya and Steffen (2015). As shown in Figures 14(a) and 14(b) (online appendix), there seems to be more of



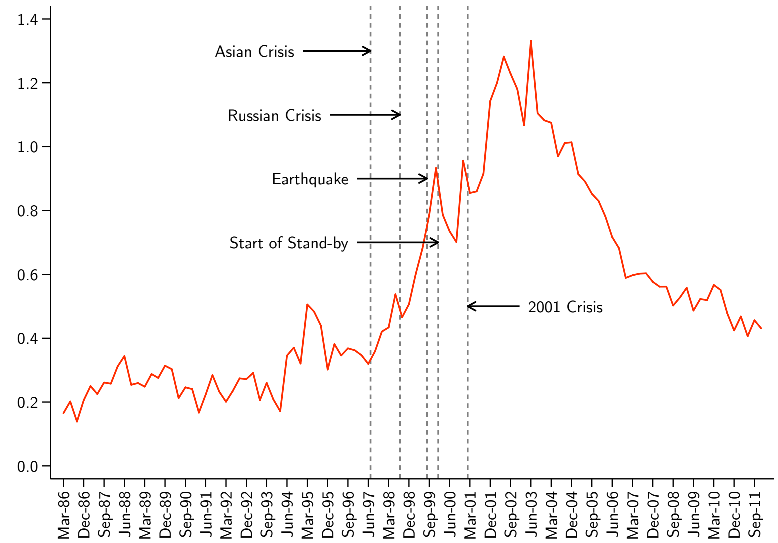
(a) Public Sector Borrowing Requirement/GDP (%)



(b) Debt/GDP (%)

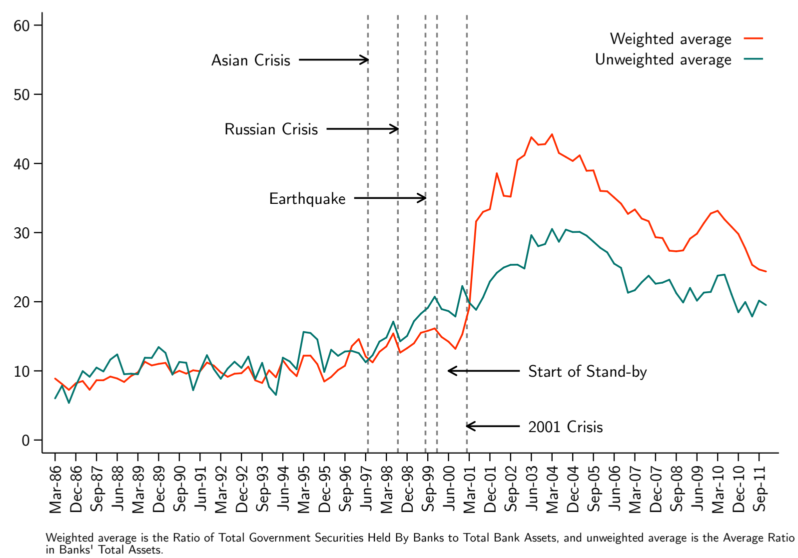
Source: CBRT.

Figure 1: Evolution of Public Sector Debt in Turkey



Source: CBRT.

Figure 2: Government Bond Holdings/Credit to Non-Financial Sector



Source: CBRT.

Figure 3: Government Bond Holdings/Total Assets: Aggregate vs Average

an increase in holdings of government debt for the very large banks, which increased their exposure right up until the 2001 crisis.

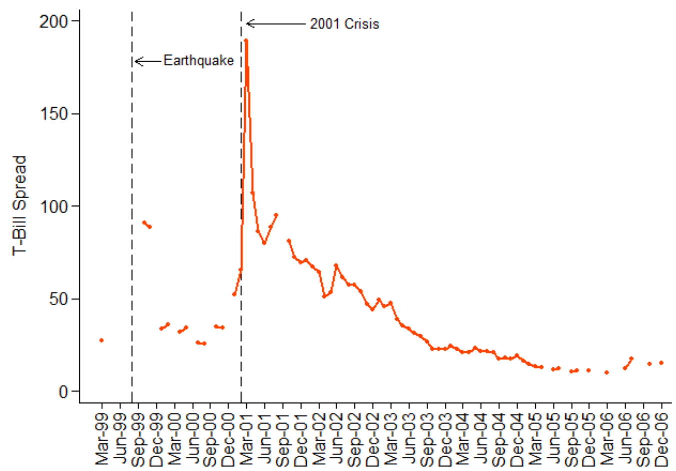
The tipping point for the sustainability of the Turkish government's debt has occurred in August 1999, when the Turkey was hit by one of the largest earthquakes in world history in terms of the number of causalities and as well as the economic cost. The event increased the concerns on the debt sustainability and paved way to a Stand-By agreement with IMF. As shown in Table I, the borrowing cost for government and default risk has increased sharply as a result of the earthquake. Table shows approximately a 10 percentage point increase in 3 month coupon yields of floating T-bills after the earthquake, Table also shows the EMBI+ spread increased 100 basis points over a 3 month period after the earthquake. The rise of 100 basis points is maybe small in an emerging market context but not in general: Italian spreads have increased 200 basis point between July and September 2011, which is the most elevated point of sovereign risk.

Figure 4 plots percentage point spread of 3-month Turkish Treasury Bill over the US Treasury Bill, again showing almost half of the rise in spread during the 2001 crisis was observed during the earthquake. Figure 5 shows an increase from 20 to 50 percent in the share of short term borrowing in total borrowing of government after the earthquake. Notice that this share gets close to 100 in the wake of the 2001 crisis, as typical in EM crisis.

The 1999 Marmara earthquake played a crucial role for the perceptions on the sustainability of the public debt. The earthquake brought about a total cost estimated to be around 20 billion USD, i.e. roughly 11 percent of the GDP at year 2000 current prices. These costs consist of infrastructure expenditures, tax revenue losses, production losses and the contingent liabilities resulting for the government.[7] High government debt exposure of the banking sector was accompanied with almost non-existent corporate bond market and equity market exposure implied limited diversification.

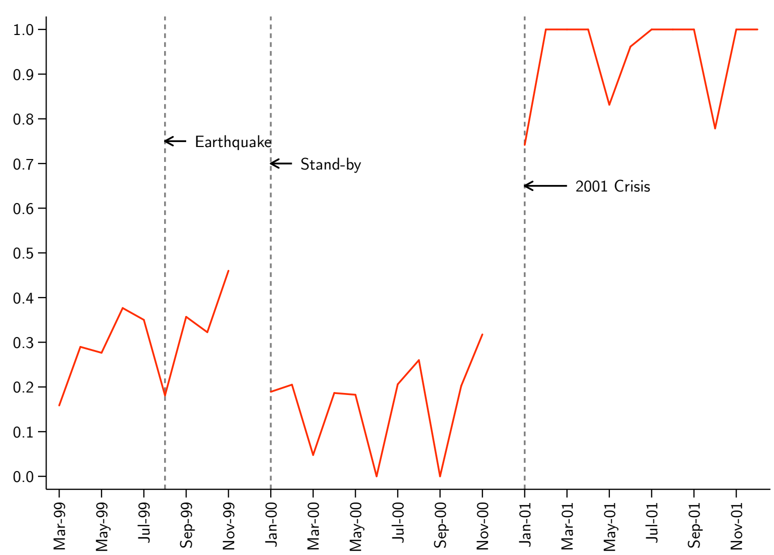
A particular question regarding to the earthquake, which is important for our identi-

[7]See Akgiray and Erdik (2004) for the estimated economic cost of the earthquake.



Source: CBRT.

Figure 4: Spread of 3-month Turkish bill over 3-month US-T bill



Source: CBRT.

Figure 5: Ratio of Short Term Borrowing in Total Government Borrowing

fication strategy, was whether it led to significant changes in the non-performing loans in the region. According to CBRT, the estimated credit risk to the total banking sector in the earthquake region for 1999 was 1.5 billion USD, of which about 60 percent were private bank credits and 40 percent were public bank credits. Despite the perceptions of increased default probabilities and the credit rescheduling needs in the region, the total amount of rescheduling as of August 2000 was only 26 million USD in the earthquake region, i.e. only the 1.6 percent of initial estimate of the perceived risk for the earthquake region. In other words, there was no evidence of wide spread defaults in the region and neither a region wide or country wide recession during this period as shown in Figure 15 (online appendix), where recession periods are shaded which are outside the period of earthquake.

