Essays on Firm and Household Borrowing

by Erzsébet Judit Rariga

Submitted to
Central European University
Department of Economics and Business

In partial fulfillment of the requirements for the degree of
Doctor of Philosophy

Supervisor:
Ádám Szeidl

Budapest, Hungary
2020

10.14754/CEU.2020.11

CENTRAL EUROPEAN UNIVERSITY
DEPARTMENT OF ECONOMICS AND BUSINESS

The undersigned hereby certify that they have read and recommend to the Department of Economics and Business for acceptance a thesis entitled **"Essays on Firm and Household Borrowing"** by Erzsebet Judit Rariga.
Dated: September 21, 2020

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
Chair of the Thesis Committee:

Laszlo Matyas

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
Advisor:

Adam Szeidl

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
Internal Examiner:

Koren Miklós

Miklos Koren

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
External Examiner:

Christine Zulehner

Christine Zulehner

I certify that I have read this dissertation and in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.
External Member:

Janos Kollo

Janos Kollo

Signature Certificate

Document Ref.: WZ63B-3HN3Z-MBESS-JAIWF

Document signed by:

Christine Zulehner

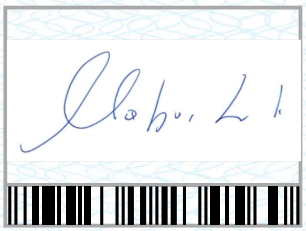
Verified E-mail:
christine.zulehner@univie.ac.at

IP: 131.130.85.40 | Date: 21 Sep 2020 09:58:45 UTC

Laszlo Matyas

Verified E-mail:
matyas@ceu.edu

IP: 193.225.200.93 | Date: 21 Sep 2020 10:31:21 UTC



Adam Szeidl

Verified E-mail:
szeidla@ceu.edu

IP: 193.225.200.93 | Date: 21 Sep 2020 11:33:54 UTC

Miklos Koren

Verified E-mail:
korenm@ceu.edu

IP: 193.225.200.92 | Date: 23 Sep 2020 12:57:01 UTC

Document completed by all parties on:
24 Sep 2020 07:17:36 UTC

Signature Certificate

Document Ref.: WZ63B-3HN3Z-MBESS-JAIWF

Document signed by:

Janos Kollo

E-mail:
kollo@econ.core.hu

Signed via link

IP: 176.63.30.118 Date: 24 Sep 2020 07:17:36 UTC

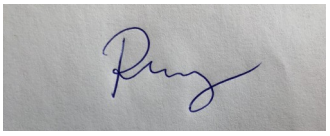
Document completed by all parties on:
24 Sep 2020 07:17:36 UTC

10.14754/CEU.2020.11

CENTRAL EUROPEAN UNIVERSITY
DEPARTMENT OF ECONOMICS AND BUSINESS

Author: **Erzsébet Judit Rariga**
Title: **Essays on firm and household borrowing**
Degree: **Ph.D.**
Dated: **September 21, 2020**

Hereby I testify that this thesis contains no material accepted for any other degree in any other institution and that it contains no material previously written and/or published by another person except where appropriate acknowledgement made.



Signature of the author

10.14754/CEU.2020.11

Disclosure of co-author contribution

Spillover effects in firms' bank choice

Co-author: Attila Lindner, Pálma Filep-Mosberger

The nature of cooperation and the roles of the individual co-authors and approximate share of each co-author in the joint work: The paper was developed in cooperation with Attila and Pálma. We contributed equally to the idea of the paper, formulated together the final research question and developed together the identification strategy. Pálma and I worked together on data management and programming. I wrote the first draft.

Consumption, currency crisis and household foreign currency debt

Co-author: Győző Gyöngyösi, Emil Verner

The nature of cooperation and the roles of the individual co-authors and approximate share of each co-author in the joint work: the paper was developed in cooperation with Győző and Emil. All authors contributed equally in all stages of research.

10.14754/CEU.2020.11

Abstract

This thesis studies firms' and households borrowing decisions. In the first chapter, I study the long-term borrowing behavior of firms exposed to a large and unexpected financial shock. In the second chapter, we investigate firm-bank relationship formation. In the third chapter, we study the consumption response of increased household debt by exploiting a household foreign currency debt crisis in Hungary.

Chapter 1: The effect of transitory shocks on firm borrowing

In this paper, I investigate the long-term borrowing behavior of firms exposed to a large and unexpected financial shock. Using census and credit registry data for Hungarian firms, I examine how a balance sheet shock stemming from foreign currency denominated debt during the 2008 financial crisis affects borrowing decisions in the decade after the crisis. My identification strategy relies on the comparison of unhedged Swiss franc borrowers to domestic currency borrowers. Firms exposed to a large revaluation in outstanding debt are more likely to become delinquent in the medium term, are less likely to obtain a new loan up to seven years after the shock and even if they do so, borrowing from the pre-crisis bank is less likely. While the shortage in credit supply contributed to the slow recovery after the crisis, these results suggest that demand side factors might have also played a role.

Chapter 2: Spillover effects in firms' bank choice

In this paper, we study firm-bank relationship formation. Combining domestic inter-firm network data from value-added tax declarations and credit registry for Hungary, we esti-

10.14754/CEU.2020.11
mate the spillover effects in bank choice, identifying from variation on the bank level. We document that having at least one firm in the network who has an existing loan with a bank increases the probability that the firm will borrow a new loan from the same bank. In addition, we show that spillover effects are stronger for smaller firms and the largest when firms obtain bank loans, in comparison with other types of borrowing. Our results suggest that firms can learn about banking practices from their network but they also point to financial stability concerns in the event of shocks to domestic supply chains.

Chapter 3: Consumption, currency crisis and household foreign currency debt

This paper studies the consumption response of increased household debt by exploiting a household foreign currency debt crisis in Hungary unfolding in late 2008. We use a consumption survey that follows households for several years. We document that the revaluation of household debt significantly decreases consumption, the consumption of foreign currency debtors declines by 7 percent in the post crisis period. One HUF increase in debt burdens translates to an almost 1 HUF decrease in consumption, indicating that consumption declines one to one for increased debt service.

10.14754/CEU.2020.11

Acknowledgement

I would like to express my deepest gratitude to my supervisor, Ádám Szeidl, for all the valuable guidance I received on his office hours in the past years. This thesis would not have been possible without his continuous support. I am very grateful to Miklós Koren for the inspiring and encouraging talks since my master studies at CEU and for his guidance in the first years of my PhD studies.

This thesis benefited a lot from the insightful comments of the external examiners Christine Zulehner and Miklós Koren as well as the entire dissertation committee, for which I am very thankful.

I am grateful to my co-authors Attila, Emil, Győző and Pálma for showing me how to turn ideas into regressions and papers.

I am thankful for the support of my colleagues from the Economics, Research and Financial Sytem Analysis Directorates at the Central Bank of Hungary. This thesis benefited a lot from talks with Mariann Endrész and Zsolt Oláh.

I am also indebted to the entire Economics and Business Department for their continous support. This thesis benefited from talks with Adam Zawadowski and Sergey Lychagin, as well as fellow PhD students Judit Krekó, Balázs Krusper and Olivér Rácz. I am grateful to Corinne Freiburger, Márta Jombach, Melinda Molnár, Veronika Orosz and Katalin Szimler for the support in all administration matters.

I thank the CEU Microdata team and especially András Vereckei for preparing the data needed for research and for being always available to answer our questions.

Special thanks go to long time friends Anna, Ágnes, Krisztina, Ewa, Dragana, Tatyana and Réka as well as tennis partners Anna and Anikó for making my PhD life more fun.

Mostly, I am grateful to my family and partner for all the love and support during the hardest times. I dedicate this thesis to the memory of my father.

10.14754/CEU.2020.11

Contents

10.14754/CEU.2020.11

10.14754/CEU.2020.11

10.14754/CEU.2020.11

List of Figures

10.14754/CEU.2020.11

10.14754/CEU.2020.11

List of Tables

10.14754/CEU.2020.11

10.14754/CEU.2020.11

Chapter 1

The effect of transitory shocks on firm borrowing

1.1 Introduction

Borrowing determines many firm level outcomes. Firms borrow in order to finance their investment, raise working capital and pay their suppliers. Despite the importance of bank credit for firm operation, we know little about their financing related behavior and attitude towards borrowing. [1]

Using a large and unexpected financial shock, this paper shows how the attitude of firms towards borrowing changes on the long term. Combining credit registry with firm level census data for Hungary and covering a decade after the crisis, I show that firms affected by the financial shock are less likely to borrow up to seven years after the crisis. In the period after the crisis, affected firms are less likely to borrow a bank loan (in comparison with other types of lending) and are less likely to return to their pre-crisis bank.

To study the effect of a large financial shock on firm level borrowing, I exploit the abrupt and unexpected Hungarian forint/Swiss frank (HUF/CHF) exchange rate depreciation in

[1] Evidence on firms' expectations and more specifically on their attitude towards financing and lending conditions is rather scarce. In the years after the crisis, survey data on firms' external financing needs and attitude towards existing lending conditions became available. For example, the SAFE Survey for access to finance for European enterprises asks a representative sample of European firms on the current developments in financial situation, need and availability of external financing. For the most recent survey see ECB (2019).

10.14754/CEU.2020.11

Hungary in October 2008. After years of stable HUF/CHF exchange rate, at the onset of the crisis the forint depreciated relative to the Swiss frank by 32 percent from September 2008 to March 2009. This large change in exchange rate is explained by investors' withdrawal of funds from emerging markets, motivated by flight to safety, unrelated to Hungarian corporate sector developments.

In the years prior to 2008, Hungarian firms built up a large amount of debt denominated in foreign currency. By 2008, 60 percent of corporate debt is denominated in foreign currency, with around 15 percent of total debt denominated in Swiss frank. CHF borrowers, as they were less likely to be exporters, did not have income in foreign currency and did not hedge against exchange rate risk, were severely affected by the large domestic currency depreciation.

In order to show that being exposed to a financial shock has long term effects on firm level borrowing, I use a difference-in-differences approach and compare the behavior of HUF and CHF borrower firms for the period 2005-2017. I define the control group as those firms which had only HUF denominated outstanding debt in September 2008, the month before the start of the large exchange rate depreciation. The treated group is composed of firms with CHF exposure. The key identifying assumption is that there are no time varying shocks affecting firm level outcomes that are correlated with foreign exchange (FX) debt. [2] First, the estimates are conditional on a wide set of firm level controls, such as sales, investment, initial debt, employment, age, industry, location and main bank of the firm. This allows the comparison of firms with similar observable characteristics in 2007, some affected by the exchange rate shock and some not. Second, my dataset allows to test for the presence of parallel trends for treated and control firms for 2005-2007. As I show later, conditional on observable characteristics, in the pre-crisis period, the difference between the outcomes for treated and control firms is statistically not significant.

My main findings are as follows. Affected firms are significantly more likely to become 90 days past due on their loans in the period 2011-2013, 3 years after the onset of the crisis. Moreover, treated firms are 3.5 percentage point less likely to recover from delinquency than control firms. While it seems that it takes time to de-leverage, it takes firms a much longer time to borrow again. Treated firms are 2.7 percentage point less likely to borrow in

[2] Throughout the paper, I will use CHF debt and FX debt interchangeably.

10.14754/CEU.2020.11

the period after the crisis. There is a significant negative effect on new borrowing for seven years, for the period 2009-2015. After the crisis, firms are 3.8 percentage point less likely to obtain a bank loan (versus other types of borrowing such as financial leasing). Finally, I show that treated firms are 4 percentage point less likely to turn to their pre-crisis bank when they borrow and this effect is significantly negative for 2009-2017. When examining heterogeneous effects, I find that small firms, firms operating in manufacturing and services and younger firms with CHF debt before the crisis are more negatively affected in their financing related decisions.

All else unchanged, the 2.7 percentage point difference in new borrowing between treated and control firms translates into a HUF 193 billion decrease in the stock of debt in the decade after the crisis. Altogether, the new borrowing that did not materialize is equivalent to 4.4 percent of total debt in 2007.

It is widely documented that banks were affected in the 2008 crisis, but the reduction in lending cannot be explained by supply side factors alone (e.g. Ivashina and Scharfstein (2010)). While it is challenging to disentangle credit supply from demand, I provide further empirical evidence suggesting that the differences in financing related outcomes between treated and control firms are rather driven by firms' borrowing decisions. The main concern is that banks are simply not willing to lend to firms for many years after the crisis. To the extent that banks take their lending decisions based on firm level outcomes and firm level credit history, I show that controlling for these variables does not affect my main coefficient of interest. First, I show that the ability to repay as observed by the bank cannot be an explanation for the results obtained. Commercial bank loan request forms [3] suggest that beyond general information (e.g. industry of activity) about the firm that I also control for, the main firm level outcome considered by banks is sales. In order to capture the creditworthiness of firms in a certain period and its ability to repay, I control for log sales value in my regressions. The estimated coeffient of interest is unchanged, showing that the creditworthiness of firms, as observed by banks, has no impact on financing related outcomes. Second, banks can observe the creditworthiness of firms from the credit registry. Banks have access to all information regarding firms' loan contracts, including events such as delinquency, for up to five years after the end of a contract. I construct a variable

[3] These forms are filled out by firms upon applying for a new loan.

indicating whether the firm has no observable credit history, has credit history or has bad credit history in a given year. Adding this variable to my regression does not change my main result regarding financing related outcomes. Third, I use the exact date when a bank queried a firm's credit status from the credit registry as observed firm credit demand and show that there is no significant difference in loan acceptance rate for treated and control firms.

This paper relates to several literatures. First, after the emerging market crises in the 1990s, theoretical literature focused on explaining the recessions unfolding after exchange rate depreciations through the mismatch in firm balance sheet(e.g. Christiano et al. (2002), Krugman (1999), Aghion et al. (2001), Eichengreen et al. (2007)).

This paper is also related to the literature examining foreign currency borrowing using country level data for emerging economies. According to Basso et al. (2011), debt dollarization in transition economies is driven by the increase in foreign funding and interest rate differentials. Firms borrowing in foreign currency build up a mismatch in their balance sheet, which leads to higher growth in tranquil times but to severe recessions afterwards (Ranciere et al., 2010). Kalemli-Ozcan et al. (2018), for a sample of ten Asian economies and for the period 2002-2015 shows that more indebted firms increase their leverage after exchange rate appreciations.

Fewer papers analyze the effect of currency mismatch and depreciation using firm level data. Mexican firms, especially those with large short term FX debt experience low levels of investment after the Mexican peso crisis of 1994 (Aguiar, 2005a). Varela and Salomao (2018) develop a model and using micro data show that firms with less capital who are less productive self select into foreign currency borrowing. On the aggregate, this results in higher investment and lower default, but this is not the case when less productive firms borrow in foreign currency. According to Niepmann and Schmidt-Eisenlohr (2017), firms are more likely to default on their forreign currency loans as they do not hedge perfectly against exchange rate risk in normal times. Vonnák (2018) finds that higher default rates of foreign currency borrowers are explained by both currency denomination and firm characteristics. Hardy (2018), using a small sample of stock exchange listed firms in Mexico which borrow in foreign currency and are exposed to a large domestic currency depreciation by the end of 2008, finds that below median firms (in terms of their log assets) borrow less

which subsequently translates into lower employment and investment growth. Endrész and Harasztosi (2014) show that before the 2008 FX crisis in Hungary, FX lending increased corporate investment rates, while after the crisis, due to the balance sheet effect, investment rates decrease for FX borrower firms. Compared to these papers, I study the effect of an exchange rate shock and its subsequent balance sheet effect using firm level census data on bank financing related decisions for a period of ten years after the crisis.

Third, this paper also relates to the literature showing that firm level leverage is an important propagator of business cycles with substantial effect on the real economy. According to Dinlersoz et al. (2018), leverage and the growth of private firms are positively related for U.S. firms, but leverage declines during the Great Recession for these firms. Kalemli-Ozcan et al. (2019) show that high leverage accumulated in the pre-crisis period hinders investment in the aftermath of the crisis for European firms. The effect of debt overhang is larger if firms are connected to weaker banks with exposures to sovereign risk. Giroud and Mueller (2016), using US census data shows that higher firm level leverage reinforces the effect of consumer demand shocks during the Great Recession, as more levered firms face higher employment losses when local consumer demand declines. According to Giroud and Mueller (2018), changes in firm borrowing are associated with regional business cycles: on the short run, U.S. regions where firms build up higher leverage face larger growth in employment, but on the medium run these regions face larger declines in employment.

More broadly, this paper relates to earlier work on economic agents' beliefs and change in their attitudes in response to financial and macroeconomic conditions. Regarding availability of credit since the crisis, using survey data, it has been shown that firms update their belief based on the available data set, but they do not use information efficiently (Ferrando et al., 2019). Ferrando and Mulier (2013) find that firms perceive access to finance more problematic when they are more indebted on the short term. Coibion et al. (2018), using a survey of firms in New Zealand show that there is a large dispersion about recent beliefs and expectations about the economy (inflation, unemployment, GDP growth), but inattentiveness decreases for firms which face more competitors or expect to change prices soon. Firm level decisions can be attributed to the decisions of managers who operate the firms. Some recent papers looked at how the experience of managers affects corporate policies. Dittmar and Duchin (2015) find that firms run by CEOs who worked earlier at

10.14754/CEU.2020.11
firms facing financial difficulties (e.g shocks to cash flow, stock returns and credit ratings) hold less debt and invest less. Malmendier et al. (2011) shows that corporate CEOs who experienced the Great Depression prefer internal finance over debt and CEOs experiencing natural disasters throughout their life prefer more conservative corporate policies regarding leverage and cash holdings Bernile et al. (2017). Malmendier and Nagel (2011), Knüpfer et al. (2017) and Cruijsen et al. (2016) find that individuals who faced negative economic events during their lifetime (e.g. low stock market returns, adverse labor market conditions or depressions) show lower willingness to take financial risk and loose trust in banks.

The remainder of the paper is structured as follows. In section 1.2 I briefly describe the Hungarian corporate borrowing market and the foreign exchange shocks faced by firms. Section 3.3 describes the data. Section 1.4 presents the empirical strategy. Section 3.5 presents the main results of the paper. Section 3.5.3 presents some robustness checks while section 2.6 discusses the potential mechanism explaining the results. The last section concludes.

1.2 Corporate foreign currency debt and exchange rate shocks in Hungary

In Hungary, by the beginning of the 2000s, the majority of banks were privatised by foreign banks. [4] Foreign owned local banks were not specialized previously in retail lending and due to the high information costs of entering this segment, they served for a long period only the corporate market, with corporate credit representing their main assets (Banai et al., 2011a).

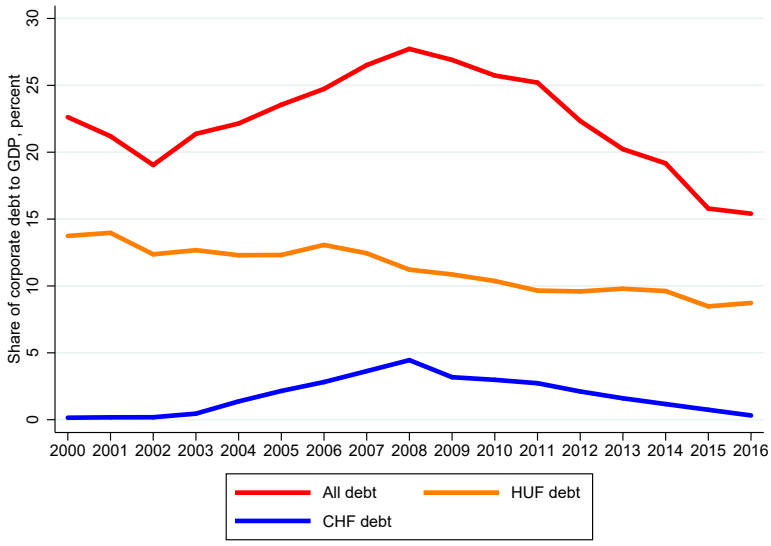
Figure 1.1 shows the evolution of corporate debt to GDP. While there is an increase in the ratio, (Kiss et al., 2006), using data until 2002, they show that credit growth is explained by the catching up process and the ratio of credit to GDP is below the level consistent with macroeconomic fundamentals.

In the period before 2004, more foreign firms entered the market and more firms started to export. As these firms had revenues in foreign currency it was natural that they had FX loans as they were hedged against exchange rate movements. If we look at the composition

[4] Berger (2007) shows that in the CEE region the privatisation processes led to a high foreign bank dominance in the sector.

10.14754/CEU.2020.11

Figure 1.1: Corporate debt to GDP



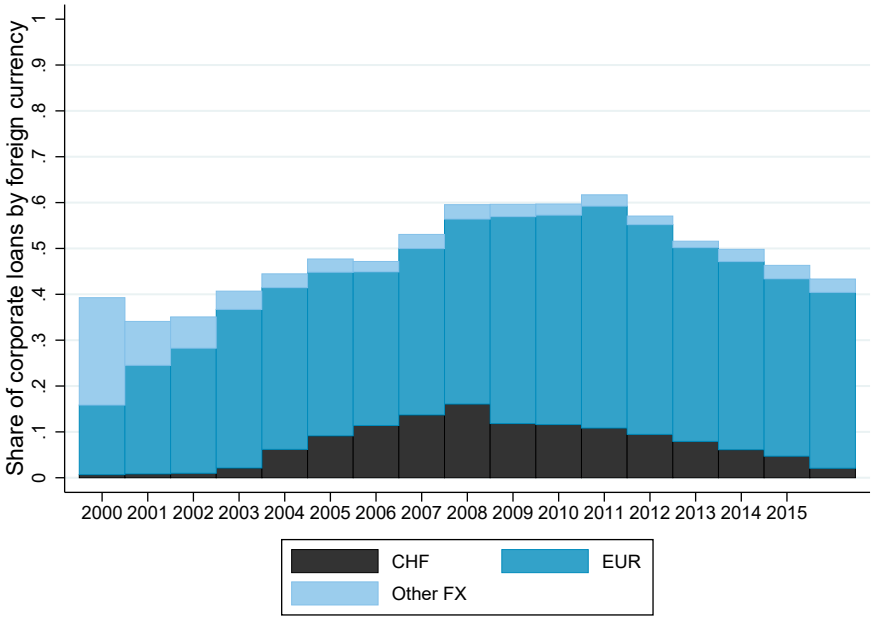
Notes: The figure shows the share of total corporate debt, corporate debt in HUF and FX, aggregated from banks' end of year balance sheets to GDP.
Source: GDP on current prices from Penn World Table.

of corporate debt by denomination, Figure 1.2 shows that FX denominated debt was present from the very beginning in the corporate sector.

The share of FX loans increased from around 40 percent to 60 percent between 2004 and 2008 and, as MNB (2006) points out, this increase was no longer backed by increasing foreign currency revenues. While there was no credit boom in the corporate sector pre-2008, risks have built up because of the lack of natural hedge among FX borrowers. Using representative survey data for the small and medium enterprise sector for 2005, Bodnar (2006), shows that around one third of corporate debt is denominated in foreign currency, and 70 percent of FX borrowers are not naturally hedged against exchange rate risk through foreign currency revenues. Most of these firms are not aware of the fact that unfavorable exchange rate changes could significantly increase their installments. The majority of these firms think that managing exchange rate risk is too costly. More than 50 percent of these firms think that exchange rate depreciations would not significantly affect their financial positions and competitiveness. However, survey data based simulations show that a 25

10.14754/CEU.2020.11

Figure 1.2: Share of corporate loans denominated in foreign currency



Notes: The figure shows the share of corporate foreign currency debt to total debt. Shares calculated based on end of year debt value reported in banks' balance sheets.

percent exchange rate depreciation would lead to 50 percent increase in the number of firms with negative profits Bodnar (2006). The 2007 wave of the survey, which includes large corporations too, shows that the choice of FX debt is driven by lower interest rates Bodnar (2009). While large firms are mostly naturally hedged, the majority of firms think that there are no suitable FX risk management tools or expect external solutions for exchange rate risk reduction, such as the introduction of euro. Endrész et al. (2012) show that in 2007 all firms with mismatch have sizeable contribution to various economic aggregates (2/3 of loans, around 1/3 of aggregate investment and value added). Katay and Harasztosi (2017) study non-financial corporations' motives to match the currency composition of their assets and liabilities and find that natural hedging explains new foreign currency borrowing to a small extent.

After years of stable HUF/CHF exchange rate (Figure 1.3), at the onset of the crisis the Forint depreciated relative to the Swiss frank by 32 percent from September 2008 to

March 2009. This abrupt change in exchange rate is explained by investors' flight to safety motive from emerging markets, in the conditions when Hungary built up a large public and private sector debt and the country was highly reliable on external funding (Banai et al., 2011b). The depreciation continued until the end of 2012.

Figure 1.3: Domestic currency (HUF) depreciation against CHF

Notes: The figure shows the percentage change in HUF/CHF exchange rate compared to September 2008. The vertical line represents September 2008, the month prior to HUF depreciation.

In the period leading to the crisis, due to the sharp increase in lending mostly in the retail sector, banks became reliant on foreign parent bank funding and FX swap market to obtain liquidity. With the onset of the crisis, banks faced severe disruptions in interbank, FX and swap markets in the last quarter of 2008. Beyond the measures taken by the Central Bank to manage the liquidity crisis, parent banks showed their commitment and increased funding as well as intra-group swaps (Banai et al., 2011a). Major banking sector player in the Central and Eastern European (CEE) region and governments signed The Vienna Initiative in January 2009, with parent banks commiting to continue lending in the region trough their affiliates. This helped ensure the financial stability in the CEE region and calm financial markets. Temesvary and Banai (2017) finds that while the crisis significantly

lowered subsidiary lending growth in the region, this effect is less pronounced for banks participating in the Vienna Initiative.

Starting from 2013, the Central Bank of Hungary introduced the *Funding for Growth Scheme* to alleviate corporate credit supply problems. As most of the firms in the economy are SMEs with no alternative sources of external finance[5], in the second quarter of 2013 the Central Bank of Hungary introduced its Funding for growth program, aiming at alleviating SME lending conditions. Through the Program, participating banks gained access to domestic currency denominated liquidity with long maturity that they could use to lend to SMEs with an interest of maximum 2.5 percent and for a period of maximum 10 years. In the first phase of the program, lasting until the third quarter of 2013, the use of the loan was restricted to financing long-term investment, working capital, pre-financing EU funds and refinancing existing loans. The program was continued immediately afterwards with the second phase, with a more accentuated scope on new lending to SMEs, especially for investment purposes. In the closing phase, which lasted between the first quarter of 2016 and the first quarter of 2017, SMEs could apply for new loans only with investment financing purposes (MNB, 2017). An alternative version of the program was run between the first quarter of 2015 and the end of 2016, which, beyond alleviating the liquidity problem of banks, also contributed to overtaking part of their credit risk. As a consequence, lending to riskier, but still credit-worthy firms, who would have otherwise been excluded from the program, was also increasing. Through this extension of the program, firms could only apply for new loans, financial leasing and factoring from banks, excluding the purpose of refinancing (MNB, 2015). All banks were participating in the Scheme from the launch of the program until the last phase.

1.3 Data used and definition of treated firms

I build a novel firm-year level database for the period 2005-2017 by combining data from credit registry with administrative firm-level data, firm location data and credit registry query data for firms in Hungary. This dataset allows me to follow the bank financing related decisions of around 35,000 firms for ten years after the crisis. All listed databases can be

[5]In Hungary, for the studied period, there is no developed corporate bond market. External financing is possible only through banks.

linked using a unique firm level indetifier. Below, I briefly describe the main sources of data and treatment definition.

1.3.1 Data

Credit registry The corporate credit registry contains the universe of loan contracts granted to firms by all credit institutions in Hungary. The dataset is available for the period 2005-2017 on a monthly frequency from reportings done by all lending institution to the Central Bank of Hungary. The credit registry offers information on the loan contract level on the borrowed amount, outstanding amount, date of origination, maturity, type of reimbursement, loan type, currency of denomination, delinquency, firm and bank identifier. It also offers information on delinquency and recovery events for the loans as well as how did a problematic contract end. All existing contracts are in the credit register (no reporting threshold). In addition, all contracts after closure are kept for 5 years in the database. I use this database to define the debt composition of firms at a certain point in time. Outcome variables of interest such as delinquency, recovery from delinquency, new borrowing, new bank loan, bank of the new loan are either given or defined based on this database and aggregated to the firm-year level. Table B.1 in the Appendix provides a detailed description of the variables used.

Firm-level data I use the census of firms for Hungary which is based on corporate tax filings to the National Tax and Customs Administration (NAV) and contains balance sheet and income statement entries on a yearly frequency. It provides information on capital, assets, sales, export sales, employment, payrolls, intermediates, value added and industry of the firm. Further variables of this dataset allow me to track whether these firms have any income in foreign currency, profit or loss from FX transactions, financial investments and any other FX-related assets or liabilities. I use the employment, sales and investment variables from this dataset as firm level controls.

Firm register The firm register offers information on the birth and death of the firm, the location of its headquarter, type of the firms and various other firm level characteristics. I use the information on firm birth to determine firm age. Headquarter location data is used

to proxy for firm location. It gives the exact address of the firm's headquarter, from which I extract the county of the firm.

Bank credit registry query data The bank query shows the day on which a given bank queried a firm from the credit registry. In case of an existing bank-firm connection such as loan contract, the bank has the obligation to query the firm yearly. Banks also have the obligation to query a firm from the credit registry when they seriously consider giving a loan to a firm. Upon query, banks can see all the variables from the credit registry listed earlier, allowing them to track the credit history of a firm. This dataset is available starting from 2011.

1.3.2 Definition of treated and control firms

I estimate the effect of being exposed to a shock by comparing firms with exposure to foreign currency debt to firms with debt denominated in local currency. The dataset used for estimation is on the firm-year level, covering the period 2005-2017. I follow those firms [6] through time, which had CHF or HUF debt in September 2008.

Treatment is defined based on CHF debt exposure.[7] I define treated and control firms based on their existing debt contracts in September 2008, one month before the start of the sharp exchange rate depreciation.[8] Firm level loan contracts taken into consideration must have existed for at least one more month after September 2008. Further on, I look only at exposures from loans with maturity beyond one year and loans which are in the balance sheet of the bank (e.g. exclude unused credit lines). The financing-related outcomes of HUF and CHF borrower firms are followed and compared before (2005-2007) and after the crisis (2008-2017). Figure 1.4 summarizes the timeline of events.

To get a sense of the magnitude of the shock faced by CHF borrowers, figure 1.5 plots

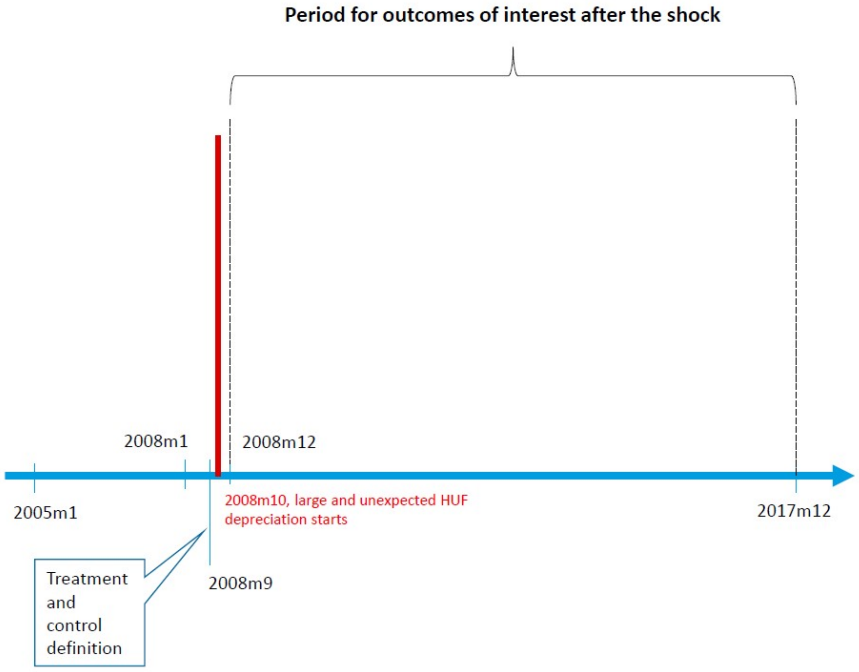
[6] I exclude state owned firms from my analysis as well as firms operating in the financial sector, postal services, public administration, education, health, cultural and other services.

[7] While EUR borrowing was also prevalent in Hungary, I exclude from my analysis those firms which had EUR denominated debt as these firms are larger and more likely to be exporters, thus being able to hedge against exchange rate changes through their foreign incomes. See for example Vonnák (2018) and Varela and Salomao (2018).

[8] In 2007, 50 percent of total debt stock was owned by firms in the sample. Control firms held around 66 percent of this debt. Treated firms held around 33 percent of the debt, which amounted to 857 billion HUF. 857 billion HUF is equivalent to 3,38 billion EUR using 2007 december HUF/EUR exchange rate.

10.14754/CEU.2020.11

Figure 1.4: Timeline of events



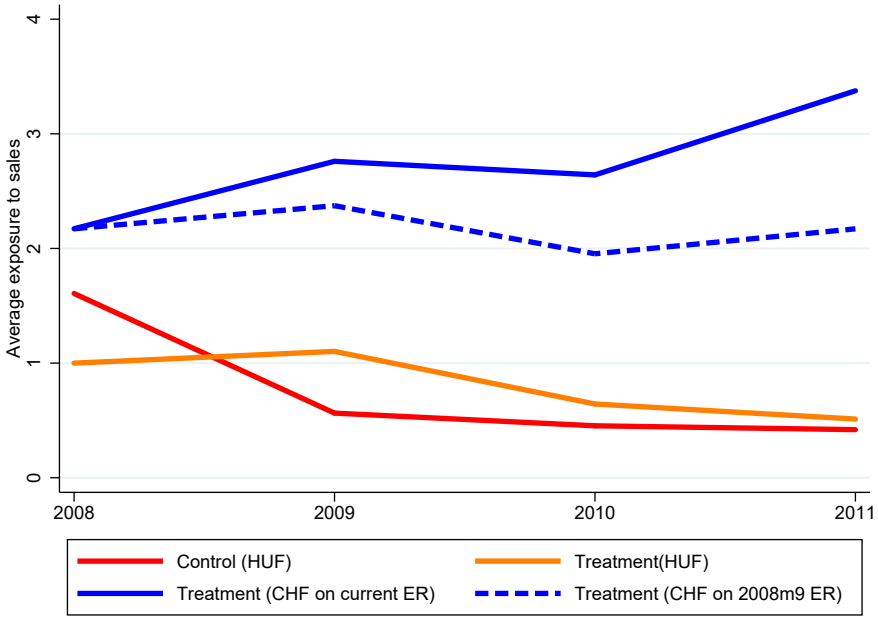
Notes: This graph summarizes the periods for treatment definition and outcomes of interest. Based on September 2009 loan exposures, the month prior to the start of the sudden HUF depreciation, firms with HUF-only debt are grouped into the control group, whereas firms with CHF (and some HUF) denominated debt are treatment firms. It is required that debt contracts existing in September 2009 do not expire for at least one more month and debt has long term maturity and is in the balance sheet of the bank.

the change in exposure relative to 2007 sales for debt contracts existing in September 2008 by assuming September 2008 HUF/CHF exchange rate throughout the period. While exposures from HUF denominated contract are gradually decreasing for both control and treated firm, the exposures from CHF contracts for treated firms change on average from the value of twice their 2007 sales value in 2008 to three times their 2007 sales value by the end of 2011.

Importantly, for firms in the sample the increase in the value of debt is not offset by any income in foreign currency. Firms are non-exporters and have no income from abroad, so they are not naturally hedged against exchange rate risk. In addition, firm do not manage exchange rate risk. Based on balance sheet entries, they do not have financial investments

10.14754/CEU.2020.11

Figure 1.5: Change in debt burden due to depreciation (relative to sales)



Notes: The figure shows average outstanding debt to total assets. Sales is fixed to its 2007 value. Debt is defined as end of year outstanding debt by currency, on the firm level. The dashed line gives the average CHF exposure to sales for treatment firms by assuming September 2008 HUF/CHF exchange rate throughout the period.

or income from financial investments, do not have stocks of FX holdings and do not use financial instruments for hedging.