On December 9, 1999, the Government and the CBRT announced the program aiming at reducing inflation and restoring the fiscal balance, which involved a 36-month Stand-By agreement with the IMF. Relative to the pre-program period, the Stand-By Program brought about a rapid decline in inflation and interest rates, and a significant improvement in the primary fiscal surplus, leading to a lower ratio of debt to GDP and public sector borrowing requirement. On the other hand, the weaknesses in the banking system and the political uncertainties undermining the credibility of the structural reform agenda brought about concerns on the sustainability of the program in 2000Q4. The official collapse of the Stand-By Program, triggered by a political crises, took place in February 2001, resulting in the free-float of Turkish lira after a sharp devaluation as well as a rapid surge in the inflation rates, nominal interest rates on government debt and one of the largest contraction episodes in the economic activity in Turkey. This also resulted in a substantial financial crises associated with a collapse of a number of private banks.

III Conceptual Framework

We will adopt a multi-period version of the two-period model of bank lending by Khwaja and Mian (2008). In period t, bank i's lending is L_{it}. The bank funds itself via deposits,

D_{it} and also via other instruments such as bonds, B_{it}, with a marginal cost of α_B. Deposits until an amount $\bar{D_{it}}$ are costless. Bank has a marginal return on loan given by $r - \alpha_L L_{it}$. This captures increasing monitoring costs with each loan. r is the fixed interest rate. Hence the bank's balance sheet is given by $D_{it} + B_{it} = L_{it}$.

In the next period, bank faces a deposit supply shock and a credit demand shock. Hence deposits in the next period are:

$$\overline{D}_{it+1} = \overline{D}_{it} + \bar{\delta} + \delta_i \tag{1}$$

where $\bar{\delta}$ represents a common shock to all banks and δ_i represents a bank-specific supply shock. The credit demand shock will affect the marginal return on loan as:

$$\text{marginal return on loans in } t+1 = r - \alpha_L L_{it} + \bar{\eta} + \eta_{ij} \tag{2}$$

where $\bar{\eta}$ represents a common shock to all demand and η_{ij} represents a bank-specific demand shock from its customer j.

Using the equilibrium conditions and subtracting FOCs in two adjacent periods, we have:

$$-\alpha_B \Delta B_i = \alpha_L \Delta L_i - \bar{\eta} - \eta_{ij} \tag{3}$$

Rearraging terms, we obtain:

$$\Delta L_i = \frac{\alpha_B}{\alpha_B + \alpha_L}\left(\bar{\delta} + \delta_i\right) + \frac{1}{\alpha_B + \alpha_L}\left(\bar{\eta} + \eta_{ij}\right) \tag{4}$$

Which can be re-grouped into economy-wide shocks and idiosyncratic shocks:

$$\Delta L_i = \frac{1}{\alpha_B + \alpha_L}\left(\alpha_B \bar{\delta} + \bar{\eta}\right) + \frac{1}{\alpha_B + \alpha_L}\left(\alpha_B \delta_i + \eta_{ij}\right) \tag{5}$$

Or alternatively:

$$\Delta L_i = \frac{1}{\alpha_L + \alpha_B}\bar{\eta} + \frac{\alpha_B}{\alpha_L + \alpha_B}\Delta D_i + \frac{1}{\alpha_L + \alpha_B}\eta_{ij} \tag{6}$$

In a multi period version we can write the above equation as:

$$L_{it} = \frac{1}{\alpha_L + \alpha_B}\bar{\eta} + \frac{\alpha_B}{\alpha_L + \alpha_B}D_{it} + \frac{1}{\alpha_L + \alpha_B}\eta_{ijt} + \frac{1}{\alpha_L + \alpha_B}\alpha_i \tag{7}$$

The first term represents common shocks for all banks, such as the aggregate macroeconomic shocks, and hence can be captured in the empirical analysis by a time fixed effect. The second term is idiosyncratic to the bank and time varying in a multi-period setting. The interpretation of this term is a bank specific change to net worth or deposits. Third term is bank specific demand effect from customer j, which can also vary across time and finally last term is a bank fixed effect.

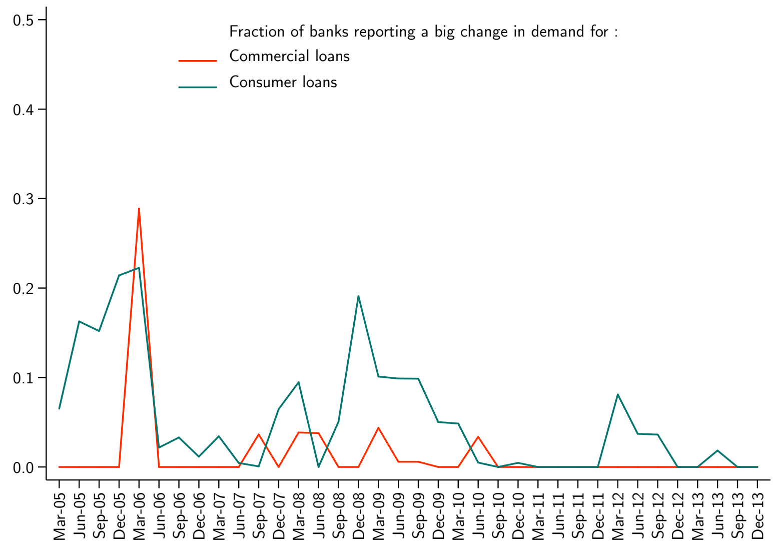
IV Identification and Measurement

Based on the above framework, we estimate the equation below:

$$\begin{aligned} L_{it} = {} & \alpha_i + \lambda_t + \omega_{iq} + \beta_1 Gov\ Debt\ Exp_{it-1} \\ & + \beta_2 Earthquake_t \times GovDebtExp_{it-1} + \beta_3 X_{it-1} + \epsilon_{it} \end{aligned} \tag{8}$$

where i is bank, t is month and α_i and λ_t stand for bank-fixed effects and month-fixed effects, which control for the time-invariant unobserved heterogeneity across banks and all common shocks to the banks (including direct effect of the earthquake), respectively. ω_{iq} controls for loan demand (η_{ijt} in the above framework), where q stands for quarter.

We do not have loan level data and hence we do not have customer j level variation. We argue that we can capture the first order effect of bank specific customer demand η_{ijt}



Source: CBRT.

Figure 6: Fraction of Banks Reporting a 25 Percent Change in Credit Demand

by ω_{iq}. Our reasoning for this control is based on the loan officer survey data provided by CBRT. Each bank undertakes such a survey since 2005 that suggests that firms' demand for loans move very slowly as shown in Figure 6. We assume that this was also the case during the earthquake period. Our assumption is supported by the fact that the firm-bank relationships in general have a very sticky nature even the US that has developed financial markets.[8] Hence, given the monthly nature of our bank level data, the bank-quarter fixed effects will absorb slow moving firm-bank specific demand.

The outcome of interest, L_{it}, is banks' lending. We measure the loan supply with credit provision normalized by assets, that is, share of credit to non-financial firms in total assets. We measure the government debt exposure, $Gov\ Debt\ Exp_{it-1}$, by ratio of banks' government security holdings to total banks' assets. As explained above, β_2 gives us how the outcomes of banks with low and high exposure to government debt differ before and after the exogenous shock. In order to assure that we do not capture the effects of other events that might have

[8]For example, see Chodorow-Reich (2014).

affected the sustainability of the government debt differentially, we also control interactions of government debt with the other major events that happened before and after the 1999 Marmara Earthquake, such as Asia Crises, Russia Crisis, Stand-by agreement, and 2001 crisis. The direct effects of these events are absorbed by the month fixed effects.[9] We use $Gov\ Debt\ Exp_{it-1}$, lagged 1 month, 2 month and 3 months to check robustness of our results since we will define the "Earthquake" period with a dummy equals to 1 for August-November 1999. Other bank-time varying factors are included in X.