Table 1.1 compares control and treated firms in their observable characteristics by the end of 2007. [9] The last column of the table shows whether there is a significant difference between affected and non-affected firms in their observable characteristics pre-crisis. Control and treated firms are not significantly different in employment, sales, assets, investment, productivity, leverage and foreign ownership. Treated firms are significantly older and are more likely in the manufacturing and services industries.

[9] 2007 is the last year which does not comprise the effect of the crisis.

10.14754/CEU.2020.11

Table 1.1: Correlates of foreign currency borrowing on the firm level

	(1) Control		(2) Treated		T-test Difference
Variable	N	Mean/SE	N	Mean/SE	t-stat
Employment	22442	10.052	10920	10.412	-0.360
		(0.349)		(0.254)	
Sales	24300	180.785	11628	172.484	8.301
		(13.445)		(6.165)	
Assets	24300	132.232	11628	125.933	6.300
		(10.168)		(4.097)	
Investment	24300	14.626	11628	14.052	0.574
		(5.945)		(0.756)	
Productivity	22439	4.074	10918	4.123	-0.050
		(0.078)		(0.068)	
Leverage	20892	2.112	10296	3.006	-0.894
		(0.589)		(1.540)	
Age	24300	7.189	11628	7.354	-0.164***
		(0.029)		(0.042)	
Foreign	24300	0.019	11628	0.017	0.002
		(0.001)		(0.001)	
Manufacturing	24300	0.124	11628	0.134	-0.009**
		(0.002)		(0.003)	
Construction	24300	0.164	11628	0.154	0.010**
		(0.002)		(0.003)	
Service	24300	0.608	11628	0.625	-0.017***
		(0.003)		(0.004)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

1.4 Empirical strategy

I estimate the effect of an unexpected and large change in the HUF/CHF exchange rate on the long term borrowing outcomes of firms and their banking related attitudes. I compare the outcomes of firms affected by an FX shock through their foreign debt holdings to the outcomes of non-affected domestic currency-only borrowers before and after the FX shock, using the following difference-in-differences model:

$$Outcome_{it} = \alpha_i + \theta_t + \beta FX_i \times Post_t + \Gamma X_{it} + \varepsilon_{it}, \tag{1.1}$$

where $Outcome_{it}$ is a borrowing related outcome for firm i at time t, α_i represents firm fixed effects, θ_t represents year fixed effects, FX_i is a dummy indicating whether the firm had some CHF exposure in September 2008, the month before the depreciation starts. $Post$ is a dummy variable taking value 0 for the period 2005-2007 and 1 for the period after the crisis, 2008-2017. X_{it} is a vector of characteristics of firm i in 2007 interacted with $Post_t$ dummy. In this specification, the parameter of interest is β, which gives the effect of FX debt for treated relative control firms, for the post-crisis period (2008-2017) relative to the period before the crisis (2005-2007).

To assess the dynamic effect of FX debt, I estimate the following model:

$$Outcome_{it} = \alpha_i + \theta_t + \sum_{k \neq 2007} \beta_k FX_i \times I(t = k) + \Gamma X_{it} + \varepsilon_{it}, \tag{1.2}$$

where $I(t = k)$ is an indicator variable that equals 1 in year t, and 0 otherwise. The vector of parameters of interest is β_k. For each year, it shows the difference in outcomes between treated and control firms relative to the difference in outcomes in 2007. These regressions are estimated on 240,510 firm-year observations. Standard errors are clustered at the firm level.

The key identifying assuption behind the employed difference-in-differences strategy is that the outcomes for treated and control firms would have evolved similarly, had there been no FX shock. In equations 1.1 and 1.2, I control for a wide set of firm level observable characteristics. In the preferred specification, difference-in-difference estimates are conditional on sales, value added, investment, end of year debt, employment, age, 2-digit NACE

industry code, bank and location in 2007, interacted with time dummies. This allows the comparison of outcomes for two firms with similar observable characteristics, same bank and same county in 2007, some with FX and some with HUF-only debt. Firm level outcomes such as sales, value added and investment reflect the operation of a firm. Size, captured through employment and age both reflect the life cycle of a firm. All these variables are indicative of firm level demand for loan. Existing debt determines the increased future value in debt. The county of the firm allows to control for firm-location specific shocks such as demand.[10] Controlling for pre-crisis bank is important as it allows to compare firms facing the same bank level shocks, thus controlling for the supply side. [11]

Further on, the dataset allows to test for the presence of parallel trends for treated and control firms for 2005-2007. As I show later, conditional on observable characteristics, in the pre-crisis period, the difference between the outcomes for treated and control firms is statistically not significant.

Time varying shocks affecting firm level outcomes that are correlated with FX debt would represent possible threaths to identification. For instance, a boom-bust cycle in credit supply, if we assume that firms with FX debt are less credithworthy, would allow firm with FX debt to easily obtain new loans in the boom period, but less likely in a credit rationing period. While my main specification cannot entirely separate loan supply from loan demand in the realization of the FX shock, I show that treated firms are not less creditworthy in the pre-crisis period, to the extent that creditworthiness is captured by firm level outcomes observed by the bank. While I cannot directly observe loan supply, in the 2.6 part of the paper I show indirect evidence that firm level financing decisions are not driven by credit supply.

Further on, it is important to note that the financing related outcomes for firms do not imply any general equilibrium effects. If for instance, less new borrowing on the firm level translates to less investment and lower economic growth, this effect will not be captured by β_k. Any changes in economic conditions faced by firms are subsumed in time fixed effects.

Finally, it could be the case that some firms in the treatment group strategically interact

[10] Controlling for settlement level firm location does not change my results. There are 19 counties in Hungary and the capital city and around 3200 settlements.

[11] Following Oster (2019), I provide a test for evaluating robustness to omitted variable bias in Table C.16 in the Appendix. I show that the coefficients are not quantitatively different when unobservables are accounted for.

10.14754/CEU.2020.11

with some firms in the control group, if the firms are active in the same industry. For example, firms not hit by the shock might start to more agressively acquire clients and expand through their pricing behavior. Unfortunately, there is no data available (e.g. on prices) to measure the outcome of strategic interaction between firms, caused by financial market distress.

1.5 Results

In this section, I present my results for firm level financing related outcomes, for firms with existing HUF or CHF debt in September 2008, and I follow the outcomes of these firms for the period 2005-2017. [12] My main outcome of interest is new borrowing in the years after the crisis. At the same time, I explore the behavior of firms related to contracts existing from the time around the crisis (e.g. delinquency and no recovery from delinquency) and I document the circumstances of new borrowing, such as type of new borrowing and the provider bank.

1.5.1 Delinquency

Table 1.2 shows the effect of foreign currency debt on firm delinquency. The outcome variable is 1, if the firm is 90 days past due on at least one of its loans in a given year.[13] The reported coefficient is β from equation 1.1 with a different set of controls in each column. The period covered in the estimation sample is 2005-2017, with after period starting in 2008. In the specification in column 1, only firm and time fixed effects are included. In column 2, I add 2007 firm level controls interacted with year dummies. Further on, in column 3 I include the location of the firm in 2007 interacted with year dummies and in column 4, in addition I include firms' bank in 2007, interacted with years. After the inclusion of controls the coefficient of interest decreases slightly, from 1.1 percentage point

[12] In this period, firms might exit the sample, however, with the available data, I am not able to disentangle between true exit (due to bankruptcy or other issues) and omitting to submit a tax declaration. The studied outcome variables delinquency or no recovery refer to past due on at least one loan contract of the firm in a specific year but it does not capture firm level bankruptcy. In order to avoid any confusion, I redo my estimations for a balanced panel of treated and control firms existing in the period 2005-2017. Results are unchanged, see Table A.5 and Charts A.4, A.5,A.6, A.7, A.8 for more detail.

[13] Commercial loans are considered non-performing if the borrower is 90 days past due.

to 0.7 percentage point. As explained earlier, my preferred specification is column 4. The estimated coefficient shows that changing the foreign currency debt from 0 to 1 causes a 0.7 percentage point increase in delinquency in the period after the crisis.

Table 1.2: Delinquency

	(1)	(2)	(3)	(4)
treatedxafter	0.0114***	0.0079***	0.0075***	0.0070***
	(0.0012)	(0.0013)	(0.0013)	(0.0017)
N	373997	250647	240993	240510
R^2	0.181	0.182	0.185	0.203
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Firm controls	NO	YES	YES	YES
Location	NO	NO	YES	YES
Bank	NO	NO	NO	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. The outcome variables is 1, if the firm is 90 days past due on at least one of its loans. The specification in the first column contains firm and year fixed effects. In addition, in column 2 I control for 2007 firm level characteristics (sales, employment, investment, age, real value added and industry) interacted with year. In column 3 I further control for firm location in 2007, interacted with year. In column 4, I add firms' bank in 2007, interacted with year to the previous set of controls. In all specifications standard errors are clustered at the firm level.

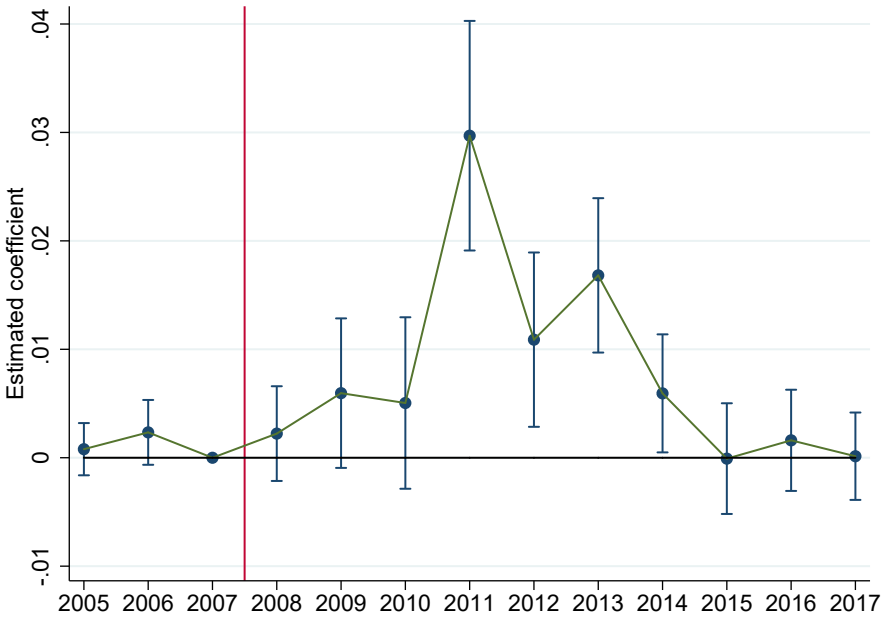
How does the magnitude of this effect change over time? Figure 1.6 plots the estimated β_k coefficients from equation 1.2 and it shows the effect for each year. Two years after the shock, there is no significant difference between treated and control firms. However, there is a spike in delinquencies in 2011, which fades away by 2015. For the 2005-2007 period, the estimated coefficients are not significantly different from zero; this supports the parallel trends assumption.

1.5.2 No recovery

Moreover, as Figure A.1 in the Appendix shows, firms are less likely to recover from delinquency. The outcome of no recovery is 1 for a firm, if, by the end of the year, it does not recover on at least one of its delinquent loan contracts. For the period after the crisis, firms are 0.3 percentage point less likely to recover from the delinquency, as shown in Table A.1 in the Appendix. No recovery is significantly larger for FX borrowers in the period

2011-2013. Again, the parallel trends assumption is valid, as the estimated coefficients are not significantly different from zero for the period 2005-2007.

Figure 1.6: Does the firm become delinquent?



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variables is 1, if the firm is 90 days past due on at least one of its loans. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

These results confirm that relative to HUF borrowers, CHF denominated loans put a burden on FX borrowers and two years after the FX shock are unable to meet their repayment obligations on their existing loans due to the unexpected increase in installments.

1.5.3 New borrowing

Next, I turn to the analysis of new borrowing following the sudden increase in debt. Table 1.3 shows the estimates from equation 1.1 for new borrowing under various specifications. The outcome variable is 1, if the firm has at least one new borrowing in a given year. By

adding more controls to the regression, the estimated coefficient of interest changes from -3.67 percentage point to -2.72 percentage point. The results in column 4, which is the preferred specification, show that having foreign currency debt is associated with a 2.7 percentage point decrease in new borrowing in the period after the crisis.

Table 1.3: New borrowing

	(1)	(2)	(3)	(4)
treatedxafter	-0.0367***	-0.0210***	-0.0237***	-0.0272***
	(0.0044)	(0.0049)	(0.0050)	(0.0060)
N	373997	250647	240993	240510
R^2	0.410	0.432	0.433	0.445
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Firm controls	NO	YES	YES	YES
Location	NO	NO	YES	YES
Bank	NO	NO	NO	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. The outcome variables is 1, if the firm is 90 days past due on at least one of its loans. The specification in the first column contains firm and year fixed effects. In addition, in column 2 I control for 2007 firm level characteristics (sales, employment, investment, age, real value added and industry) interacted with year. In column 3 I further control for firm location in 2007, interacted with year. In column 4, I add firm's bank in 2007, interacted with year to the previous set of controls. In all specifications standard errors are clustered at the firm level.

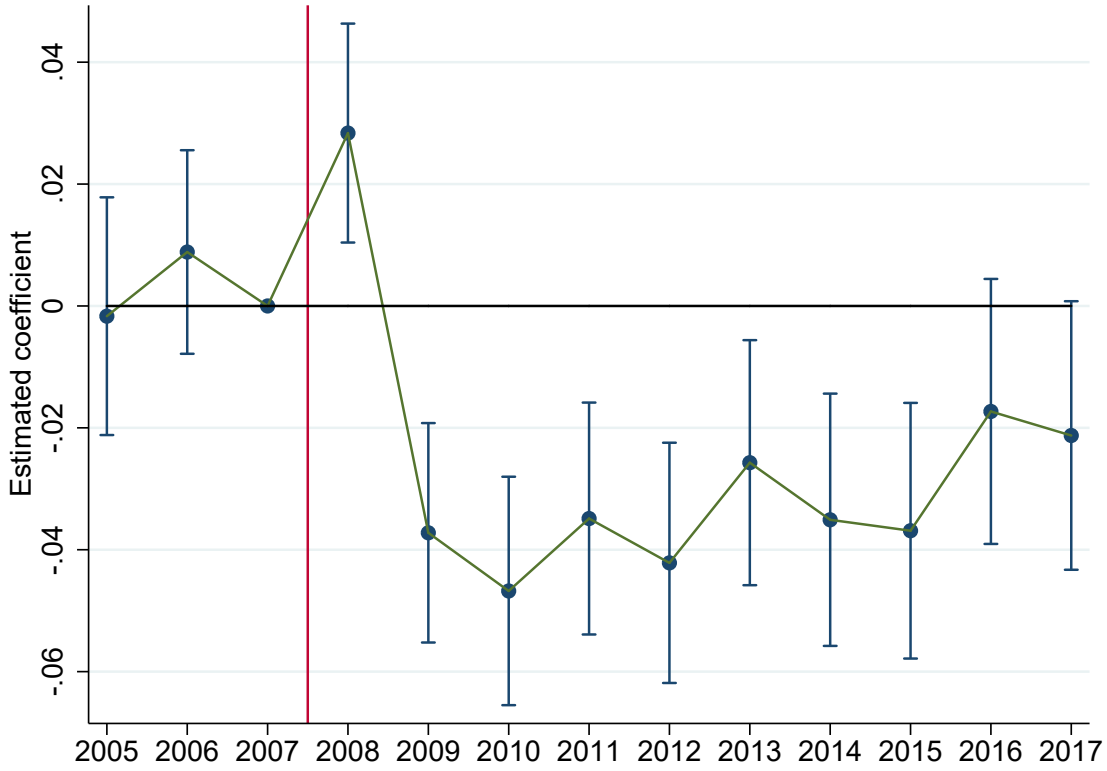
While firms are less likely to borrow while they are 90 days past due on their debt contracts, they may begin to borrow once they find a solution to repay their obligations from contracts with an unexpected increase in debt. Thus, it is more interesting to look at the effect on new borrowing in each year, which is given by Figure 1.7.

While treated firms still manage to borrow more in the year when the crisis starts, 2008, they borrow significantly less than HUF-only borrowers up until 2016. This result shows that new borrowing is affected negatively for CHF borrowers up to 7 years after the start of the depreciation and up to 3 years after affected firms cease to have significantly more non-repayment related issues. [14] As confirmed by non-significant coefficients before 2008,

[14]Firms might have various options to finance their activities, e.g. by issuing shares or bonds or by raising their own capital. In Hungary, bond financing is almost non-existent. Also, 98 percent of the sample represent SMEs with an organisational structure not allowing bond issuance. Chart A.9 in the Appendix shows that treated firms are indeed not likely to finance their activities by increasing their own

10.14754/CEU.2020.11

Figure 1.7: Does the firm borrow?



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the firm borrowed at least once in a given year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard error are clustered at the firm level.

pre-crisis borrowing for treated and control firms evolved similarly.

1.5.4 Type of new borrowing

Further on, I analyze what is the type of new borrowing (A.2). Do firms take out bank loans or do they prefer other types of bank financing? Figure A.2 in the Appendix shows that FX borrower firms are significantly less likely to borrow a bank loan in the period 2009-2017.

capital.

Even if affected firms' new borrowing is not significantly different for the years 2016-2017, their new financing is not through bank credit. [15] Again, as confirmed by non-significant coefficients before 2008, pre-crisis borrowing of bank loans for treated and control firms evolved similarly.

1.5.5 Bank for new borrowing

After analyzing the status of existing loans and new borrowing I look at which bank the firm borrows from in the years after the shock. The outcome variable of interest takes value 1, if the firm takes out at least one new loan from its pre-crisis bank in a given year. Table 1.4 summarizes the results and according to the specification in column 4, affected firms are 4 percentage point less likely to take out a new loan from their pre-crisis bank.

Table 1.4: Bank for new borrowing

	(1)	(2)	(3)	(4)
treatedxafter	-0.0465***	-0.0373***	-0.0388***	-0.0418***
	(0.0039)	(0.0047)	(0.0048)	(0.0058)
N	373997	250647	240993	240510
R^2	0.475	0.488	0.489	0.504
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Firm controls	NO	YES	YES	YES
Location	NO	NO	YES	YES
Bank	NO	NO	NO	YES

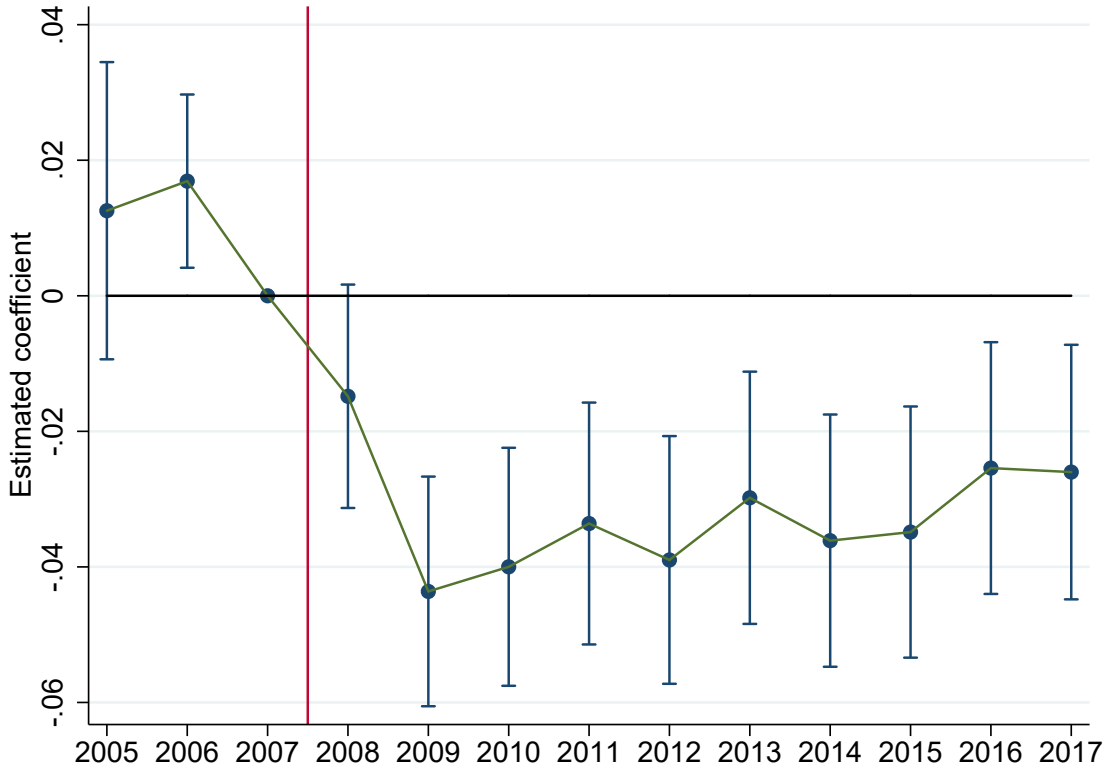
Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. The outcome variables is 1, if the firm takes out at least one new loan from its pre-crisis bank in a given year. The specification in the first column contains firm and year fixed effects. In addition, in column 2 I control for 2007 firm level characteristics (sales, employment, investment, age, real value added and industry) interacted with year. In column 3 I further control for firm location in 2007, interacted with year. In column 4, I add firm's bank in 2007, interacted with year to the previous set of controls. In all specifications standard errors are clustered at the firm level.

Figure 1.8 shows the effect on bank choice for each year. While there is a significant, slight increase in the coefficient in 2006 for threated firms, there is a large decrease in 2008

[15] Other types of new banking relationship could be bank guarantee, documentary letter of credit, credit line, financial leasing or loan guarantee.

which continues until the end of the studies period. These results might be interpreted as lack of trust towards the bank.

Figure 1.8: Does the firm take out a loan from its pre-crisis bank?



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the bank from which the new loan is obtained coincides with at least one of the banks of the firm in 2007. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard error are clustered at the firm level.

1.5.6 Aggregate effects

In this section I quantify the effect of the shock on aggregate lending using a back-of-the-envelope calculation. The estimated yearly effect of the shock is a 5 percent decrease in the

10.14754/CEU.2020.11

probability of obtaining a new loan.[16] For the period 2008-2017, treated firms borrowed 3862 billion HUF in total. In the decade after the crisis, the 5 percent decrease in the probability of obtaining a new loan for treated firms translates into a 193 billion HUF borrowing that was not realized due to the shock. This is equivalent to 4.4 percent of total debt in 2007.

1.5.7 Heterogeneity across firms

In this section, I explore the effect of the shock on different firm types. First I look at the effect by different size groups defined based on employment. Second I explore the differential impact of the crisis in the manufacturing, services and construction sectors. Third, I look at the effect by firms in different periods of their life cycles. Firms are grouped based on their characteristics in 2007.

Firm size I divide my sample of firms in three size groups: the bulk of firms are small firms, with less than 10 employees. [17] There are fever medium sized firm, with employment between 10 and 49 employees an there are even less large firms, with at least 50 employees. Table 1.5 shows the results from equation 1.1 for different firm categories by employment. Small firms are the most affected by the shock. They are 0.7 percentage point more likely to enter delinquency, are 0.4 percentage point less likely to recover, are around 4 percentage point less likely to borrow, are 5 percentage point less likely to take out a new bank loan and are 4 percentage point less likely to borrow from their pre-crisis bank. These results are very similar to the earlier discussed results pointing to the fact that the results are driven by small firm behavior. While medium sized firms are more likely to enter delinquency and borrow later on from other banks, their overall new borrowing is not affected. Also, the few large firms in term of employment in the sample are not affected in their financing related outcomes. As small firms are more likely to be dependent on external financing, their financing-related decisions can have a large impact on the future of their activity.

[16] This effect is obtained as the sum of differences of predicted values from two regressions. The first regression is the baseline regression, whereas the second regression is the baseline regression with 0 treatment value for all observations.

[17] The balance tables by firm size are provided in Tables A.12, A.13 and A.14 in the Appendix.

Table 1.5: Difference in differences regression by firm size groups

	(1) Delinquency	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
<10 empl.	0.0072***	0.0040**	-0.0378***	-0.0476***	-0.0423***
	(0.0022)	(0.0016)	(0.0077)	(0.0078)	(0.0071)
N	173006	173006	173006	173006	173006
R^2	0.205	0.208	0.433	0.441	0.481
10-49 empl.	0.0075***	0.0026	-0.0073	-0.0119	-0.0404***
	(0.0028)	(0.0023)	(0.0106)	(0.0110)	(0.0109)
N	59696	59696	59696	59696	59696
R^2	0.238	0.229	0.423	0.439	0.515
>49 empl.	-0.0009	-0.0005	-0.0162	-0.0528	-0.0555
	(0.0084)	(0.0062)	(0.0302)	(0.0336)	(0.0337)
N	6568	6568	6568	6568	6568
R^2	0.372	0.372	0.532	0.550	0.587
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. After period starts in 2008. Standard error are clustered at the firm level.

Industry Table 1.6 Next, I turn to the analysis of borrowing behavior in the manufacturing, services and construction sectors. [18] Firms in the manufacturing (e.g. Rajan and Zingales (1998),Braun and Larrain (2005)) and construction sector are more credit dependent because of physical investment and their buyer-supplier links, as these transactions might need to be financed with short term credit. I classify firms based on their 2007 industry. Manufacturing firms represent about 12 percent, services firms around 60 percent and construction firms around 16 percent of the sample. Estimation result in Table 1.6 show that new borrowing is significantly negatively affected in the manufacturing and services industries. Firms in these sectors are also less likely to borrow a loan or to return to their pre-crisis bank in the decade after the crisis. While crisis affected firms in the manufactur-

[18] Balance tables for the subsamples of firms by industry are provided in Tables A.6, **??** and A.8 in the Appendix.

ing are not more likely to become deliquent, services and construction firms are more likely to de affected by loan default.

Table 1.6: Difference in differences regressions by industry

	(1) Delinquency	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
Manufacturing	0.0037	-0.0025	-0.0550***	-0.0486***	-0.0543***
	(0.0046)	(0.0035)	(0.0162)	(0.0166)	(0.0155)
N	33697	33697	33697	33697	33697
R^2	0.232	0.243	0.458	0.463	0.524
Services	0.0075***	0.0027*	-0.0253***	-0.0367***	-0.0398***
	(0.0021)	(0.0016)	(0.0076)	(0.0079)	(0.0073)
N	148089	148089	148089	148089	148089
R^2	0.210	0.209	0.444	0.447	0.501
Construction	0.0112**	0.0101**	-0.0152	-0.0383**	-0.0158
	(0.0047)	(0.0041)	(0.0158)	(0.0164)	(0.0158)
N	38540	38540	38540	38540	38540
R^2	0.235	0.239	0.477	0.479	0.542
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. After period starts in 2008. Standard error are clustered at the firm level.

Age The need for and ability to raise external finance varies throughout firms' life cycle. In the first years of their activity, firms might need more external resources for establishing their business and expanding. Dinlersoz et al. (2018) show that young, private firms are in need of more external financing. I divide my sample into subsamples of firms who are younger than 6 years, who are between the age of 6 and 15 and firm older than 15 year, as of 2007. [19][20] Table 1.7 shows the financing related outcomes for firms in different age groups. Firms who were younger when they faced the financial shock are more affected in

[19]Median firm age in the sample is 10 years.

[20]Balance tables for the subsamples of firms by age group are provided in Tables A.9, A.10 and A.11 in the Appendix.

their borrowing outcomes in the 10 year period after the shock. Firms up to 6 years and up to 15 years old are more likely to become delinquent are less likely to borrow and are less likely to borrow a loan and are less likely to return to their pre-crisis bank.

Table 1.7: Difference in differences regression by firm age groups

	(1) Delinquency	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
<6 years	0.0083***	0.0036	-0.0295***	-0.0459***	-0.0303***
	(0.0031)	(0.0024)	(0.0100)	(0.0101)	(0.0093)
N	99641	99641	99641	99641	99641
R^2	0.224	0.221	0.450	0.449	0.504
6-15 years	0.0058***	0.0031*	-0.0255***	-0.0343***	-0.0468***
	(0.0022)	(0.0016)	(0.0084)	(0.0086)	(0.0082)
N	120463	120463	120463	120463	120463
R^2	0.207	0.211	0.447	0.456	0.503
>15 years	0.0094**	0.0029	-0.0219	-0.0264	-0.0427**
	(0.0047)	(0.0027)	(0.0173)	(0.0188)	(0.0176)
N	24637	24637	24637	24637	24637
R^2	0.268	0.260	0.487	0.489	0.531
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. After period starts in 2008. Standard error are clustered at the firm level.

1.6 Robustness

Weighted regressions (Harasztosi and Lindner, 2019), in their paper using Hungarian firm level data, propose log sales weighted regressions. [21] I rerun a log sales weighted version of 1.1 and I show in Table 1.8 that the results for the outcomes of interest do not change in terms of magnitude or significance.

[21] As sales are highly skewed, using level weights would be problematic.

10.14754/CEU.2020.11

Table 1.8: Weighted regressions

	(1) Delinquency	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
treatedxafter	0.0063***	0.0026**	-0.0269***	-0.0370***	-0.0434***
	(0.0016)	(0.0012)	(0.0060)	(0.0063)	(0.0060)
N	231793	231793	231793	231793	231793
R^2	0.203	0.207	0.437	0.445	0.511
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Log sales weighted regressions. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

Continuous treatment So far, I used treatment as a dummy variable, taking value 1 if the firm had some outstanding CHF debt. This measure could be slightly misleading, as it is not explicit about the exact amount of CHF debt firms are holding.[22] To be more precise, I redefine treatment as the share of CHF debt in total debt in September 2008 and I rerun equation 1.1 for all outcomes of interest as a robustness check. [23] Table 1.9 reports the financing related outcomes using this alternative measure of treatment. Results for new borrowing are very robust to the continuous definition of treatment: new borrowing is estimated to deprease by 3.4 percentage point, while earlier the obtained result was a decrease of 2.7 percentage point. The probability of obtaining a bank loan decreases by 3.2 percentage point under this specification, whereas earlier the coefficient indicated a 3.7 percentage decrease. The probability of returning to the pre-crisis bank decreases by 2.9 percentage point, this coefficient was 4.2 percentage point in the baseline specification. The effect on delinquency and no recovery from delinquency is not significant.

[22]Mean firm level CHF debt share is 0.27, with 0.42 standard deviation, based on September 2008 exposure.

[23]Debt amounts used to construct the share of CHF debt in total debt are calculated from the contracts used before to define treatment dummy.

Table 1.9: Regressions with continuous treatment

	(1) Delinquency	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
treatedxafter	0.0037*	0.0009	-0.0342***	-0.0324***	-0.0285***
	(0.0020)	(0.0015)	(0.0070)	(0.0072)	(0.0067)
N	240413	240413	240413	240413	240413
R^2	0.203	0.202	0.445	0.449	0.504
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, end of year debt industry, bank and location) interacted with year. Treatment is defined as the share of CHF debt to total debt in September 2008, the month prior the crisis. Standard error are clustered at the firm level.

Small firms Earlier research using the Hungarian census of firms argues that firms with less than 3 employees or less than 5 employees are very volatile and provide less reliant data, as they have higher incentives for tax evasion. [24] These firms are usually discarded from estimations. As firms in my estimation sample were borrowers, at least before the crisis, I assume that the financial statements were thouroughly examined for these firms when they obtained loans. Nevertheless, I follow earlier work and discard firms with less than 3 employees in 2007 from my sample. I rerun a log sales weighted version of 1.1 and I show in Table 1.10 that the results for the outcomes of interest do not change in terms of magnitude or significance. [25]

Lagged dependent variable As firms past financing related outcomes might influence their current decisions, I rerun my main regressions by controlling for the first lag of the dependent variable. Table 1.11 summarizes the results for the main outcomes of interest. While the estimated effects slightly decrease, all coefficients of interest remain significant at 1 percent significance level.

[24] For example (Harasztosi and Lindner, 2019), (Katay and Harasztosi, 2017), (Endrész and Harasztosi, 2014).

[25] Results are unchanged when I discard firms with less than 5 employees in 2007.

Table 1.10: Regressions without small firms

	(1) Delinquency	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
treatedxafter	0.0082***	0.0041***	-0.0267***	-0.0340***	-0.0438***
	(0.0019)	(0.0015)	(0.0069)	(0.0073)	(0.0071)
N	143268	143268	143268	143268	143268
R^2	0.218	0.216	0.438	0.444	0.512
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Log sales weighted regressions. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

Table 1.11: Controlling for lagged dependent variable

	(1) Delinquency 90d	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
treated_after	0.0059***	0.0026***	-0.0182***	-0.0315***	-0.0213***
	(0.0013)	(0.0010)	(0.0054)	(0.0058)	(0.0061)
N	216115	216115	216115	216115	216115
R^2	0.075	0.056	0.329	0.340	0.406
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Log sales weighted regressions. Year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

Time trend To account for time varying firm specific factors, I rerun my main regressions by controlling for firm specific time trend. Table 1.12 summarizes the results for the main outcomes of interest. While the estimated effects change to some extent, all coefficients of interest remain significant at 10 percent significance level. Firm specific time trends might reflect omitted variables, however, the relatively short period before the shock might result in misleading results from fitting panel-specific trends (Wolfers, 2006).

10.14754/CEU.2020.11

Table 1.12: Controlling for time trend

	(1) Delinquency 90d	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
treated_after	0.0104***	0.0037*	-0.0156*	-0.0151*	-0.0412***
	(0.0027)	(0.0020)	(0.0086)	(0.0089)	(0.0078)
N	240510	240510	240510	240510	240510
R^2	0.204	0.202	0.445	0.449	0.504
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Log sales weighted regressions. Firm fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

1.7 Mechanism

So far, I have documented that firms which were more affected by the crisis through their foreign currency borrowing are more likely to have financing difficulties and borrow less for up to seven years after the crisis. It is natural to ask whether these firms do not want to enter into new borrowing contracts later on or it is rather the banks who do not want to lend to these firms. While it is challenging to disentangle credit demand from supply, I provide further empirical evidence suggesting that the differences in financing related outcomes for treated and control firms are rather driven by firms' decisions to borrow. The main concern is that banks are simply not willing to lend to firms for many years after the crisis. To the extent that banks take their lending decisions based on firm level outcomes and firm level credit history, I show that these variables do not affect my main coefficient of interest. Further on, I provide suggestive evidence that it is not firms' ability to borrow that explains decreased borrowing on the long term.