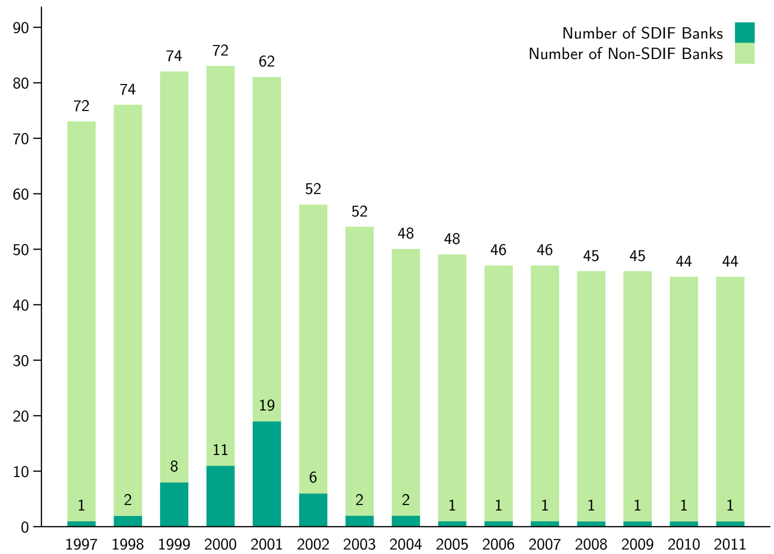
V Data and Descriptive Statistics

We use administrative monthly bank balance sheet data from Turkey for 1997–2012 period. This data is collected regularly as part of the *Monitoring Package*, which is the data collection and processing system for monitoring and regulation purposes. All the banks operating within Turkey are obliged with reporting their balance sheets as well as extra items by the end of month to the regulatory and supervisory authorities, such as the CBRT and the Banking Regulation and Supervision Agency (BRSA). We also use the extra reporting of the banks, such as the decomposition of the banks' securities portfolio including the information on which particular securities are held by banks by the end of each month, net positions against domestic and foreign creditors and the currency denomination of assets and liabilities through interbank operations.

The banks in our sample are all banks operating within Turkey, regardless of the ownership status or the classification with respect to the main activity-such as deposits banks or investment banks.

In terms of bank entry and exit, the Turkish banking industry has experienced important variations over time as shown in Figure 7. While there were 49 banks (6 of which being state-

[9]We define the crises and other dummies as follows. The Asian crisis is a binary variable equal to 1 between July 1997–December 1997. The Russian crisis is a binary variable equal to 1 between August 1998–January 1999. The earthquake is a binary variable equal to 1 between August 1999–November 1999. The Turkish crisis is a binary variable equal to 1 between February 2001–December 2001.



Source: CBRT.

Figure 7: Bank Entry and Exit

owned deposit/savings banks) in 1986, the number of banks reached 82 (4 of which being state-owned deposit/savings banks) by the end of 1999. However, in 1999–2003 period, the number of banks has declined substantially due to the series of events including the financial crisis in 2000–2001 period. In particular, if the regulatory agency observes a private bank to experience a decline in its capital adequacy ratio resulting from losses due its operations, then the bank is asked to add new capital and to improve the balance sheet quality. However, if the bank fails to take necessary actions and bank's capital adequacy ratio falls below the legal limit, then its control is taken over by SDIF to provide immunity to the depositors as well as to limit the risks to the banking system. In the aftermath of the 2001 crises, the weak capital structure of the Turkish banks resulted in a number of takeovers. As a result, in 2000–2004 period, a total of 25 banks were taken over by SDIF. Also, a number of mergers and acquisitions resulted in a decline in the number of private banks in Turkey in the post-crises period, resulting in a total of 45 banks operating in Turkey as of end of 2011.

Table II presents the key descriptive statistics of our banks. We observe a significant cross-sectional heterogeneity with respect to holdings of government securities in banks' balance sheets, where mean is around 18-20 percent depending on the period and it can be as high as 46 percent.[10] Table III presents key macro indicators.

VI Empirical Analysis

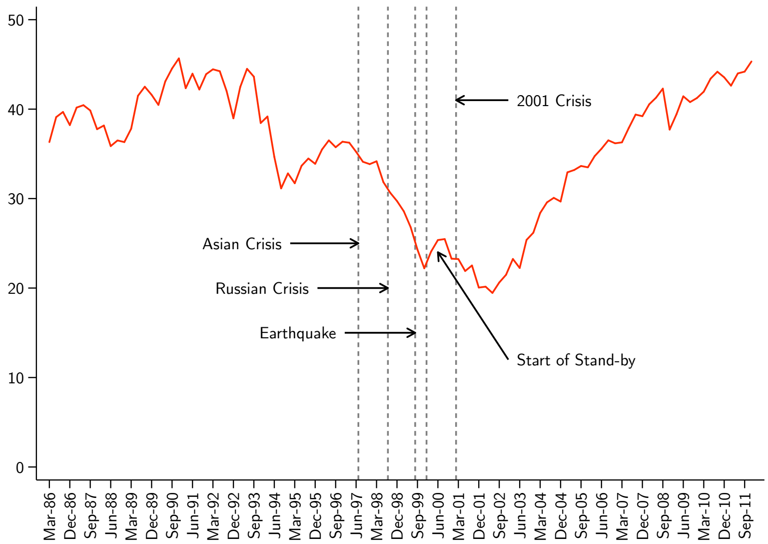
Figure 8 presents aggregate data, plotting credits to non-financial sector as a ratio to total assets of the financial sector, where this ratio falls to 22 percent from approximately 36 percent during the events starting with Asian crisis. This figure mimics our previous Figure 2 where we show typical bank also decreases credit to non-financial sector during this period, increasing loans to government sector by similar amounts. Our analysis below recovers that during this period where credit to private sector declined as a resulting of a crowding out effect coming from government borrowing, there is an additional effect of an unanticipated fiscal shock. The banks who were exposed more to government debt and hence affected more from this shock, decreased their lending to private sector even more. We interpret this finding as the evidence for the balance sheet channel.

Another important observation for our identification is the fact that there was no visible change in government bond holdings post earthquake. Table IV present the average ratios for government securities to assets and loans to assets before and after the earthquake. It is clear that average exposure to public debt stayed around the same but average credit provision declined.

A The Banks' Balance Sheet Health and Credit Provision

We identify how banks' performance in terms of net worth and profits and their credit provision are affected from government debt exposure by comparing banks with different

[10] For a world-wide sample of banks, the average for government debt holdings to assets is 12 percent and for German banks it is 15 percent. See Gennaioli, Martin, and Rossi (2014a) and Buch, Koetter, and Ohls (2013), respectively.



Source: CBRT.

Figure 8: Lending to Private Sector as a Ratio of Financial Sector Assets

degrees of exposure before and after the earthquake, which was a sizable and unanticipated fiscal shock experienced in Turkish economy.

Table V runs a simple cross sectional regression by collapsing the sample in two periods as pre- and post-earthquake to highlight the intuition of the exercise. Loans to the private sector as a ratio to total assets for each bank are averaged over the period from August 1999 to November 1999. Similarly government bond holdings as a ratio to total assets for each bank are also averaged over the period from January 1997 to July 1999. This simple cross sectional regression shows a clear reduction in loan supply after the earthquake by the banks who have higher exposure to government bond market before the earthquake. This effect is robust to excluding state owned banks and foreign owned banks as shown in columns (2) and (3) and also robust to excluding both type banks as shown in column (4).

The coefficient varies between -0.4 and -0.6, getting stronger when state and foreign owned banks are dropped from the sample. This of course can be due to variety of selection issues in a cross sectional regression of this sort. In fact, given the cross sectional nature of this exercise, one cannot tell whether the effect is driven by unobserved time-invarying bank characteristics, the inherent negative relation between the loans to government and loans to private sector, that is the crowding out nature of lending to government. We also cannot tell whether our channel, i.e., the balance sheet effect, works via the lower value of government bonds as a result of increased spreads reducing banks' net worth. In fact the estimated coefficient is very high since this estimate probably includes all these effects: A coefficient of -0.6 suggests that a bank who holds 20 percent of its portfolio in government assets (the mean), reduces credit supply defined as loan to asset a mere 12 percentage points, which represents a 60 percent decline in the loan to asset ratio relative to its mean value.

Next, in Table VI, in order to control unobserved time-invarying bank characteristics and also shocks to all the banking system, we run a differences-in-differences specification with bank and month fixed effects, where we keep the bond holdings constant at their level in the month of July 1999, one month prior to the earthquake. Given the bank fixed effects, the non time-varying nature of bond holdings will not allow us to estimate their direct average impact but we can estimate their impact after the earthquake, as shown by the interaction term with an "Earthquake" dummy. This dummy takes a value of one from August 1999 to November 1999, and zero otherwise. Table VI shows that there is a strong negative effect of government debt holdings of pre-earthquake, on credit provision post-earthquake. An estimated coefficient of -0.2 implies a 4 percentage point reduction in loan to asset ratio, which represents a 20 percent decline in this ratio relative to its mean.

Columns (2) and (3) add interaction terms of bond holdings as of July 1999 with Asian crisis and Russian crisis dummies to make sure our "Earthquake" dummy does not proxy effects of these events that took place earlier. "Asia" is a dummy that takes a value of one from July 1997 to October 1997. "Russia" is a dummy that takes a value of one from August 1998 to November 1998. The "Earthquake" dummy effect is robust to these other events. However these other events, though they are not domestic events, also have a negative effect on the loan provision of banks who hold high levels of government debt in July 1999. These events happened before and will not have a direct impact on the value of the domestic debt.

Hence they must be proxying for the general crowding out effect, that is the tendency to have less and less private sector loan provision with more and more lending to government over time due to an increase in the fiscal needs of the government as a result of these external shocks.

In order to deal with this concern, Table VII runs a full panel differences-in-differences specification. This specification allows us to control the direct crowding out effect over time by entering time varying bond holdings into the regression. We introduce other events and their interactions with lagged government bond holdings in addition to earthquake, such as Asian crises, Russian Crises, and the 2001 crises as controls for exploring the differential loan supply effect of fiscal shock induced by the earthquake with respect to banks' government debt exposure. Regardless of whether we control for these events or not, we observe that the banks with higher exposure to the treasury bills faced higher declines in loan supply after the earthquake.

The effect of bond holdings during other events is very intuitive. As conjectured, now there is no significant impact of pre Asian crisis bond holdings during Asia crisis, as opposed to the previous tables since we control the direct effect of bond holdings. We obtain the same result with Russian crisis. These events are external shocks and although they had an effect on Turkish economy, and even on the spreads to a certain extent via contagion fears, they should not have a differential effect on the balance sheet of banks holding high or low levels of Turkish bonds since these events do not constitute a direct fiscal shock to Turkish government's ability to pay its' debt. By the same token we should expect to see a large negative effect for Turkey's own banking, currency, and sovereign debt crisis of 2001. Columns (5) and (6) introduces a "2001" crisis dummy that takes a value of one from December 2000 to December 2001. These columns show a similar negative effect of holding government bonds during the 2001 crisis, where the estimated coefficient is bigger than that of the "Earthquake" dummy interaction, as expected. These columns will be a typical representation of the regression that is run in the literature as we argued above (both historical emerging market sovereign debt crisis and recent European sovereign debt crisis), where the crisis is endogenous. Although both the "Earthquake" period and "2001" Turkish crisis period constitute fiscal shocks and cause a decline in the value of government bonds with the heightened sovereign risk, the earthquake allows us to estimate the causal impact given the exogenous and unanticipated nature of this event.

The last three columns of Table VII control for bank specific demand with bank-quarter effects. As argued above, these effects can capture bank specific demand that moves slower, from quarter to quarter and hence if a certain banks clientele is specifically located in the earthquake region, these effects will capture such clients lower demand during the last quarter of 1999. We can still identify the balance sheet effect thanks to the monthly data where the value of the bonds will be marked down and affect the banks' balance sheets quicker than the changes in demand. Of course, bank-quarter fixed effects make the specification extremely restrictive, absorbing a lot of variation, which is why the estimated coefficients are now much smaller.

The first five columns Table VII define the earthquake period as August-November 1999, whereas column (6) defines it as August-October 1999. The main reason for this alternative definition of the earthquake is that the government unexpectedly imposed a tax on banks' income on government securities holdings on November 26, 1999 to cover the fiscal burden due to the earthquake. This naturally raises the question of whether our results hold even when we disregard this direct tax implication of the earthquake on banks' balance sheets. Hence we define the "Earthquake" dummy in the last column to make sure the tax imposed afterwards.

Our estimates imply that, a bank with the mean holdings, that is 20 percent of its assets are in government bonds decreases credit provision almost 1 percentage point during earthquake. If we add the regular time crowding out effect, the total effect of bond holdings for the bank with the mean holdings becomes 1.5 percentage point. These are much smaller magnitudes than before but given the fact that they are conditional on controlling demand effects and they are still sizeable representing a 5 percent decline in loan to assets relative to the mean. If we focus on a bank at the 90th percentile, who holds almost half of its assets in government bonds, then the total effect of holdings becomes 2.5 percentage point. The actual decline in loan provision is 3 percentage points.[11]

A.1 Non-Random Nature of Bond Holdings

Government bond holdings are not random. Certain banks, like small in size, might hold more government bonds. In this section, we try to understand both the time in-varying and time variant determinants of government bond holdings. As show in Table VIII most determinants of government bond holdings are time invarying such as being a state bank, as shown in column (1). Columns (2) and (3) absorb these time in-varying determinants by using bank fixed effects and column (3) does double clustering for standard errors both at bank and month level to allow for serial correlation. Column (3) still shows that banks who increase their capital ratio over time hold less government bonds in their portfolio over time. Same is true for interbank balances since banks who accumulate higher surpluses on their interbank balances need less government bond holdings as collateral. Banks who accumulate more non performing loans over time also tend to accumulate less government bond holdings over time, which must be due to the fact that these banks lend more to private sector. Banks with more cash also decrease their government holdings over time.

Of course what is important for our identification is whether these determinants of government bond holdings at bank-time level vary systematically at the time of earthquake. Table IX investigates this possibility. As shown in column (2), once we account for all the fixed effects, banks with higher cash holdings than average are the only ones who increase their government holdings at the time of earthquake. This can be associated with risk taking behavior but also with supplying government with the needed funds since these are the stronger banks. Nevertheless we will control for cash holdings at the time of earthquake below for robustness when we investigate the effect of government bond holdings on private sector credit provision. It is clear from this table that, there are no "usual-suspect" deter-

[11]Note that in theory there can be yet another differential effect depending on the maturity structure but all the bonds are less than 14 month maturity in our data given the specifics of that period where Turkish government can only borrow short term both externally and domestically.

minant of bond holdings that change over the "Earthquake" period that can explain our results due to an omitted variable bias.

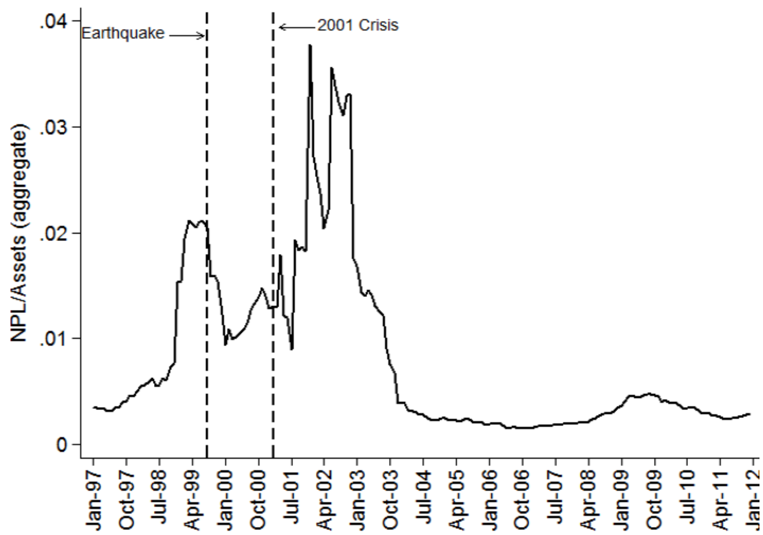
To make sure, in Table X, we control for all of these potential determinants of government bond holdings that may be correlated with loan provision at regular times and at crisis times. Although we know that the most important determinant of government bond holdings during earthquake is cash holdings, we still control each determinant one by one in respective columns. In this table we also use banks that are not taken over by State Deposit Insurance Fund (SDIF) to make sure we guard against the claim that "bad bank will fail anyway." This exercise is important especially if there are concerns about the unobserved confounding features of the banks taken over by the SDIF, which would affect these banks' performance even in the absence of a fiscal shock. Although most of these factors will be taken care for by bank fixed effects and bank-quarter effects, we still run our regressions in a sample of surviving banks throughout the sample period in order not to bias our results.[12] In this table we show that this is not the case. In fact upon using survivors and controlling for bank-time level determinants, we still find the same size coefficient as in our benchmark table.