1.7.1 Ability to repay

Given that CHF borrower firms, in comparison with HUF-only borrowers, face an unexpected increase in their leverage and subsequent debt-related obligations, it is likely that

the prospectives of these firms substantially worsen and even if they would like to obtain a new loan or refinance their existing debt, banks do not consider them creditworthy. They hit their credit constraint. Loan request forms from commercial banks suggest that beyond general information about the firm and a short description of the purpose of the requested credit, one of the main firm level outcomes that banks take into consideration for the application of a firm is sales. In order to capture the credithworthiness of the firm and its ability to repay, I control in my regression for the logged value of sales. Figure 1.9 shows the results from 1.2, with log sales as an additional control. [26] The estimated coefficients are unchanged, showing that the credithworthiness of firms, as observed by banks, has no impact on financing related outcomes.[27]

1.7.2 Credit history

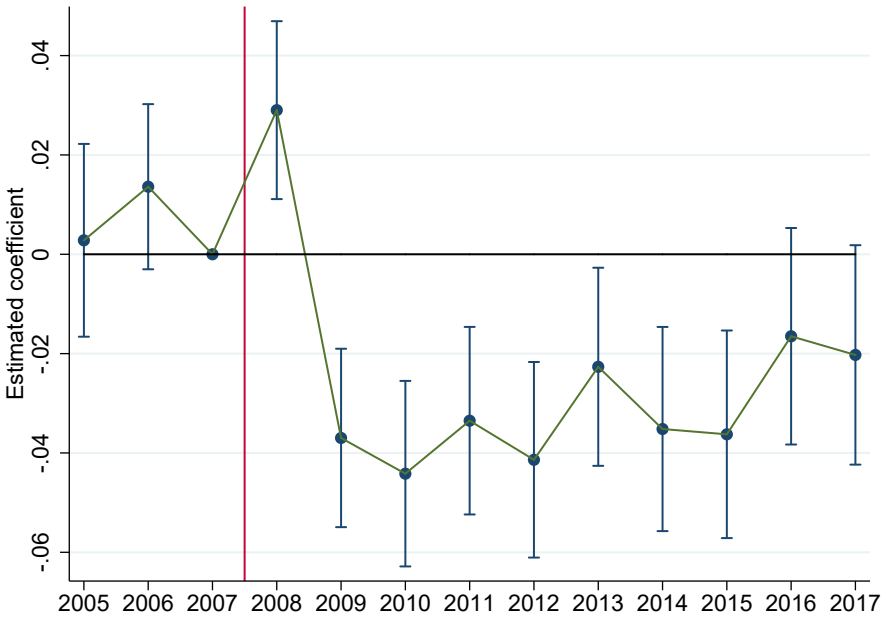
Beyond realized firm level balance sheet outcomes, banks can observe the creditworthiness of firms from the credit registry. Banks can observe all existing contracts with characteristics of the firm, including any events such as delinquency. Even if a contract was ended, it is kept in the credit registry for 5 years after its closure. Following Jiménez et al. (2014), I construct a proxy for firm level credit risk using credit registry data. For a given year and a given firm, I construct a categorical variable indicating whether any bank would observe no history for that firm in the credit registry, no bad history or bad history. No history refers to the case when no entry is observable for a given firm in the credit registry. In the case of no bad history, the firm has at least one contract in the credit registry, but no bad event is observale for the firm, such as delinquency (90 days past due). Bad history refers to the case when there is at least one delinquency event in the past of the firm. I rerun my main regression with outcome for new borrowing by including in the regression the categorical variable for credit history. To the extent that the creditworthiness measure captures banks' willingness to lend to firms, by including the categorical variable for credit history in the regression I control for credit supply. Figure 1.10 shows the estimated coefficient from 1.2,

[26] It is likely that banks can observe all balance sheet entries for a firm, thus, I rerun the regression with various sets of controls defined from balance sheet items. Figure A.3 in the Appendix shows the result for new borrowing, when controlling for sales, materials, total wagebill and capital as these variables capture to a larger extent the activity of a firm. Results for all other outcomes are shown in Table A.3.

[27] Firms have to fill in the credit request form with sales in t, $t-1$ and $t-2$, if applicable. Including contemporaneous and lagged values of sales does not change my main results.

10.14754/CEU.2020.11

Figure 1.9: Does the firm borrow? Controlling for sales



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the firm borrows at least once in a year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

with the credit history variable as an additional control. The results are unchanged. [28].

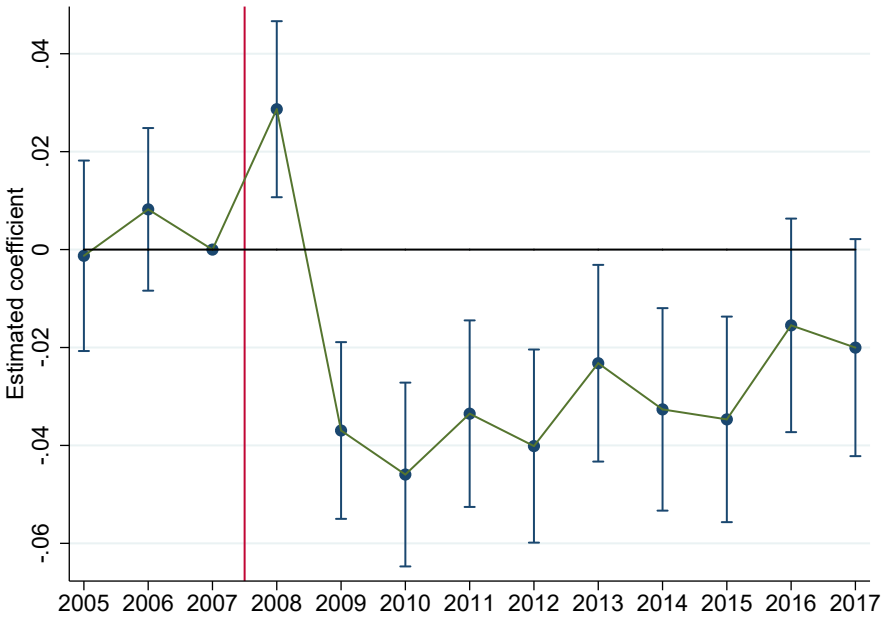
1.7.3 Bank query as observed demand

I further separate credit demand from supply by using data on the exact time when a bank obtained information about a firm from the credit registry. Following Jiménez et al. (2012), I use loan applications as an equivalent to observed loan demand by firms. Banks facing this loan demand have to decide about their firm specific loan supply. I define loan applications from the credit query database. I discard those observations where an existing client of the bank was queried, as in this case obtaining information because of a new loan application or

[28]Results for all firm level financing related outcomes are reported in Table A.4

10.14754/CEU.2020.11

Figure 1.10: Does the firm borrow? Controlling for credit history

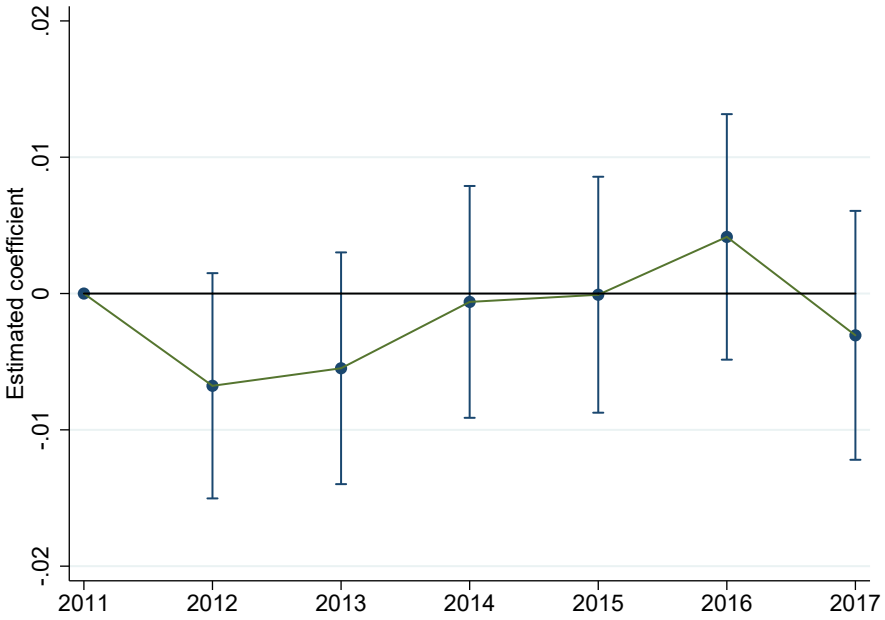


Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the firm borrows at least once in a year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

checking the status of an existing loan cannot be separated. Instead I focus on queries done by banks with whom the firm does not have a loan. In this way, I focus on the extensive margin of new lending. At the same time, I observe which bank gave a new loan to a firm. I aggregate up the database on the firm-year level for the period 2011-2017 by counting the number of banks who gave a new loan to a firm and the number of banks who queried a firm in a given year. From these, I construct a variable giving the probability of granting new loans on the firm level for the period 2011-2017. I ask wether the difference in rate of granting a new loan is explained by treatment status in the period after the crisis. Figure 1.11 plots the estimated coefficients from equation 1.2 for the period 2011-2017, with the rate of granting a new loan as an outcome variable. There is no significant difference in the probability of granting a new loan for the treated and controls firms, indicating that the

evolution of the financing related outcomes in the decade after the crisis are rather driven by firm demand.

Figure 1.11: Rate of granting a new loan



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is the rate of granting a new loan, defined as the number of new loans to queries in a given year. Only those queries and new loans are accounted for where there is no contemporaneous relationship between the bank and the firm. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Base year is 2011. Standard errors are clustered at the firm level.

1.7.4 Borrowing from other banks

One of the main results of the paper is that affected firms borrow less from their pre-crisis bank. This finding could also be interpreted as a supply effect and it can be claimed that the pre-crisis bank knows the firm well and refuses to lend to the firm in the period after the crisis. In Appendix Figure A.12 I show that, while there is an uptick in borrowing for treated firms in 2006, there is no significant difference in borrowing up until 2009 and that

treated firms borrow less in the entire post-crisis period from banks which do not coincide with their pre-crisis bank. This evidence suggests that treated firms borrow less compared to control firms from all banks.

1.7.5 Liquidity and wealth effect

How does the shock materialise at the firm level? Does it create a debt overhang on the long term which prevents firms from resuming their normal operations? First, in figure A.10 in the Appendix I show that there is no significant difference in the cash flow of control and treated firms for the period 2005-2017. Thus, treated firms are no worse off in generating cash to pay their debt obligations and operating expenses. Second, in figure A.11 in the Appendix I show that there is no significant difference in the share of own funds to total liabilities for the treated and control firms in the period 2005-2007. This suggests that there is no difference in the financial independence of the firms in the two groups but rather behavioral differences between the two groups of firms.

1.8 Conclusion

While firm-level real effects of being exposed to a crisis are widely documented, our understanding of borrowing decision is much less limited. To study the effect of a large financial shock on firm level borrowing, I exploit the large and unexpected HUF/CHF exchange rate depreciation in Hungary in October 2008. After years of stable HUF/CHF exchange rate, at the onset of the crisis the Forint depreciated relative to the Swiss frank by 32 percent from September 2008 to March 2009. This abrubt change in exchange rate is explained by investors' withdrawal of funds from emerging markets, explained by flight to safety motives.

In the years prior to 2008, Hungarian firms built up a large amount of debt denominated in foreign currency. By 2008, around 15 percent of total debt in Hungary is denominated in Swiss frank, while around 40 percent is denominated in domestic currency. CHF borrowers, with a mismatch in their balance sheet, were severely affected by the large domestic currency depreciation.

I compare the financing related outcomes of firms affected by the exchange rate through their debt holding to non-affected firms for up to ten years after the crisis. While on

10.14754/CEU.2020.11

the medium term affected firms are more likely to be distressed by delinquency, on the long term not even bank supply explains their lower borrowing, compated to control firms. Firms exposed to a large revaluation in foreign currency debt are 0.7 percentage point more likely to become 90 days past due on their debt-related obligations. Affected firms are significantly more likely to become delinquent on their loans in the period 2011-2013, 3 years after the crisis. Moreover, treated firms are 3.5 percentage point less likely to recover from delinquency than control firms. This effect is significant and positive for the period 2011-2013. While it seems that it takes time for firms to de-leverage, it takes them a much longer time to borrow again. Treated firms are 2.7 percentage point less likely to borrow in the period after the crisis. There is a significant negative effect on new borrowing for seven years, for the period 2009-2015. In the period after the crisis, firms are 3.8 percentage point less likely to obtain a bank loan (versus other types of borrowing such as financial leasing). There is a significant negative effect for the entire post crisis period. Finally, I show that treated firms are 4 percentage point less likely to turn to their pre-crisis bank when they borrow and this effect is significantly negative for 2009-2017. I show that small firms, firms operating in manufacturing and services and younger firms are more negatively affected in their financing related decisions. All else unchanged, the 2.7 percentage point difference in new borrowing between treated and control firms translates into a HUF 193 billion decrease in the stock of debt in the decade after the crisis. Altogether, the new borrowing that did not materialize is equivalent to 4.4 percent of total debt in 2007.

My results have several policy implications. First, they show the importance of leverage reduction after the crisis. For the time firms face and unexpected increase in debt in their balance sheets, they cannot continue their operations as in normal times, including borrowing. Second, they point to the severe effects of mismatch on delinquency and its possible impact on financial stability. Third, according to my results, it is important to raise financial awareness among firms as some early negative financial market experiences can have long term borrowing consequences.

10.14754/CEU.2020.11

Chapter 2

Spillover effects in firm's bank choice

2.1 Introduction

Banking relationships shape the financing decisions of firms. For many firms, borrowing from banks represents the only source of external finance. How do firms decide which bank to borrow from when they apply for a new loan? Existing theory (e.g. Rajan (1992)) describes how firms choose the amount of borrowing from different sources, suggesting that bank-firm relationships are strongly shaped by firm decisions. However, we know little about what drives firms' choice of specific banks.

In this paper, we provide evidence on network effect in bank choice, pointing to a new mechanism explaining firm-bank relationship formation. Combining domestic production network data from value-added tax (VAT) declarations and corporate credit registry for Hungary, we estimate that having at least one firm in their network who has an existing loan with a bank increases the probability that the firm will borrow a new loan from the same bank by 0.36 percentage point. This spillover effect is large compared to the baseline probability of 0.55 percent of obtaining a new loan in our sample. As the estimated coefficients are similar for buyer and supplier links, the direction of trade does not matter in information diffusion about banks.

Next, we turn to the estimation of heterogeneous spillover effects by firm characteristics. Network effects are stronger for smaller firms (in terms of employment and total assets) and they are increasing in traded value between firms. In addition, we show that spillover effects

are stronger when firms obtain a bank loan, bank guarantee and credit line, in comparison with other types of borrowing such as leasing.

We examine what mechanism can explain our result and provide suggestive evidence that the estimated spillover effect is due to firm-to-firm information transmission about banks. Learning about bank specific borrowing opportunities is important when firms apply for new loans and such information might be discussed among buyer-supplier firms. We provide evidence against the main alternative mechanism of bank information advantage when giving a new loan. If banks know the network of the firm through existing contracts, they might be more willing to lend to a firm who is in a business relationship with an existing borrower. From the symmetric network effect for buyers and supplyers and the decreasing effects by firm characteristics' quartiles, we infer that it is rather the firm-to-firm information transmission mechanism explaining our results. The estimated spillover effects further increase when hubs are excluded, which we consider yet another suggestive evidence for this mechanism.

We build a new firm-bank-quaerter panel dataset for firms borrowing a new loan that combines several sources. First, the VAT declaration database allows us to observe buyer and supplier links for domestic firms. Second, firms' credit history, existing exposure with banks and new borrowing can be defined from the firm credit registry. Thus, for any firm borrowing a new loan we observe its credit history, its connections and connected firms' credit history, on the bank level. We complement this dataset with firm level characteristics from census data, firm headquarter and bank branch location data, firm ownership and management data.

Our sample construction allows us to identify the effect of interest from bank variation, despite the difficulty of network effect estimation using observational data. First, by looking at connected firms' past experience with banks and by constructing a sample with firms who never had a bank loan in the past, we overcome the problem of peers' and firm's behavior being jointly determined. Second, by exploiting variation on the bank level, we can overcome the selectivity problem in network formation, namely that certain types of firms trade with certain types of firms who might borrow from the same bank. Estimating our regression on a firm-bank-quarter level database allows us to include firm-quarter fixed effects, which mitigates this selectivity problem. Third, this specification allows us to

10.14754/CEU.2020.11

control for any unobserved shock by including bank-quarter fixed effects. A main concern would be that there are changes in the supply of credit at certain banks, influencing the availability of credit for firms in a network. Bank-quarter fixed effects capture such changes in credit supply and it allows us to disregard any other bank level controls.

Given this specification, a remaining concern is that the source of variation in connected firms' bank choice is unknown, which could lead to omitted variable bias. For instance, some banks are present only in some regions, so that it is rather availability of credit through distance to a bank that determines bank choice. Our choice of banks for the estimation sample mitigates this bias. We focus on the eight main banks on the Hungarian market, which have a country-wide branch network, have similar corporate portfolio market shares, offer products with comparable conditions and are similar in terms of average characteristics of their corporate portfolio. Thus, we think that it is less likely that certain types of firms borrow from certain banks. Nevertheless, we complement our estimations with a wide set of robustness checks through which we rule out various alternative stories that could drive our results.

This paper contributes to a growing literature on the effect of networks on various firm level outcomes. In a randomized experiment, Cai and Szeidl (2018) find that the networking of owner-managers of young Chinese firms persistently increases firm revenue, profits, inputs, the number of partners, bank and informal borrowing and leads to improvements in management practices. In a similar setting, Fafchamps and Quinn (2018) show that meetings between experienced and aspiring entrepreneurs influence VAT registration and having a bank current account for firms in the manufacturing sector in Africa. In addition, Mion and Opromolla (2014) and Bisztray et al. (2018) document spillover effects in exporting and importing in firm networks. Compared to these papers, our work explicitly focuses on firm-bank level borrowing.

In terms of outcomes of interest, our paper is related to that of Khwaja et al. (2011) and Bao (2019). In the first paper, the authors show that for firms entering a network, borrowing increases both on the intensive and extensive margin and new relationships are more likely to be formed with banks that already have a lending relationship with one of the immediate giant-network neighbors of the firm which enters the network. Membership in the network also reduces the propensity to enter financial distress. Interfirm network is

defined based on common directors in the study. In the second paper, the author shows that firms obtain lower loan rates when borrowing from banks that lent to their peers in the syndicated loan market in previous quarters, where peers are defined based on the proximity of products sold. We add to these papers by clearly defining interfirm connections from a production network, where we observe supplier-buyer links and by knowing the universe of bank-firm lending relationships for a country where bank lending is the main source of external finance.

Finally, our paper builds on a broader literature on bank-firm relationships. This literature (e.g. Degryse and Van Cayseele (2000), Ongena and Smith (2001), Bolton et al. (2016), Dass and Massa (2011), Santos and Farinha (2000), Cole (1998), Agarwal and Ann Elston (2001), Boot (2000)) focuses mostly on the informational advantage stemming from durable bank-firm relationships. Fewer papers have studied how firm-bank relationships actually form. Ongena et al. (2011) show that those firms which find bank reputation more important than costs when choosing a bank form fewer banking relationships and are less likely to end their relationship. By estimating a spillover effect in bank choice, we add to the understanding about how firms choose banks when applying for a new loan.