A surprising result from Table X is the fact that non-performing loans seem to have no effect. This is due to the fact that neither on aggregate nor at the average level, non-performing loans were increasing during the earthquake period; on the contrary, they were on a decline as shown below in Figures 9 and 10 respectively.

B Channel: Valuation and Net Worth Effect

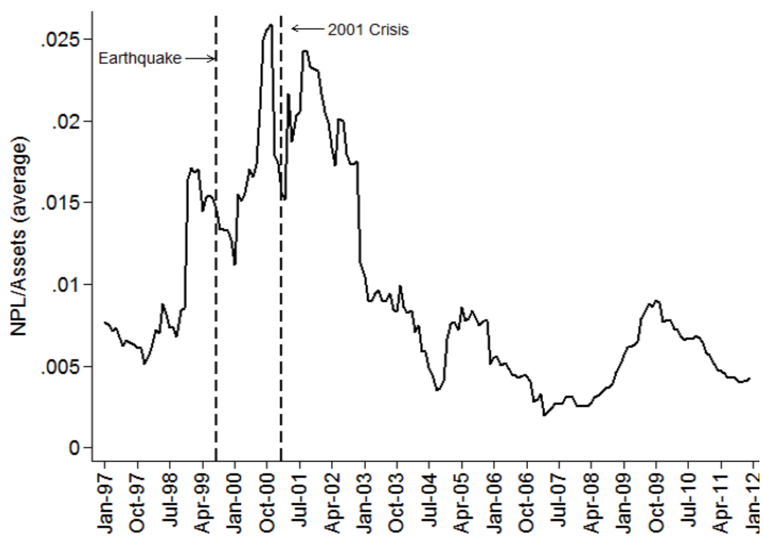
We argue that the channel from the earthquake driven rise in spreads to reduced private sector loan provision goes via the balance sheet deterioration of banks. The banks whose balance sheets were exposed to government debt in large quantities before the earthquake, suffer from a balance sheet shock after the earthquake, due to a lower value of this asset on

[12]Only 8 banks are taken over in 1999, so this is not likely to affect our results. Note that if the claim, "bad banks will fail anyway," is true and we fail to control for this then a diff-in-diff strategy should not give us any result since this strategy identifies off of the relative difference between bad and good banks at the time of the earthquake.



Source: CBRT.

Figure 9: Non-performing Loans to Assets: Aggregate



Source: CBRT.

Figure 10: Non-performing Loans to Assets: Average

their balance sheet, that cause their net worth to go down.

To provide evidence on the channel, Table XI investigates the impact of the earthquake on banks' balance sheet performance by first considering the banks' financial asset valuation changes between current and previous period as a ratio to their total assets (column (1)). Next column investigates the effect on bank net worth and final column on profits. In practice, the banks have to revaluate the value of their portfolio as the prices change since they do not mark their portfolio to market (during our period of study).[13] For the banks which hold the same government security portfolio both at time t and t-1, an increase (a decrease) in the price of the government security induces a revaluation indicating an increase (a decrease) in portfolio's monetary value. We find that the banks with higher share of government securities in their balance sheets had a decline in the value of portfolio, given the decline in the value of this asset with the fiscal shock, as shown in column (1). This evidence is unique and shows first time the direct effect of a decline in the collateral value on bank's balance sheet.

Columns (2) and (3) show that the same shock also constitutes a direct hit to banks net worth and profits for those banks who had higher holdings of government securities before the shock. Although there is a direct negative effect of government bond holdings on valuation and profits (which captures the general trend), this is not the case for net worth as shown in column (2). Hence, it is not necessarily the case that in the absence of the fiscal shock, banks who accumulate more government bonds over time, have declining net worths; these banks do not differ systematically from the banks who reduced their government bond holdings over time in terms of their net worth. However, after the earthquake, the banks who accumulated more before, suffer a bigger decline in their net worth. This is direct evidence for our channel.

In terms of magnitudes, we find that a bank in 90th percentile who holds almost half of its portfolio in government securities, suffers a 2 percentage point loss to the value of its

[13]Notice that the rule of keeping the sovereign bonds in the trading book and marking them to the market value, was introduced to Turkish banks after December 2002 regulation for the banks' accounting standards.

portfolio as a ratio to its assets and a 3 percentage loss in its' networth as a share to its assets. For this high exposure bank, profits to assets go down by 1 percentage point. These are significant effects relative to the mean values of these variables.

C Threats to Identification

C.1 Placebo Tests

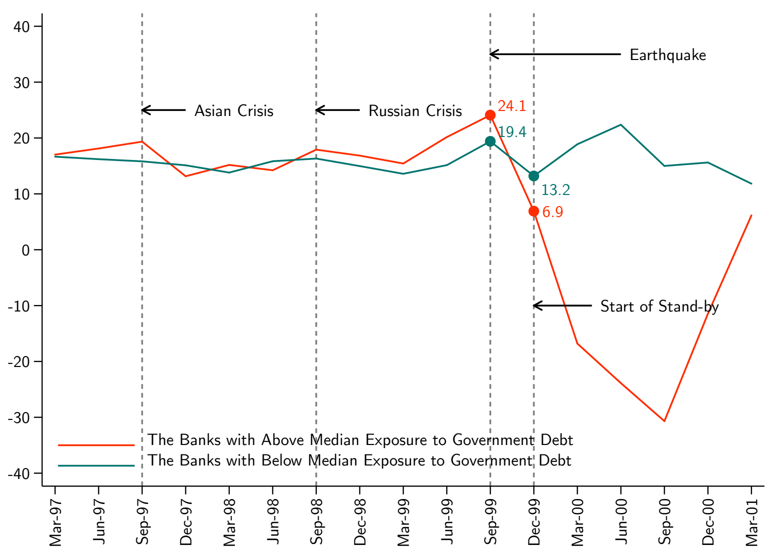
Table XII, column (1) runs placebo tests, where we define a "Placebo Earthquake" as a binary variable equal to 1 between April 1999 and July 1999. Despite the existence of a negative relation between high government debt exposure and lending in normal times, there is no additional effect at the time of our pseudo earthquake. This suggests that the effects we find with the earthquake are a result of increased default risk on the part of government which deteriorated the balance sheet health of banks with high ex-ante exposure and hence negatively affected their lending.

The second column of this table uses the shorter sample until the end of 2002 showing that our results stay intact, though here we obtain a larger coefficient given less time series observations that prevent us from using bank-quarter fixed effects.

Table XIII undertakes an alternative placebo analysis to hedge against the negative demand effect by the firms who were affected from the earthquake iff these firms happen to be borrowing from the banks with higher ex-ante government holdings. We matched the foreign banks (there were 14 of them at the time) operating in Turkey to their balance sheets in Bankscope database and subtract their lending in Turkey from their lending in the region (Eastern Europe), obtaining their lending outside Turkey. The bankscope data is annual/quarterly depending on the foreign bank's filing and our data is monthly so we do a linear interpolation for the missing months. Since this lending will not be affected at all by the earthquake in Turkey, this provides smoking gun evidence that these banks are also affected by their Turkish bond holdings after these bonds lost their value as a result of the fiscal shock. The difference between the two columns is that, in the second column, we also control for their lending in Turkey. Their lending in Turkey and outside Turkey is positively related and these foreign banks do not show the regular time crowding out effect as a result of government bond holdings as the domestic banks. But they still provide less loans outside Turkey after the earthquake if they were exposed to Turkish government bond market relatively more before the earthquake. The magnitude of the coefficient is smaller than our benchmark estimate of 0.03 but not that much.

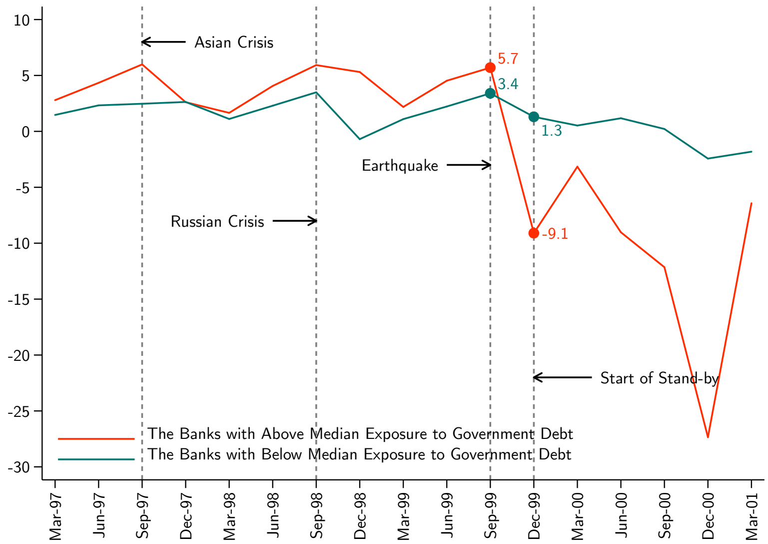
C.2 Prior Trends in Outcomes

A key threat to identification is existence of differential prior trends in our dependent variable. In particular, in order to attribute the corresponding changes in lending to the role of the differences in government debt exposure at the time of the exogenous fiscal shock, one of the issues that we need to check is the parallel movement of the outcome variables for the banks with high and low government debt exposure. The placebo exercise we showed earlier confirms that this is not the case but we still show here the actual trends in the data.



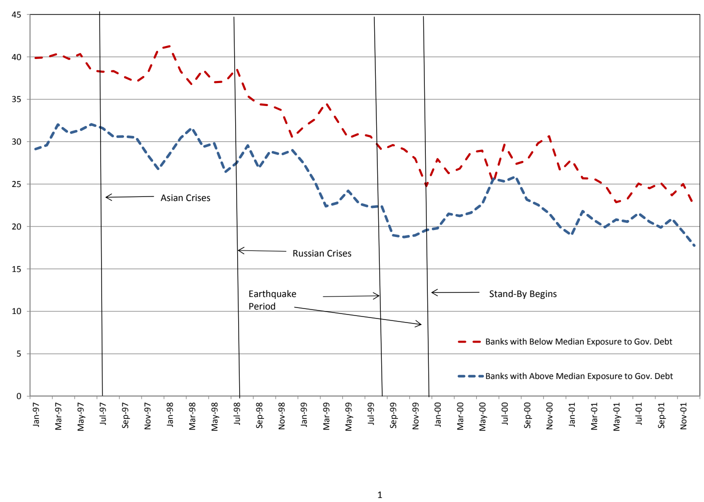
Source: CBRT.

Figure 11: Net Worth of Banks with High-Low Exposure to Government Bond Market



Source: CBRT.

Figure 12: Profits of Banks with High-Low Exposure to Government Bond Market



Source: CBRT.

Figure 13: Loan Provision of Banks with High-Low Exposure to Government Bond Market

In Figure 11, 12 and 13, we present respectively the time series behavior of the net worth, profits and the loan provision of banks with above and below median exposure to the government debt. These clearly indicate that there were no differential prior trends in our key outcome variables, loan provision, net worth, and profits, across high and low government debt exposure banks. In other words, the estimated negative and significant coefficient on the interaction between the government debt exposure and the earthquake variable does not reflect the already existing deterioration in profits, net worth and loan provision of the banks with higher exposure, but rather the impact of the earthquake on the banks' balance sheet performance and the loan provision.

D IV Regressions for Spreads

In this section, we run IV regressions to link the increase in spreads to our exogenous shock, that is the earthquake. The spreads are measured as shown in Figure 6 by the CBRT Auction data compound rate in short term T-bills, minus the US T-Bill rate taken from the IMF.

In the first stage regression, as shown in Table XIV we regress "government bonds×spreads" on "government bonds×earthquake" and use the residuals in the second stage regression of loan to assets, as shown in Table XIV. The first stage regression is very strong, especially when bank-quarter fixed effects are added in second column in its predictive power. The second stage regression gives a strong negative effect of instrumented "holdings×spread" on credit supply.

In terms of the magnitudes, a 100 basis point spread implies a 1.6 percentage point decline in loan to asset ratio for a bank who has the mean level of government bond holdings ex-ante. This amount is 55 percent of the actual decline in loan to asset ratio during this period.

Overall, we show the strong positive effect of an exogenous fiscal shock on spreads and the strong negative effect of the same shock on loan provision, driven by banks who had higher ex-ante exposures to these bonds, which became toxic after the shock. Banks' net worth and profits got hurt as a result of the shock and hence their credit provision have declined.

VII Conclusion

We identify the effect of government debt on banks' balance sheet health and credit provision. We use data from the universe of banks in Turkey during 1997–2012. For identification, we use a rare disaster, the 1999 Marmara Earthquake—one of the largest earthquakes in world history, as a major unanticipated fiscal shock. Using a differences-in-differences methodology, we investigate whether the differences in the degree of banks' exposure to the government debt matter for the effect of fiscal shock on differences in outcomes, such us banks' balance sheet health and loan provision.

Our results indicate that high government debt exposure resulted in a differential decline in the credit provision. We show that the negative differential effect of fiscal shock on the credit provision of the banks with higher government debt exposure works via the balance sheet channel. We trace the effect of earthquake to a 100 basis point increase in spreads and that to a decline in loan provision through the decline in banks' net worth for the banks who had higher exposure to government bond market before the fiscal shock.

Our results provide evidence on the link between fiscal distress and financial imbalances, where the causality goes from fiscal to financial stress impacting the real sector.[14] Using an exogenous rare event which triggered a fiscal shock and an increase in sovereign risk, we identify that the fiscal imbalances has important causal implications for the performance of the financial sector and credit provision. Although our identification is clear, valid and policy relevant, it works only for the link from the government debt to banks' balance sheet health and loan provision. Hence, the caveat is that we cannot say anything for the predictive power of banking crisis on sovereign defaults, which is equally important.

[14] See Perez (2015) who shows big and persistent output loss as a result of the balance sheet channel.

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Table I: Sovereign risk

	(1)	(2)	(3)
	Compounded Interest Rates on Government T-Bill Auctions (Percent)		Turkish Bond-Spreads
	For Bills with Approximately 550 Days to Maturity	For Bills with Approximately 1,050 Days to Maturity	EMBI+
July 1999	117.71	119.91	564
August 1999	123.80	127.62	665

Note: (1) The numbers in Columns 1 and 2 show the annual compunded interest rates on auctions for 3-month coupons for floating rate government bonds of approximately 550 and 1050 days to maturity. (2) Numbers in Column 3 are the end-of month basis-point value of EMBI+ spread for Turkey.

Table II: Descriptive Statistics

	January 1997 - December 2011						
	count	mean	sd	p25	p50	p75	p90
Gov Bond Holdings	10203	0.2145	0.1776	0.0829	0.1698	0.2974	0.4602
Capital Ratio	10199	0.2238	0.2559	0.0943	0.1385	0.2855	0.6311
Loans to Private Sector	10203	0.3161	0.2148	0.1318	0.3106	0.4807	0.6142
Non-Performing Loans	10193	0.0073	0.0131	0.0000	0.0011	0.0076	0.0233
Bank Size	10203	12.4164	2.2023	10.8247	12.4399	13.9221	15.4404
Cash Holdings	10193	0.0065	0.0079	0.0002	0.0046	0.0093	0.0159
Interbank Balances	10193	-0.0892	0.2802	-0.2187	-0.0688	0.0417	0.2155
Valuation	10141	0.1398	0.3823	0.0000	0.0000	0.0377	0.5316
Profits	10199	0.0109	0.0515	0.0016	0.0104	0.0251	0.0564
	January 1997 - December 2002						
	count	mean	sd	p25	p50	p75	p90
Gov Bond Holdings	5153	0.1824	0.1566	0.0690	0.1436	0.2451	0.3975
Capital Ratio	5153	0.1678	0.2511	0.0742	0.1172	0.2306	0.5022
Loans to Private Sector	5153	0.2709	0.1779	0.1270	0.2644	0.3908	0.5063
Non-Performing Loans	5147	0.0091	0.0156	0.0000	0.0012	0.0096	0.0407
Bank Size	5153	12.1259	2.0483	10.6258	12.2497	13.5374	14.8369
Cash Holdings	5147	0.0083	0.0096	0.0005	0.0057	0.0124	0.0198
Interbank Balances	5147	-0.0858	0.2824	-0.2373	-0.0601	0.0588	0.2234
Valuation	5095	0.1068	0.3529	0.0000	0.0000	0.0000	0.1652
Profits	5153	0.0121	0.0636	0.0010	0.0128	0.0348	0.0777

Note: Gov Bond Holdings is defined as the bank's holdings of government bonds in ratio to Total Assets. Capital Ratio is defined as the ratio of Shareholder Equity to Total Assets. Loans to Private Sector is defined as Total Loans to Private Sector in ratio to Total Assets. Non-Performing Loans is defined as (Non-Performing Loans - Provisions on Non-Performing Loans) in ratio to Total Assets. Bank Size is defined as the log value of total assets deflated to 2000 USD using PPI. Cash Holdings is the banks cash holdings in ratio to total assets. Interbank Balances are defined as (Receivables-Payables) from banks (except the Central Bank), in ratio to Total Assets. Valuation is financial assets valuation difference (i.e. loss provision) as a ratio to total assets. Profits are the bank profits in ratio to total assets.