Our paper has two main contributions. As the literature above suggests, there is a diffusion in various firm level decisions among networked firms. By showing that there is a network effect in bank choice upon obtaining a new loan, our paper adds to the knowledge about firm behavior on credit markets. This helps us uncover a new channel of bank-firm relationship formation. Moreover, our results point to important aggregate effects stemming from the selective choice of banks due to network effects. Shocks to domestic supply chains can have an impact on corporate failure (e.g. Jacobson and Schedvin (2015)) and loan repayment and, as a consequence, on bank profitability, raising financial stability concerns.

The remainder of the paper is structured as follows. In section 2.2, we briefly describe the Hungarian market for corporate loans. Section 3.3 describes the data. Section 2.4 presents the empirical strategy. We present our results in Section 3.5. The mechanism behind our results is presented in 2.6. The results of an extensive set of robustness checks are summarized in Section 3.5.3. The last section concludes.

10.14754/CEU.2020.11

2.2 Bank lending in Hungary

In Hungary, the banking industry is dominated by eight large banks covering most of the corporate lending market. These banks, in comparison with smaller ones present on the market, have a wide territorial coverage. The eight main banks have at least 2 branches in a county.[1] Motivated by the fact that geographic distance matters for loan availability (Degryse and Ongena, 2002), we exclude smaller, area-specific lending institutions from our sample. We focus on the eight largest bank in terms of their corporate portfolio market share, which are present at least at the county level so that they are equally accessible for firms.

Beyond accessibility, the eight large banks chosen for our estimation sample are similar in their corporate portfolio and lending conditions. We refer to the main banks in Hungary as Bank1 through Bank8 and we present the main facts regarding corporate lending for these banks for the period 2015-2017 in Table 2.1. Bank9 refers to all other banks present in the Hungarian market. Column 1 shows that the top eight banks cover almost 75 percent of the corporate lending market, with individual shares varying between 5 and 13 percent. These banks have also the largest shares in terms of new corporate loans issued, with an aggregate market share of 73.6 percent in new lending. Compared to the rest of the banks, the eight main banks have large corporate portfolios, with shares between 35 and 76 percent. In terms of lending conditions, for the main banks, interest rates on new loans are in the range of 1.9 and 2.5 percent, whereas the weighted average for the rest of the banks is 2.9 percent. The interest rate spread on new lending varies between 1.4 and 2 percentage points for the top eight banks, with 2.3 percentage points for the banks representing the rest of the market.

2.3 Data and summary statistics

We build a novel firm-bank-quarter level database by combining firm-to-firm sales data with credit registry, firm tax filings as well as various other sources of data. Below, we briefly

[1] Hungary is subdivided administratively into 19 counties and the capital city, Budapest. We assume that for most of the administration as well as banking, firms have to travel to the county seat, which is the main city within the county.

Table 2.1: Bank characteristics and lending conditions

	Corporate lending market share, %	New corporate lending market share, %	Firm portfolio, %	Interest rate on new loans, %	Interest rate spread on new loans, pp
Bank1	8.1	6.6	59.0	2.1	1.8
Bank2	8.2	2.0	60.1	1.9	1.9
Bank3	10.6	8.5	52.0	2.3	2.0
Bank4	5.0	5.3	53.2	2.3	2.0
Bank5	6.5	9.7	34.6	1.9	0.9
Bank6	10.7	13.4	67.4	2.5	1.6
Bank7	13.0	14.1	76.1	1.9	1.5
Bank8	12.0	14.1	58.9	2.2	1.4
Bank9	25.8	26.3	15.7	2.9	2.3

Notes: Descriptive statistics represent mean values for the period 2015-2017. Bank1 to Bank8 represent the eight largest banks in the Hungarian market. Bank9 refers to all the other banks present in the Hungarian market. Corporate lending market share gives the share of bank specific corporate lending in total corporate lending. New corporate lending market share is defined as the share of new bank specific corporate lending in total new corporate lending. Firm portfolio gives the bank specific share of corporate lending in total lending. Interest rates on new loans and interest rate spreads on new loans are loan volume weighted average interest rates. The interest rate spread can be calculated for HUF loans and it represents the spread over 3-month BUBOR. In this period, around 80 percent of new lending was denominated in HUF. For Bank9, representing the rest of the banking sector, values for firm portfolio, interest rate and interest rate spread on new loans are corporate market share weighted averages.

describe our main sources of data, estimation sample construction and present descriptive statistics to justify our sample used for estimation.

2.3.1 Data

Production network data We use domestic firm-to-firm sales data to construct our production network for Hungary for the period 2015-2017. The data originates from value added tax (VAT) filings submitted to the National Tax and Customs Administration (NAV).

The reporting rules for the VAT data are the following. By default, firms have to declare on a quarterly basis the value of their purchases/sales, the VAT claims/obligations stemming from transactions which imply a VAT due/claim of around aboe EUR 3000 and the identity of the transaction partner. Firms which generated a high tax value have the obligation to

report monthly, while firms with a low tax liability report on a yearly basis. The cutoffs for declaration frequency are defined based on the difference between VAT payable and VAT deductible, two years prior to the fiscal year: if this difference (irrespective of sign) is below appr. EUR 750 for the year $t-2$, firms can report on a yearly basis. In addition, yearly reporting implies gross sales below EUR $145,000$. If tax liability was above EUR 3200 on a yearly basis two years before the current fiscal year, firms have the obligation to report monthly. [2]

We define our dataset on quarterly frequency.[3] We define two firms to be connected in the production network if the quarterly transaction of a given firm pair is positive. For some of our regressions, we will account for the direction of transactions as well as traded value.

Credit registry The corporate credit registry contains all loans granted to firms by all credit institutions on the contract level in Hungary. The dataset is available for the period 2012-2017 on a monthly frequency.[4] The credit registry offers information on the original amount, outstanding amount, date of origination, maturity, type of reimbursement, loan type, currency, delinquency, firm and bank identifier for each contract.

In our definition, a firm obtains a new loan from a given bank in a given quarter if that firm borrowed at least one new loan from that bank. The database also allows us to construct the credit history of the firm with a specific bank: we define a firm being connected to a bank if in a quarter it has exposure with that bank. Regarding loan types, we know whether the loan is short or long term borrowing and whether it enters the balance sheet of the bank. [5] We can differentiate between the following types of corporate borrowing: bank loan, bank guarantee, documentary letter of credit, credit line, financial leasing and

[2]Quarterly reporting implies the submission of the VAT filings up to 20 days after the last month of the quarter, monthly reporting implies the submission of the VAT filings up to 20 days after the end of the month, whereas yearly reporting implies the submission of the VAT filing until February 25 of the next year.

[3]Yearly tax declarations are accounted for in the fourth quarter of the year, while monthly declarations are aggregated to quarterly frequency. For example, in the raw dataset for 2017, 4 percent of firms report on a yearly frequency, 34 percent report on a quarterly frequency and 62 percent report on a monthly frequency.

[4]While credit registry data is available from 2005 for Hungary, data reporting has changed from 2012. We use the version of the credit registry starting in 2012.

[5]For example, unused credit line is not in the balance sheet of the bank, whereas if it has been drawn down, it enters the balance sheet of the bank.

loan guarantee.

Firm-level data Firm-level data originates from corporate tax filings to the National Tax and Customs Administration (NAV) and contains balance sheet and income statement entries for all double bookkeeping firms in Hungary. It contains information on capital, assets, sales, export sales, employment, payrolls, intermediates, value added and industry of the firm. Using this dataset, we estimate firm level total factor productivity (TFP) using the Olley and Pakes (1996) method.

Bank query data The bank query shows the day on which a given bank queried a firm from the credit registry. In case of an existing bank-firm connection such as loan contract, the bank has the obligation to query the firm yearly. Banks also have the obligation to query a firm from the credit registry when they seriously consider giving a loan to a firm. Upon query, banks can see all the variables from the credit registry listed earlier, allowing them to track the credit history of a firm. This dataset is available starting from 2011.

Other datasets used We use several other data sources for our robustness checks. We add direct ownership data to our firm level and network data. Starting from 2012, this dataset shows who is the owner of the firm (person or another entity). We also use firm headquarter location data on the zip-code level and we have information on the address of each bank and its branches. In addition, we have data for the bank at which the firm has a current account.

Table B.1 in the Appendix provides a description of the variables used.

2.3.2 Database construction and descriptive statistics

For our estimations, we construct a database on the bank-firm-quarter level. As our production network data is available for the period 2015-2017, this will give the time dimension for our analysis. The production network data contains some VAT resident firms which do not have a Hungarian tax identification number. We discard those transaction pairs from our estimation sample, where at least one firm does not have a Hungarian tax number.[6]

[6]These firms are foreign firms and we would not be able to add any other firm level characteristics to these observations.

10.14754/CEU.2020.11

As detailed earlier, out of the banks and lending institutions which we observe in the credit registry, we focus on the lending and bank-firm connections of eight banks.[7] We obtain a sample of 5,644,537 firm-bank-quarter observations.

Throughout our estimations, we consider only firms in the network which obtained a new loan from any of the 8 banks in period q. To be more restrictive, and ensure that no past bank connections of the firm influence the bank choice in the present, we look only at those firms with new loan after q which never borrowed from that specific bank in the past. Our credit registry allows us to trace back the history of borrowing until 2012. By considering partner firms' outstanding exposures with any of the 8 banks and by adding the network data with trading partners' banks to the database of new borrowers we define trading partners bank connections.

After merging the databases we show that, on average, the firms connected to these banks are similar in terms of their size (employment and assets total), productivity, SME and exporter status and industry. Table 2.2 gives the bank-specific average value for various firm level outcomes for those firms, which have an existing exposure with banks, i.e. connected firms which obtain a new loan. Bank1 through Bank8 refer to the top eight banks in the Hungarian market in terms of their corporate loan portfolio, while Bank9 shows an average for the rest of the banks in the economy.

Table 2.3 presents descriptive statistics for the firms in our sample, in comparison with all firms in the economy, all firms in the network and firms in the network who have a new loan in the period 2015-2017. Comparing the first two columns shows that firms in the network relative to the firm in the economy are slightly older, are larger in terms of employment, sales and total assets. Firms in the network have a higher share of their sales from exports and they are more productive both in terms of value added and estimated TFP. These firms are also more likely to be in the manufacturing and construction sectors compared to the population of firms. Firms in the network who obtain a new loan (column 3) are even larger and more productive in comparison with all firms in the network. However, we do not see a large difference between the characteristics of firms in the network with new loans and those with new loans from the 8 banks chosen for our sample. While on average firms are larger in our database, 97 percent of our sample are small and medium

[7] In our robustness checks we rerun our main regression for combinations of varying numbers of banks. Our results are unchanged.

Table 2.2: Firm characteristics by bank

	Employment (log)	Assets total (log)	Sales (log)	Value added (log)	Productivity (log)	SME (%)	Exporter (%)	Manufacturing (%)	Construction (%)	Services (%)
Bank1	3.5	13.9	14.3	12.4	8.4	66.8	27.3	20.3	9.7	59.1
Bank2	3.4	13.7	14.1	12.2	8.4	67.9	25.0	17.6	9.0	62.1
Bank3	3.6	14.0	14.5	12.5	8.4	64.8	29.7	21.3	8.6	57.1
Bank4	3.6	14.0	14.4	12.5	8.4	64.4	29.4	22.9	10.6	54.5
Bank5	3.6	14.0	14.4	12.6	8.5	64.7	27.1	20.5	9.6	56.9
Bank6	3.6	13.9	14.4	12.5	8.4	67.1	26.1	18.9	10.7	58.7
Bank7	3.6	13.9	14.3	12.5	8.5	68.7	28.0	21.9	9.6	58.9
Bank8	3.5	13.9	14.4	12.4	8.3	65.4	25.5	18.7	11.3	57.6
Bank9	3.3	14.0	14.2	12.3	8.5	64.5	23.3	14.4	7.5	61.6

Notes: The table shows average values for the period 2015-2017. Bank1 to Bank8 represent the eight largest banks in the Hungarian market. Bank9 is a market share weighted average for all the other banks in Hungary. Descriptive statistics refer to firms in the production network, which were connected to banks and which obtained a new loan. For these firms, bank specific firm-level average characteristics are calculated from the firm level database.

sized enterprises.

Table 2.4 gives the number of peers in different networks. In the firm network, most of the firms, 69 % have up to five links. The average number of peers is 11. Those firms in the network who obtained a new loan have more connections, 76 percent of the firms have up to 20 connections and on average these firms have 24 links. By comparing columns 2 and 3, again, we notice that firm with new loans from those 8 banks chosen for our sample are quite similar to firms in the network with new loans; 70 percent of the firms have up to 20 links and have on average 31 connections.

Table 2.5 shows link strength. On a quarterly basis, the average traded value in our database is HUF 53 million, while the median traded value is around HUF 13 million.

10.14754/CEU.2020.11

Table 2.3: Firm level characteritics

	All firms	Firms in the network	Firms in the network with new loan	Firms in the network with new loan from 8 banks
Number of firms	1,185,200	285,690	78,984	45,474
Age	10.7	11.2	12.7	13.23
	(7.6)	(7.9)	(7.5)	(7.6)
Nr of employees	9.1	22.3	34.9	43.9
	(115.9)	(201.4)	(318.5)	(399.1)
Log sales	9.6	11.6	12.3	12.6
	(2.2)	(1.6)	(1.6)	(1.5)
Log assets total	9.2	11.3	12	12.2
	(2.4)	(1.8)	(1.6)	(1.6)
Export sales share	0.05	0.07	0.08	0.09
	(7.3)	(0.3)	(0.2)	(0.212)
Log value added	8.5	10.1	10.7	10.9
	(2.0)	(1.8)	(1.6)	(1.6)
Log TFP	6.9	7.6	7.6	7.7
	(1.3)	(1.1)	(0.9)	(0.9)
Percentage SME	98	97	98	97
Share in:				
Manufacturing	8.4	12.9	17.0	17.9
Construction	8.7	12.6	14.2	14
Service	64.3	62.2	57.2	57.3

Notes: The table includes averages and shares by industry for firm-year observations for the period 2015-2017. The share of firms in other industries is not reported. Below the sample averages standard deviations are included in parantheses.

2.4 Empirical strategy

2.4.1 Network effect estimation

We assume that learning about bank specific lending is important when a firm borrows a new loan. Such information is discussed among buyer-supplier firms and we expect that if at least one of the connected firms borrows from a specific bank, then the firm is more likely to borrow a new loan from that bank.

Using our compiled dataset, in Table 2.6 we motivate our main hypothesis by showing

Table 2.4: Links

		Firm network	Firm network, new loan	Firm network, new loan from 8 banks
Network	up to 5 links	80.08 %	62.26 %	56.63 %
	up to 10 links	89.93 %	78.24 %	73.67 %
	up to 20 links	95.58 %	89.79 %	86.88 %
	up to 50 links	98.70 %	96.94 %	96.03 %
	Average number of peers	5.7	10.5	12.69
Sellers only	up to 5 links	74.6 %	52.7 %	46.4 %
	up to 10 links	86.6 %	70.9 %	65.1 %
	up to 20 links	93.7 %	84.7 %	81.0 %
	up to 50 links	98.0 %	94.8 %	93.4 %
	Average number of peers	5.7	18.8	19.6
Buyers only	up to 5 links	74.8 %	55.8 %	48.2 %
	up to 10 links	84.9 %	72.3 %	65.6 %
	up to 20 links	93.3 %	85.3 %	80.3 %
	up to 50 links	97.7 %	94.9 %	92.6 %
	Average number of peers	7.9	14.5	18.7

Notes: The table gives the cumulative distribution and the average number of peers in the network for 2015-2017.

Table 2.5: Trade value characteristics

	Average	p25	p50	p75	p95
All	53	6.8	12.9	29.5	135.7
Buyers	50.7	6.8	12.8	29	131
Sellers	51.6	6.8	12.9	29.2	132

Notes: The table shows the distribution of traded values in million HUF for all links, purchase values for buyer links and sale values for seller links for the period 2015-2017 on quarterly data.

that if the firm's connection borrowed from bank b, then it is more likely for the firm to borrow from the same bank b. The columns represent the bank choice of firms in the network, whereas the rows represent the bank choice of a given firm. Given that the partner

has a loan from bank b, or from any other bank out of the eight banks, the table shows the probability that the firm takes out a new loan from bank b. We calculate the probabilities for each bank b and we report average shares weighted by the number of observations for each bank from our sample. For all definitions of connectedness (trading partners, seller-only relationships, buyer-only relationships) the share of firms which choose to obtain a new bank loan from bank b if at least one of the firms in the network has a loan from bank b is higher compared to the probability when the peer has exposure with any other bank. We interpret this result as a suggestive evidence on networked firms' bank choice influencing the bank choice of the firm.

Table 2.6: Firm's bank choice

	Firm has peer with the same bank	
Share of firms that obtained a new loan	Only from bank b	From any other bank
Network		
Only from bank b	17.4%	8.4%
Sellers only		
Only from bank b	17.3%	7.8%
Buyers only		
Only from bank b	17.3%	8.1%

Notes: For each bank b, we calculate the share of firms that obtained a new loan only from bank b, given that the partner has a loan only from bank b or from any other bank. The table shows a weighted average across the 8 banks, with the number of observations by bank as weight. Our sample is for the period 2015q1-2017q4.

2.4.2 Empirical specification and identification

In the most straightforward approach we would regress the bank choice of the firm on the bank choice of the connected firm as well as own and connected firm's characteristics. However, as detailed in Manski (1993) and other papers (e.g. (Angrist, 2014); (Sacerdote, 2001) this approach would yield biased estimates for at least three reasons. First, the actions and outcomes of firms in a network are determined contemporaneously in equilibrium.

Second, network form endogenously, e.g. more productive firms sell to more productive ones who might have relationships with specific banks. Third, firms in a network could be exposed to the same unobserved shocks, influencing both connected firms' and own bank choice.