Table III: Selected Macroeconomic Statistics (%)

	1997-2002	1997-2011
Average Annual GDP Growth Rate	2.50	4.29
Average Investment to GDP Ratio	20.55	22.19
Credit to Private Sector to GDP	15.30	19.60
Bank Assets to GDP	53.40	59.10
Public Debt to GDP	48.47	47.50

Table IV: Loans to Private Sector and Government-Bond Holdings Before and After EQ

	Government-bond holdings	Loans to Private Sector
April-July 1999 Average	18.7	26.8
August-October 1999 Average	19.0	24.8

Note: Measures are expressed as a percent of Total Assets.

Table V: Average Bond Holdings and Credit Supply After EQ

	(1) All	(2) Drop State	(3) Drop Foreign	(4) Drop State and Foreign
Avg Gov Bond Holdings Before EQ	-0.378***	-0.400***	-0.597***	-0.641***
	(0.0167)	(0.0170)	(0.0182)	(0.0185)
Constant	0.306***	0.309***	0.387***	0.399***
	(0.00360)	(0.00375)	(0.00399)	(0.00419)
R^2	0.047	0.053	0.127	0.150

Note: Dependent variable is the average value of loans to the private sector in ratio to total assets for each bank over the period from August 1999 to November 1999. Independent variable is the average value of Government bond holdings in ratio to total assets for each bank over the period from January 1997 to July 1999. Sample in column (1) is all banks. Sample in column (2) drops banks that were ever owned by the state. Sample in column (3) drops banks that were majority foreign owned at the time they entered the sample. Column (4) drops both state owned and foreign owned banks. Standard errors are robust. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table VI: Government Bond Holdings in July 1999 and Credit Supply After EQ

(Gov Bond Holdings$_{J99}$)*(Earthquake)	-0.232***	-0.238***	-0.243***
	(0.0118)	(0.0125)	(0.0126)
(Gov Bond Holdings$_{J99}$)*(Asia)		-0.159***	-0.165***
		(0.0216)	(0.0217)
(Gov Bond Holdings$_{J99}$)*(Russia)			-0.119***
			(0.00311)
Observations	9880	9880	9880
R^2	0.683	0.683	0.683
BankFixedEffects	Yes	Yes	Yes
MonthFixedEffects	Yes	Yes	Yes

Note: Dependent variable is loans to the private sector, in ratio to total assets. Earthquake is a dummy that takes a value of one from August 1999 to November 1999. Asia is a dummy that takes a value of one from July 1997 to October 1997. Russia is a dummy that takes a value of one from August 1998 to November 1998. Gov Bond Holdings is the T-Bill holdings of each bank in July 1999. Standard Errors are clustered at bank, month, and state-bank levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table VII: Lagged Government Bond Holdings and Credit Supply After EQ

	(1)	(2)	(3)	(4)	(5)	(6)
Gov Bond Holdings$_{t-1}$	-0.336***	-0.336***	-0.336***	-0.0242***	-0.0182***	-0.0183***
	(0.0118)	(0.0116)	(0.0113)	(0.00151)	(0.00187)	(0.00160)
(Gov Bond Holdings$_{t-1}$)*(Earthquake)	-0.0681***	-0.0689***	-0.0698***	-0.0324***	-0.0331***	-0.0304***
	(0.0243)	(0.0246)	(0.0252)	(0.00884)	(0.00814)	(0.00576)
(Gov Bond Holdings$_{t-1}$)*(Asia)		-0.0590	-0.0608	0.0354	0.0336	0.0336
		(0.0412)	(0.0421)	(0.0287)	(0.0282)	(0.0313)
(Gov Bond Holdings$_{t-1}$)*(Russia)			-0.0333	-0.0102	-0.0108	-0.0108
			(0.0238)	(0.0204)	(0.0202)	(0.0194)
(Gov Bond Holdings$_{t-1}$)*(2001 Crisis)					-0.0421***	-0.0420***
					(0.00413)	(0.00591)
Observations	10119	10119	10119	10119	10119	10119
BankFixedEffects	Yes	Yes	Yes	Yes	Yes	Yes
MonthFixedEffects	Yes	Yes	Yes	Yes	Yes	Yes
BankQuarterFixedEffects	No	No	No	Yes	Yes	Yes

Note: Dependent variable is loans to the private sector, in ratio to total assets. Earthquake is a dummy that takes a value of one from August 1999 to November 1999. Column (6) defines Earthquake as August 1999 to October 1999, for robustness. Asia is a dummy that takes a value of one from July 1997 to October 1997. Russia is a dummy that takes a value of one from August 1998 to November 1998. 2001 Crisis is a dummy that takes a value of one from December 2000 to December 2001. Standard Errors are clustered at bank, and month levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table VIII: Determinants of Government Bond Holdings on Average and Over Time

	(1)	(2)	(3)
Capital Ratio$_{t-1}$	-0.0892***	-0.143***	-0.143***
	(0.0108)	(0.0126)	(0.0509)
Non-Performing Loans$_{t-1}$	-0.964***	-1.175***	-1.175**
	(0.129)	(0.136)	(0.558)
Bank Size$_{t-1}$	0.00491***	-0.0288***	-0.0288*
	(0.000997)	(0.00344)	(0.0168)
Cash Holdings$_{t-1}$	-0.839***	-2.398***	-2.398*
	(0.220)	(0.318)	(1.263)
Interbank Balances$_{t-1}$	-0.127***	-0.127***	-0.127***
	(0.00710)	(0.00934)	(0.0395)
Domestic Bank	-0.0269***		
	(0.00435)		
State Owned Bank	0.121***		
	(0.00754)		
Observations	10107	10107	10107
Bank Fixed Effects	No	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes
Double Cluster	No	No	Yes

Note: Dependent variables is Government Bond holdings in ratio to total assets. Domestic bank is a dummy that takes a value of 1 if the bank was majority domestic owned at the start of the sample. State bank is a dummy that takes a value of one if the bank was ever state owned. Double clustered regressions are clustered at the bank and month levels. Otherwise, standard errors are robust. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table IX: Determinants of Government Bond Holdings During EQ

Capital $Ratio_{t-1}$	-0.148***	-0.0157
	(0.0494)	(0.0353)
Non-Performing $Loans_{t-1}$	-1.123**	-0.194
	(0.538)	(0.309)
Bank $Size_{t-1}$	-0.0284*	0.0178
	(0.0162)	(0.0150)
Cash $Holdings_{t-1}$	-2.608**	0.0300
	(1.214)	(0.270)
Interbank $Balances_{t-1}$	-0.127***	-0.0238
	(0.0369)	(0.0255)
(Capital $Ratio_{t-1}$)*(Earthquake)	0.186**	0.0321
	(0.0828)	(0.0486)
(Non-Performing $Loans_{t-1}$)*(Earthquake)	-0.732	0.191
	(0.613)	(0.204)
(Bank $Size_{t-1}$)*(Earthquake)	-0.0106	-0.000984
	(0.00717)	(0.00273)
(Cash $Holdings_{t-1}$)*(Earthquake)	3.802***	2.263***
	(0.918)	(0.730)
(Interbank $Balances_{t-1}$)*(Earthquake)	-0.0616	-0.0142
	(0.0485)	(0.0402)
Observations	10107	10107
Bank Fixed Effects	Yes	Yes
Month Fixed Effects	Yes	Yes
Bank Quarter Fixed Effects	No	Yes

Note: Dependent variables is Government Bond holdings in ratio to total assets. Earthquake is a dummy that takes a value of one from August 1999 to November 1999. Standard errors are clustered at the bank and month levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table X: Government Bonds and Credit Supply: Survivors and Controls