Instead, we exploit variation in connected firms' bank connections in our estimations. Following Bisztray et al. (2018) and Mion and Opromolla (2014), we specify a linear probability model, on the firm-bank-quarter level:

$$Newloan_{ibq+t} = \beta Connected_{ib,q} + \alpha_{iq} + \mu_{bq} + \varepsilon_{ibq}, \tag{2.1}$$

where i denotes firm, b denotes bank and q denotes time in quarters. Our outcome variable $Newloan_{ibq+t}$ is an indicator which equals one if firm i obtains a new loan from bank b after time q. The sample used for this estimation contains only firms which never had a bank loan from bank b before q. [8] The right hand side variable $Connected_{ib,q}$ is also and indicator which equals one if firm i is connected to at least one other firm from its network in q, which had an outstanding exposure with bank b before q. [9] α_{iq} refer to firm-quarter fixed effects, μ_{bq} denote bank-quarter fixed effects and ε_{ibq} is the error term. We cluster our standard errors at the firm level.

We expect $\beta > 0$ due to information transmission about banks in firm networks, meaning that there are spillovers in bank choice. In our baseline specification, we will define linked firms by considering all interfirm relationships, by considering only supplier relationships and by considering only buyer relationships.

We believe that by using this specification we address most of the concerns with network effect estimation detailed above. First, by looking at connected firms' past experience with banks and by constructing a sample with firms who never had a bank loan before, we overcome the problem of connected firms' and firm's behavior being jointly determined.

Second, by exploiting variation on the bank level, we can overcome the selectivity prob-

[8] As our credit registry starts in 2012, we trace back the credit history of each firm until the beginning of 2012.

[9] In our regressions, we look at new borrowing up to 4 quarters after the link between two firms is observed, i.e. $t <= 4$. Similarly, at least one of the connected firms need to have a bank connection up to 4 quarters before the connection with firm i is observed. The timeline of events is illustrated in Figure **??** in the Appendix. We motive our preferred lead and lag structure for the regressions with the results in Table B.3 in the Appendix.

lem in network formation, namely that certain types of firms trade with certain types of firms who might borrow from the same bank. Estimating our regression on a firm-bank-quarter level database allows us to include firm-quarter fixed effects which implies that no other standard observable firm level characteristics have to be controlled for (e.g. employment, sales).

Third, this specification allows us to control for any unobserved shock by including bank-quarter fixed effect. A main concern would be that there are changes in the supply of credit at certain banks, influencing the availability of credit for firms in a network. Bank-quarter fixed effects capture such changes in credit supply and it allows us to disregard any other bank level controls.

Given this specification, a remaining concern is that the variation in connected firms' bank choice is unknown, i.e. it is not known how firms in the network choose banks. This could lead to omitted variable bias. For instance, it could be the case that some banks are present only in some regions, so that it is rather availability of credit through distance to a bank that determines bank choice. To mitigate such bias, we choose the eight main banks from Hungary which have a wide territorial coverage for our estimation sample. We also showed earlier that the lending conditions at these banks are very similar and that firm borrowing from these banks are similar in their observable characteristics (e.g. Table 2.1 and Table 2.2). Thus, we think that it is less likely that certain types of firms borrow from certain banks and those firms trade with each other. Nevertheless, we complement our estimations with a wide set of robustness checks where we rule out alternative stories.

2.5 Results

We start this section by presenting the results for spillover estimation from our baseline regression. Then, we detail the heterogeneity of spillover effect by quartiles of various firm level characteristics and trade value between firms. In all specifications we find positive and significant spillover effects. Last, we present spillover effects for different credit types and by borrowing experience.

2.5.1 Baseline result

Column 1 in Table 2.7 reports the result for the baseline regression equation 2.1. [10] The estimated coefficient of interest shows that having a connection with a loan from a specific bank increases the probability that the firm obtains a new loan from the same bank by 0.36 percentage point. This effect is large compared to the baseline probability of 0.55 percent of obtaining a new loan for our sample. [11] In this specification, firms' connections are defined considering both buyer and supplier links.

Table 2.7: Baseline regressions

	(1) All	(2) Suppliers	(3) Buyers
connected	0.36***	0.36***	0.34***
	(0.02)	(0.03)	(0.03)
Bank FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
R-squared	0.1383	0.1391	0.1400
Number of observations	5,644,537	4,179,462	3,794,081

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a new loan from bank b at quarters $t+1$, $t+2$, $t+3$ or $t+4$. The main explanatory variable is also an indicator that equals one if there is at least one firm in the network of firm i which had an outstanding exposure with bank b in quarters *t-1, t-2, t-3 or t-4*. The coefficient of connected is the estimated spillover effect. Coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) for the columns are respectively: 0.55, 0.58, 0.66. Robust standard errors are shown in parentheses. Standard errors are clustered at the firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

Columns 2 and 3 in Table 2.7 report regressions separately for supplier and buyer links. As the coefficient for suppliers and buyers are similar to the estimated coefficient using all interfirm links, around 0.36 and 0.34 percentage point, it seems that the direction of trade

[10] Estimation results excluding controls are reported in Appendix Table B.2. Estimation result considering various time windows for obtaining a new loan and earlier bank connection in the network are presented in Table B.3 in the Appendix.

[11] The baseline probability of obtaining a *new loan from a bank* in our estimation sample is calculated as the share of new loans to the total number of observations.

does not matter in information diffusion about banks. Thus, we will not differentiate the direction of trade between firms and all our other regressions will include both types of interfirm links.

2.5.2 Heterogeneous spillover effects

In this section we aim to estimate the heterogeneity of bank choice spillovers by firm characteristics and strength of the trading relation. This exercise allows us to understand how information diffusion operates between certain groups of firms in terms of their observable characteristics. We group firms by quartiles of their main characteristics such as size (employment and total assets) and productivity (estimated TFP) for each quarter. In addition, we look at the strength of the spillover effect by quartiles of traded value between firms.

The heterogeneity regression specification is a slight modification of the main equation:

$$Newloan_{ibq+t} = \sum_{Q} \beta_Q Connected_{ib,q} * I^{Q}_{iq-4} + \alpha_{iq} + \mu_{bq} + \varepsilon_{ibq}, \tag{2.2}$$

where I is an indicator which equals one if firm i in time $q-4$ belongs to a particular quartile Q for a given observable characteristic.

Table 2.8 reports the results from quartile regressions, where β_Q is the estimated coefficient for quartiles of observable firm characteristics listed in the top row of the table. Column 1 reports the spillover effect for the quartiles defined by the number of employees of firm i. For example, group 1 includes firms with less than 2 employees, group 2 firms with 2-4 employees, group 3 with 5-11 employees and group 4 those with at least 12 employees. For firms with less employees than the first quartile threshold, the estimated spillover effect is 0.48 percentage point, while the effect is smaller for firms with more employees. Column 2 reports the regression for firms in different quartiles sorted by their assets. Again, the estimated effect is the largest for new borrowers in the lowest quartile and the lowest for firms in the last quartile. Column 3 reports the results by TFP groups. Here we notice that the effect is very similar for the first three quartiles and the lowest when firms in the network are the most productive. Finally, in column 4, firms are grouped in quartiles based on their trade value with peers. [12] The estimated coefficients show that the larger the

[12] If firm i has several trade partners which had a loan from a specific bank b, then we consider the

trade volume among connected firms, the larger is the spillover effect and it varies between 0.23 percentage point and 0.51 percentage points.

Table 2.8: Heterogeneity of peer effect by firm characteristics and link strenght

	(1) Employment	(2) Assets total	(3) TFP	(4) Trade value
Q1	0.48***	0.44***	0.36***	0.23***
	(0.06)	(0.05)	(0.05)	(0.03)
Q2	0.43***	0.39***	0.37***	0.19***
	(0.04)	(0.05)	(0.05)	(0.04)
Q3	0.31***	0.43***	0.37***	0.27***
	(0.04)	(0.04)	(0.04)	(0.03)
Q4	0.26***	0.23***	0.26***	0.51***
	(0.0004)	(0.03)	(0.04)	(0.03)
Bank FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R-squared	0.1391	0.1386	0.1409	0.1410
Number of observations	5,565,226	5,624,596	5,442,998	5,551,901

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a new loan from bank b at quarters $t+1$, $t+2$, $t+3$ or $t+4$. The main explanatory variables are indicators for firms in the network with prior bank specific exposure interacted with quartile group indicators for firm i. The coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) for the quartiles in column 1 are 0.46, 0.58, 0.66 and 0.64, in column 2: 0.43, 0.64, 0.60 and 0.55, in column 3: 0.51, 0.70, 0.71, 0.56. Robust standard errors are shown in parentheses. Standard errors are clustered at the firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

2.5.3 Contract characteristics

In this subsection we aim to understand what kind of information is transmitted in firm networks and analyse the spillover effect by credit types and characteristics as observed in the credit registry for each contract. We look at the main types of lending in our database

maximum of the different trade volumes among these connected firms.

such as bank loan, leasing, bank guarantee and credit line and whether the obtained loan enters the balance sheet of the bank.

In this specification the left hand side variable is an indicator that equals one if firm i obtained a specific type of new loan from bank b after time q. The main explanatory variable is also an indicator that equals one if there is at least one firm in the network of firm i which had an outstanding exposure with bank b with the same type of credit in before time q.

The coefficients for spillovers in loan characteristics are reported in Table 2.9. For bank loan, bank guarantee and credit line thecoefficients of interest are significant at one percent and larger in magnitude than for leasing.

In the last column, the coefficient of having the credit entering the balance sheet is also significant at one percent. The results suggest that firms not only recommend specific banks to the firms in their network, but also specific types of credit.

Table 2.9: Spillover effects in loan characteristics

	(1) Bank loan	(2) Leasing	(3) Bank guarantee	(4) Credit line	(5) In balance sheet
connected	0.34***	0.19**	0.23***	0.24***	0.28***
	(0.03)	(0.07)	(0.03)	(0.03)	(0.02)
Bank FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.1382	0.1381	0.1382	0.1382	0.1382
Number of observations	5,644,537	5,644,537	5,644,537	5,644,537	5,644,537

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a a new loan of a specific type (bank loan, leasing, bank guarantee and credit line or lending which enters the balance sheet) from bank b at quarters $t+1$, $t+2$, $t+3$ or $t+4$. The main explanatory variable is also an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b in quarters $t-1$, $t-2$, $t-3$ or $t-4$, in that same type of loan. The coefficient of connected is the estimated spillover effect. The coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) for the columns are respectively: 0.63, 0.64, 0.64, 0.64, 0.63. Robust standard errors are shown in parentheses. Standard errors are clustered at the firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

10.14754/CEU.2020.11

2.5.4 Experience in borrowing

The estimated spillover effect of 0.34 percentage point in Column 1 in Table 2.7 comprises both the extensive (i.e. obtain a loan or not) and intensive margin (from which bank obtain the loan) firm responses. In order to be able to answer who benefits more from the information in the network, we look at firms with absolutely no loans before and firms with at least one loan before (from a different bank). Our estimation sample contains firm-bank-quarter level data for observations where the firm never borrowed from a specific bank in the past. To disentangle the extensive and intersive margins as defined earlier, we separate the dataset into two samples, one with firms with no borrowing at all and one with firms which did borrow, but not from that specific bank.

The estimated spillover effect for the extensive margin is shown in column 2, whereas the intensive margin effect is shown in column 3 in Table 2.11. The estimated spillover effect for the extensive margin is 0.44 percentage point, while for the intensive margin it is 0.19 percentage point. This result strongly supports that networked firm's information has the highest impact on new borrowing when firms have no borrowing experience and suggests that there is more information transmitted than loan type that we can observe and quantify.

2.6 Mechanism behind our results

So far we have presented evidence on spillover effects in bank choice when firms obtain a new loan. We claimed that our results are due to information transmission among firms, however, a plausible alternative story behind our results could be banks favoring specific firms which are connected to their current customers when they decide about giving a new loan. In this section, we provide suggestive evidence for the learning effect.

Symmetric baseline effects As shown in Table 2.7, the estimated baseline spillover effects are very similar for buyer and supplier links, around 0.36 and 0.34 percentage point. As we look at firms who obtain a new loan for the first time from a specific bank, we can argue that banks have limited information about the new client i and it might be the case that banks give a new loan to these firms based on the cash flow from selling to their

network and a general trust in and informational advantage about connected firms. In this case, we would expect higher coefficients for new borrower sellers, which is not what we observe in out sample. Thus, we interpret the symmetricity of baseline effects for buyers and sellers as suggestive evidence in favor of information transmission among firms.

Peer effect by firm characteristics We presented earlier in subsection 2.5.2 that the spillover effect is larger for smaller firms (in terms of employment, assets and TFP); we consider this as an additional suggestive evidence in favor of the information diffusion among firms.

Hubs We consider that ruling out hubs form our network provides further suggestive evidence that the connected firm i does not obtain a new loan based on being connected to a well-performing large firm, as we expect that hubs are large, well known firms trusted by banks, which due to their reputation can provide collateral for smaller firms when these apply for a new loan.

We define hubs based on the upper one percentile of link distribution. In our sample, hubs are firms with at least 115 links. Table 2.10 depicts the characteristics of firms remaining in the sample and excluded firms defined as hubs. It is visible that hubs have more employees, larger balance sheet and are more productive.

If the spillover effect operates via the bank information channel, then we would expect that banks are more willing to offer loans exactly to the firms linked to these large hubs. In this case the estimated spillover effect should be much weaker when hubs are excluded. Column 1 in Table 2.11 shows the estimated spillover effect from Equation 2.1 when we exlude hubs. The estimated effect is even slightly higher than the effect in the main specification, ruling out the possibility that our result is driven by being connected to large hubs.[13] [14]

[13] We also run regressions where the top 5 percentile (at least 13 links) of firms based on the number of their links are excluded, and we obtain similar results.

[14] Arguably, a firm connected to an existing client may be deemed more creditworthy even if the current client is not very large or prominent.

10.14754/CEU.2020.11

Table 2.10: Hubs and small firm characteristics

	Hubs	Small firms
Employment	5.22	1.88
	(1.59)	(1.34)
Assets total	16.2	11.48
	(1.6)	(1.9)
TFP	9.4	7.6
	(1.28)	(1.06)
Number of links	108	3.7
	(144)	(5.3)
Number of obs.	9,289	739,194

Notes: The table includes average firm characteristics for the period 2015-2017. Hubs are firm with at least 45 links, the top 1 percentile of firms in the link distribution. Small firms are firms with less than 45 links. Employee number, total assets and TFP are in logs. Standard deviations are included in parentheses.

2.6.1 Understanding connectedness

The main right hand side variable $Connected_{ib,t}$ in equation 2.1 is an indicator which equals one if firm i is connected to at least one other firm from its network which had an outstanding exposure with bank b before time q. In this way, $Connected_{ib,q}$ can change either if firm i connects to (starts to trade with) a new firm or if an existing connected firm connects to (received a loan from) a new bank. To disentangle the two channels we reestimate the baseline regression where peers' bank connection is fixed at the 2014 level. [15] In this way, the second channel is excluded and identification only comes from the new peers. The estimated spillover effect of 0.29 percentage point in column 7 in Table 2.11 is very close to the baseline 0.36 percentage point effect, suggesting that the identification is based on new peer connections.

2.7 Robustness checks

In this section we address some alternative hypotheses which could pose threats to identification.

[15] We consider those observations where there was a bank connection in any quarter in 2014.

10.14754/CEU.2020.11

Table 2.11: Spillover effects in various samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
connected	0.50***	0.44***	0.19***	0.27***	0.39***	0.07***	0.29***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)	(0.01)	(0.02)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.1378	0.1297	0.1573	0.1384	0.1388	0.1622	0.1383
Number of observations	4,746,888	3,927,379	1,717,158	5,459,370	2,376,193	4,966,723	5,644,537

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a new loan from bank b at quarters $t+1$, $t+2$, $t+3$ or $t+4$. The main explanatory variable is also an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b in quarters *t-1, t-2, t-3 or t-4*. The coefficient of connected is the estimated spillover effect. In column 1, spillover effect is estimated for a sample where we exclude hubs. In column 2, spillover effect is estimated for a sample where firms had no loan before from any of the 8 banks. In column 3, spillover effect is estimated for a sample where firms had at least one loan before from one of the 8 banks. In column 4, the spillover effect is estimated for common ownership corrected network. In column 5, the spillover effect is estimated for networked firms located in Budapest. In column 6, the spillover effect is estimated for a restricted sample where firms already having a bank account at bank b are also excluded. In column 7, the main explanatory variable is an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b in 2014. The coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) for the columns are respectively: 0.57, 0.54, 0.60, 0.57, 0.56, 0.22, 0.57. Robust standard errors are shown in parentheses. Standard errors are clustered at firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

2.7.1 Correlated decision making due to common ownership

Firms might have common ownership or common management which could already explain correlated decision making in networks, including obtaining a new loan from the same bank for ownership or management connected firms. If this would be the case, we would falsely attribute the estimated effect to learning among networked firms.

So far, we have ignored the fact that firms in the production network might have common ownership, even if we observe them as separate tax paying entities in the firm census database.

We redefine our network data by eliminating ownership connected firm and we exclude

those links for which the two firms had a common owner any time in the period 2012-2017. Column 4 of Table 2.11 shows the result of equation 2.1 for the ownership corrected sample. With this new definition of firm connectedness, the probability of obtaining a new loan from the same bank decreases slightly, to 0.27 percentage point and it remains significant.

2.7.2 Distance from the bank

Firm-bank specific factors might influence our results and one such prominent factor we have information on is distance form the bank. Brevoort and Wolken (2008) shows that most small firm-bank distances are around 8 km, meaning that bank-firm relationships are rather local.

If distance matters for borrowing outcomes, the estimated spillover effect might be underestimated if the firm received information about a specific bank from the connected firm but that bank is located far from the firm. In this case, the travel cost can be higher than the value of the information, deterring the firm to follow the information received from its network. To rule out the problem of geographic distance in firm-bank relationship formation, we limit our sample to firms located in the capital, Budapest, where the eight banks from our sample have a dense branch network, 36 branches on average.