	(1)	(2)	(3)	(4)
Gov Bond Holdings$_{t-1}$	-0.0178***	-0.0176***	-0.0178***	-0.0182***
	(0.00208)	(0.00216)	(0.00233)	(0.00318)
Capital Ratio$_{t-1}$		-0.0187***	-0.0188***	-0.0183***
		(0.00164)	(0.00216)	(0.00212)
Non-Performing Loans$_{t-1}$				-0.609***
				(0.188)
Cash Holdings$_{t-1}$			0.258***	0.252***
			(0.0753)	(0.0774)
(Gov Bond Holdings$_{t-1}$)*(Earthquake)	-0.0202**	-0.0207***	-0.0202***	-0.0189***
	(0.00802)	(0.00736)	(0.00718)	(0.00526)
(Capital Ratio$_{t-1}$)*(Earthquake)		0.00774	0.00794	0.00754
		(0.0100)	(0.00856)	(0.00884)
(Non-Performing Loans$_{t-1}$)*(Earthquake)				0.0798
				(0.309)
(Cash Holdings$_{t-1}$)*(Earthquake)			0.123	0.0983*
			(0.101)	(0.0585)
Observations	8590	8586	8578	8578
Bank Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Bank Quarter Fixed Effects	Yes	Yes	Yes	Yes

Note: Dependent variable is loans to the private sector, in ratio to total assets. Sample consists of all banks, except those that have ever been taken over by the central bank. Earthquake is a dummy that takes a value of one from August 1999 to November 1999. Standard errors are clustered at the bank and month levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table XI: Valuation, Net Worth and Profits

	Valuation	Net Worth	Profits
Gov Bond Holdings$_{t-1}$	-0.0425***	-0.0221	-0.00403***
	(0.0123)	(0.0154)	(0.0009)
(Gov Bond Holdings$_{t-1}$)*(Earthquake)	-0.0455***	-0.0640***	-0.0159***
	(0.0106)	(0.0103)	(0.00373)
Observations	10107	10107	10107
Bank Fixed Effects	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes
Bank Quarter Fixed Effects	Yes	Yes	Yes

Note: Dependent variable in column (1) is financial assets valuation difference as a ratio to total assets. Dependent variable in columns (2) is networth s a ratio total assets, and in (3) is Profits in ratio to total assets. Earthquake is a dummy that takes a value of one from August 1999 to November 1999. Standard errors are clustered at the bank and month levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table XII: Government Bonds and Credit Supply: Placebo Earthquake and Short Sample

	(1) Placebo	(2) Short Sample
Gov Bond Holdings$_{t-1}$	-0.0185*** (0.00179)	-0.215*** (0.00982)
(Gov Bond Holdings$_{t-1}$)*(Earthquake)		-0.0592*** (0.0124)
(Gov Bond Holdings$_{t-1}$)*(Placebo)	-0.00878 (0.00543)	
Observations	10119	5069
Bank Fixed Effects	Yes	Yes
Month Fixed Effects	Yes	Yes
Bank Quarter Fixed Effects	Yes	No

Note: Dependent variable is loans to the private sector, in ratio to total assets. Earthquake is a dummy that takes a value of one from August 1999 to November 1999. Placebo is a dummy that takes a value of one from April 1999 to July 1999. Short sample is from 1997-2002. Standard errors are clustered at the bank and month levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table XIII: Government Bonds and Loans Outside Turkey - Foreign Banks

Gov Bond Holdings$_{t-1}$	0.0157*	0.0237**
	(0.00841)	(0.00941)
(Gov Bond Holdings$_{t-1}$)*(Earthquake)	-0.0170**	-0.0205**
	(0.00847)	(0.010)
Turkish Private Sector Loans$_{t-1}$		0.225***
		(0.0390)
Observations	878	878
Bank Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes

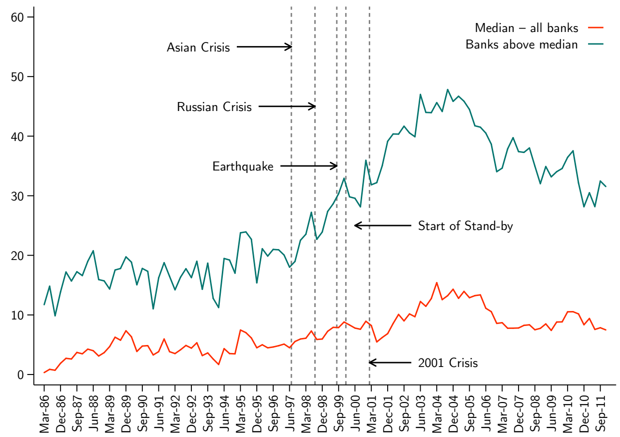
Note: Sample is of banks that were majority foreign owned. Dependent variable is loans outside of Turkey, in ratio to total assets. Earthquake is a dummy that takes a value of one from August 1999 to November 1999. Standard errors are clustered bank and month levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table XIV: IV Regressions

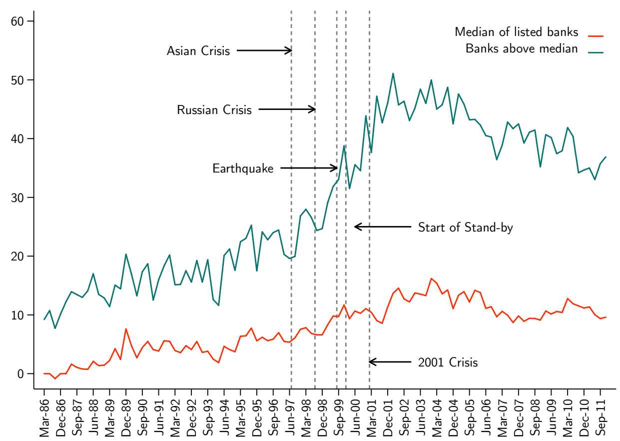
	First Stage	
(Gov Bond Holdings$_{t-1}$)*(Earthquake)	75.61	29.11
	(5.723)	(8.715)
R^2	0.567	0.954
	Second Stage	
(Gov Bond Holdings$_{t-1}$)*(Spread$_t$)	-0.0453	-0.0292
	(0.00966)	(0.00374)
Observations	10119	10119
R^2	0.707	0.986
Bank Fixed Effects	Yes	Yes
Month Fixed Effects	Yes	Yes
Bank Quarter Fixed Effects	No	Yes

Note: First stage: Dependent variable is holdings of Gov Bonds (in ratio to total assets) interacted with the spread over the US of the Gov Bond interest rate. Second stage: Dependent variable is loans to the private sector, in ratio to total assets. Earthquake is a dummy that takes a value of one from August 1999 to November 1999. Standard Errors are clustered at bank and month levels. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

VIII Online Appendix



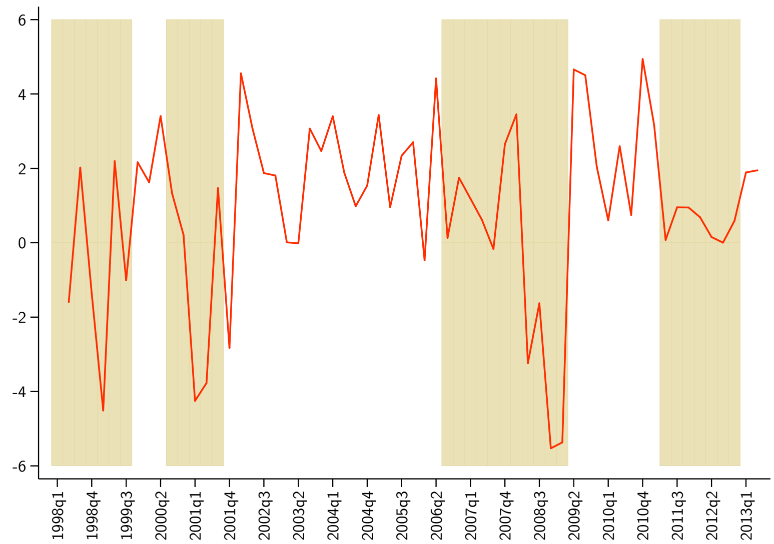
(a) All Banks



(b) Listed Banks

Source: CBRT.

Figure 14: Government Bond Holdings/Total Assets: Listed and Non-Listed Banks



Source: CBRT.

Figure 15: Quarterly GDP Growth