Column 5 in Table 2.11 presents the results from a regression restricted to firm i and firm's peers with headquarters in Budapest. The effect of obtaining a new loan from the same bank slighly increases to 0.39 percentage point if the peer had a loan from the same bank in the past for connections with headquarters in Budapest. [16]

2.7.3 Network size

As an alternative measure of connectedness, for each new borrower firm-bank observation we count the number of firms in the network, connected to the same bank. Table 2.12 shows the results of our estimation when instead of a connected dummy, we include the number of connected as the main explanatory variable. According to the result in column 1, one extra connection at bank b increases the probability of obtaining a new loan from the same

[16] We rerun our regression for only i firms located in the capital and our results are similar to the baseline. In column 1 in Table B.4 we restrict the sample to i firms in Budapest, whereas in column 2 to i firms located in Budapest or Pest county. The estimated coefficient in both cases is 0.36 percentage point.

bank by 0.02 percentage point, but this effect is not significant. Columns 2 and 3 show that once we exclude observations with a high number of links (top 1, 11 links excluded in column2 and top 5, 5 links excluded in column 3) the effect of an additional connection with the same bank increases. In column 4, the main explanatory variables are indicators for a specific number of connections. In this specification, the coefficient for one firm in the network is similar to our baseline result, whereas for higher number of links it is larger.

2.7.4 Number of banks for firms in the network

As a further robustness check, we divide the sample into 8 subsamples based on connected firms' outstanding exposure by the number of different banks. The first column of Table B.6 in the Appendix reports the result for those firms with peers' outstanding exposure to only one bank, the second column for firms with peers' exposure to exactly two banks, etc.. [17]. The estimated coefficient is the largest for those firms with peers exposed to exactly one bank. The larger the peers' various bank exposure number the smaller the estimated peer spillover coefficient. This result suggests that peer's information diffusion is more relevant and has higher impact on new borrowing when peers have only few bank connection. The reason could be that in this scenario the peer is already committed to a specific bank, and might recommend it more.

2.7.5 Loan demand

Whether firm level new borrowing is realized depends both on firm applying for a loan and bank deciding positively about giving a new loan to the firm. As a consequence, the estimated network effect also depends on whether a given bank is willing to lend to the firm. With realized new borrowing as an outcome variable, we might underestimate the effect on bank choice. Following Jiménez et al. (2012), we use loan applications data as an equivalent to observed loan demand by firms. Loan applications are defined based on the credit registry query database, which gives the day on which a bank accessed information about the firm from the credit registry. Banks have to query the credit history of firms yearly, if firms are current customers or at the time when they receive a loan application and

[17] The subsample for those firms with peers exposed to all 8 banks are missing as in this case there is no variance in the main explanatory variable *connected*

10.14754/CEU.2020.11

Table 2.12: Spillover effects by number of connected firms

	(1)	(2)	(3)	(4)
Number of peers	0.02	0.08***	0.17***	
	(0.02)	(0.02)	(0.03)	
1 peer				0.36***
				(0.02)
2 peer				0.59***
				(0.04)
3 peer				0.67***
				(0.07)
4 peer				0.71***
				(0.10)
5-10 peers				0.60***
				(0.11)
>10 peers				0.75***
				(0.22)
Bank FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R-squared	0.4315	0.4360	0.4504	0.1384
Number of observations	1,267,067	1,253,404	1,204,180	5,644,537

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a new loan from bank b at quarters $t+1$, $t+2$, $t+3$ or $t+4$. In column 1 the main explanatory variable is the number of peers which had an outstanding exposure at bank b in quarters $t-1$, $t-2$, $t-3$ or $t-4$. In column 2, observations with the top 1 % number of peers are excluded (less than 11 peers). In column 3, observations with the top 5 % number of peers are excluded (less than 5 peers). In column 4, the main explanatory variables are indicators for a specific number of peers. The coefficients are multiplied by 100 to read as percentage point marginal effects. Robust standard errors are shown in parentheses. Standard errors are clustered at firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

seriously consider giving a new loan to the firm. As our sample contains firms that never

had loan from bank b, the observed queries are related to firms expressing their demand for new loans from bank b.

In Table 2.13 we present some statistics for being queried for connected and not connected firms. For our estimation sample, the top panel of the table reports the percentage share of connected firms by query and new loan status, whereas the bottom panel of the table reports the same numbers for firms without connected firms. The percentage share of queried firms among connected and non-connected firms is reported in the last column of the table. Connected firms are more likely to be queried by bank b (4.82 % vs. 2.73 %), which suggests that firms in the network transmit information and influence firms to submit loan requests at peers' own bank. Firms with connected peers also get more new loans compared to not connected firms as shown in the first column.

Table 2.13: Statistics - firm connection, bank query, new loan

	Connected		
	New loan	No new loan	Sum
Query	0.46 %	4.36 %	4.82 %
No query	0.50 %	94.68 %	95.18 %
Sum	0.96 %	99.04 %	100 % (N=1,329,698)
	Not connected		
	New loan	No new loan	Sum
Query	0.23 %	1.50 %	1.73 %
No query	0.32 %	97.95 %	98.27 %
Sum	0.55 %	99.45 %	100 % (N=4,314,839)

Notes: The table shows percentage distribution for firm-bank-quarter observations for the period 2015-2017. The top panel of the table refers to observations with connected peers (i.e. there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b before time q), while the bottom panel refers to observations without connected peers. Query means that the firm has been queried from the credit registry in quarter q.

We reestimate our baseline regression for firm-bank-quarter observations where instead of new borrowing, we define a binary outcome variable which takes value one if the firm was queried by bank b at time q using information from the query database. Results for this regression are presented in Table 2.14. The estimated coefficient is 1.41 percentage point, more than three times larger as our baseline estimate.

10.14754/CEU.2020.11

In column 2 of Table 2.14 the baseline spillover regression is reestimated for firm-bank-quarter observations where credit history was queried by bank b at time q. The estimated coefficients is 3.5 percentage point, suggesting that the spillover effect is even larger among firms that submitted a new loan application.

Table 2.14: Bank query

	(1)
connected	1.41***
	(0.04)
Bank FE	Yes
Firm FE	Yes
R-squared	0.1822
Number of observations	5,669,248

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The main explanatory variable is an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b in quarters *t-1, t-2, t-3 or t-4*. The coefficient of connected is the estimated spillover effect. The coefficients are multiplied by 100 to read as percentage point marginal effects. Robust standard errors are shown in parentheses. Standard errors are clustered at firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

2.7.6 Pre-existing non-debt related firm-bank connections

Cole (1998) shows that pre-existing banking relationships have a positive effect on credit extension to the firm. We follow the credit history of the firms in our sample back until 2012 and keep those firms in our estimation sample which never had a loan from a specific bank. However, firms could have built bank connections through other bank transactions. For example, having a current account at a specific bank would make it easier for a firm and bank to form a borrowing relationship. We aim to rule out the possibility that the firm chooses a specific bank because it already has a current account with that bank. Using data on the bank at which the firm has a current account, we further exclude those observations from our estimation sample where a new borrower firm already had a bank account at bank b any time between 2012-2017.

Column 7 in Table 2.11 presents the estimated coefficient for a restricted sample of

firm-bank new borrowings, where the firm did not have in the past a current account at that specific bank. The estimated coefficient is still significant at one percent and positive at this restricted sample, but the effect is slighly smaller, 0.29 percentage point.

2.7.7 Bank sample choice

Based on Tables 2.1 and 2.2 showing lending conditions and connected-firm characteristics by banks one could argue that banks are not entirely similar in all the listed characteristics. We rerun our main regression for subsamples of the main banks and we show that the obtained effects are rather larger than our baseline result. The results from equation 2.1 for different subsets of banks are reported in Table B.5.

First, banks 1 to 5 in our sample have lower corporate lending market shares compared to the rest of the banks. While these firms were lending on lower interest rate, it might be the case that these banks were less accessible to some types (e.g. riskier) of firms. The results for the subsample of banks 1 to 5 are shown in column 1. The estimated coefficient is 0.28 percentage point, Second, it is possible that banks specialize in lending to some segments of the corporate sector, e.g. Paravisini et al. (2017) show that banks in Peru are specialized in firms' export market destination countries. Motivated by this evidence and by the fact that exporter firms are better in various firm level characteristics than non-exporters with possibly better access to banks, we rerun our main regression for a subsample containing Bank2, Bank6 and Bank8. Among these firms, the share of exporters is the lowest. The results in column 2 show an increase in coefficient to 0.28 percentage point. Third, banks might specialize in lending to some sectors, where firms might already know each other through other business links. We exclude banks 4, 6 and 8 from our sample, as these banks have relatively higher shares of firms operating in the construction sector. We obtain a network effect of 1.6 percentage point, shown in column 3. Fourth, we exclude banks 1,2,6 and 7 from our estimation sample as the firms connected to these banks have relatively larger shares of firm in services and we obtain a large, positive coefficient of 0.52 percentage point, reported in column 4.

In the last step of our robustness check, we rerun our baseline regression for different combinations of banks in our sample. The result are always significant and positive, pointing to spillover effects in bank choice. We omit the tables for this set of robustness checks from

10.14754/CEU.2020.11

our paper, but they are available upon request.

2.8 Conclusion

In this paper we provide evidence on a new channel of firm-bank relationship formation. Combining domestic production network data from VAT declarations and firm level credit registry for Hungary, we show that having at least one connection with bank specific experience has a positive effect on the firm choosing the same bank upon obtaining a new loan.

We find that having at least one connection who has an existing loan with a bank increases the probability that the firm will obtain a new loan from the same bank by 0.36 percentage point. This spillover effect is large compared to the baseline probability of 0.55 percent of obtaining a new loan in our sample. As the obtained coefficients are similar for buyer and supplier links, the direction of trade does not matter in information diffusion about banks. Next, we turn to the estimation of heterogeneous spillover effects by firm characteristics. Network effects are stronger for smaller firms in terms of employment and total assets and they are increasing in traded value size. In addition, we show that spillover effects are the strongest when firms obtain a bank loan, in comparison with other types of borrowing. We provide suggestive evidence that the main mechanism behind our results is information transmission between firms.

Our results imply that beyond the diffusion of various firm level decisions in firm networks, firms learn about banks from their network and turn to banks connected to their firm network for new borrowing. This suggests a new channel of bank-firm relationship formation. In addition, our results point to important aggregate effects stemming from the selective choice of banks due to network effects, which in case of shocks to supply chains, raises financial stability concerns.

10.14754/CEU.2020.11

Chapter 3

Consumption, currency crisis, and household foreign currency debt

3.1 Introduction

Foreign currency debt played a major role in many emerging market financial crises. An exchange rate depreciation leads to the revalution of foreign currency debt and increases the debt burdens in domestic currency. Previous literature focused mainly on how corporate foreign currency debt affects firm investment and default.[1] However, households can also borrow in foreign currency, which may affect their expenditures.[2]

In this paper we study the effect of foreign currency household debt on consumption, which is the main component of household expenditure. We focus on the 2008 currency crisis in Hungary. Using household level panel survey data, we compare the consumption of foreign currency borrowers to local currency borrowers and to non-borrower households. Having a foreign currency denominated loan depresses consumption per capita by 7 percent after the outbreak of the crisis. One Hungarian forint (HUF) increase in the debt burdens of households triggered by the revaluation of household debt decreases consumption almost

[1] Studies examining firm investment Bleakley and Cowan (2008); Endrész and Harasztosi (2014); Aguiar (2005b); Galindo et al. (2003). Papers focused on default (Vonnák, 2018; Niepmann and Schmidt-Eisenlohr, 2019).

[2] Verner and Gyöngyösi (2020) list the country episodes with significant household foreign currency borrowing in the recent decades.

by one HUF.

Hungary provides an appealing setting to study the consequences of foreign currency debt on consumption. Before 2008 there was a household credit boom, which started with the introduction of a government interest rate subsidy program for local currency mortgage loans. Although the program was cut back in late 2003 because of its high costs, the lending boom continued as foreign banks entered the retail market by offering cheap foreign currency denominated loans. By 2008 more than 60 percent of household debt was denominated in Swiss franc. While the exchange rate was stable until September 2008, it depreciated significantly after October 2008, by October 2010 it depreciated by more than 40 percent. This large and unexpected exchange rate shock signiciantly increased the debt burdens of households borrowing in foreign currency while it had no direct effect on the debt burdens of local currency borrowers.

Our main data source is the Household Budget and Living Conditions survey between 2005 and 2012. The data has panel structure and it follows households for four consecutive years. It contains detailed information on consumption along with information on the socio-economic background of all members of households. While the data does not contain information on debt service and outstanding debt in all years, using currency specific interest rate data we reconstruct the debt obligations of households using an annuity model.

Our analysis begins by comparing foreign currency (FC) borrowers to local currency (LC) borrowers and to non-borrowers. Though FC and LC debtor households are similar along many observable characteristics, FC borrowers have better educational attainment and slightly higher income.

To measure the effect of the debt revaluation shock, we use a difference-in-differences framework, and compare the consumption of foreign currency borrowers to local currency borrowers and to the rest of the households. The crisis significantly decreased the consumption of FC debtors, in the 2009-2012 period FC borrowers' per capita consumption declined by 7 percent relative to non-borrowers. The consumption of LC debtors also decreased, however, the change is not significant. Examining the dynamic impact of debt reveals that FC debtors consumption gradually declined after 2008, by 2012 it was 10 percent lower than in 2008. Immediately before the crisis the consumption of FC and LC borrowers and non-borrowers evolved similarly, but there was an uptick in FC borrowers' consumption in

2006.

Next, we examine by how much does the increased debt service decreases consumption. The estimated decrease in consumption to a 1 HUF increase in debt burdens triggered by the depreciation of the exchange rate is close to minus 1. This implies that the revaluation of household debt in the currency crisis decreased aggregate consumption by 1.7 percentage point in the 2009-2014 period.

Our paper connects to the literature that studies the role of debt in consumption decisions. According to Price et al. (2019), households with higher mortgage debt reduce their consumption more and are more sensitive to macroeconomic shocks. Dynan et al. (2012) studies the deleveraging process of households in the US following the Great Recession and show that households with higher debt cut back their spending to a larger extent between 2007-2009, despite the fact that their income did not change significantly. (Maggio et al., 2017) find that a decline in debt burdens due to changes in interest rate has positive effect on durable consumption. Debt to income and debt service negatively affect consumption during the 2008-2009 crisis, and the effect of debt service is stronger during the crisis, compared to the pre-crisis and post-crisis period (Kukk, 2016). Compared to these studies, our empirical strategy allows us to identify the effect of a sudden increase in household debt on consumption by comparing the consumption outcomes of affected and non-affected borrowers (and non-borrower households).

Our paper is also connected to the literature on foreign currency household debt. Several papers examined the determinants of household foreign currency borrowing (e.g. Fidrmuc et al. (2013); Csajbók et al. (2010); Beck and Brown (2015)). We contribute to this literature by showing that foreign currency debt revaluation has a large negative effect on consumption. This supports previous finding that the effect of debt revaluation can be particularly severe when foreign currency debt is concentrated on household, rather than firm, balance sheets (Verner and Gyöngyösi, 2020).

More broadly our paper relates to the literature exploring the effect of various shocks on consumption.[3] Le Blanc and Lydon (2019) show that both wealth and income shocks have a negative effect on consumption in the period of the crisis, and that hosueholds with larger debt before the crisis are more affected by income shocks. Housing market induced

[3] Pistaferri (2016) provides a review of the possible explanations of slow consumption recovery after the crisis, including wealth effects, debt overhang and financial frictions.

wealth losses and negative shocks to home value can also depress consumption (e.g Mian et al. (2013),Christelis et al. (2019)). Yet another paper by Cloyne et al. (2018) finds that the the effect of conventional monetary policy shocks is the strongest for the group of households with mortgage. Broda and Parker (2014) evaluate the effect of the Economic Stimulus Act and estimate that households wth low income and low wealth spend roughly triple in comparison with other household in the month of the payment receipt. Tax refunds also increase consumption for recipient households (Baugh et al. (2018)). At other times the same households do not decrease consumption when making tax payments. This asymmetric consumption response is not entirely explained by liquidity constrain or hand-to-mouth behavior, as even quite liquid households increase their spending when receiving tax refunds and even less liquid households smooth consumption when making tax payments. Baker (2018), using firm level shocks for household member employers, shows that highly-indebted households are more sensitive to income fluctuations and that a one standard deviation increase in debt-to-asset ratios increases the elasticity of consumption by approximately 25 percent. Jensen and Johannesen (2017) study the credit supply channel during the crisis and find that bank distress translates into lower borrowing and consumption for households. Large positive shocks to income in the form of lottery prizes in Norway lead to a sharp increase in consumption in the year of winning, but reverts to normal within five years Fagereng et al. (2016). Mortgage maturity extensions which immediately increase liquidity significantly reduce household default and likely increase spending ((Ganong and Noel, 2018)). A significant drop in mortgage rates due to changes from fixed rate to variable rate increases household car purchases Maggio et al. (2017). Jappelli and Pistaferri (2014) using survey data with a hypothetical unexpected tax reimbursement, find that households with low cash holdings exhibit a higher marginal propensity to consume. **?**, identifying from increases in credit card balances, estimate that the marginal propensity to consume increased during the Great Recession and the 2001 recession.

The remainder of the paper is structured as follows. In section 3.2 we briefly describe Hungarian foreign currency borrowing in the household sector. Section 3.3 describes the data. Section 3.4 presents the empirical strategy. We present our results in Section 3.5. The last section concludes.

10.14754/CEU.2020.11

3.2 Household foreign currency lending in Hungary

Lending to the retail sector was low in the 1990s but started to increase rapidly from the beginning of the 2000s when the government introduced mortgage subsidy program in 2000. Through the program, households could borrow in local currency on nominal interest rates similar to the rates on euro denominated mortgages. Figure C.1 shows household indebtedness increased sharply as a result. However, by early 2004 the subsidy program was cut back, leading to an increase in interest rates on domestic currency loans. Foreign banks entered the retail lending market and started to compete with domestic banks by offering foreign currency denominated housing loans with lower interest rates (Banai et al., 2011b). By 2008, household debt increased more than 30 percent of GDP from around 5 percent in 2000. In September 2008, 66 percent of total household debt was denominated in foreign currency, predominantly in Swiss franc (97 percent of foreign currency debt with the rest being mostly euro denominated debt).

The exchange rate was stable before 2008 (Figure C.2). The Central Bank maintained an ±15 percent exchange rate band to the euro in the 2000s, however, Ilzetzki et al. (2019) classify the euro exchange rate as a de facto ±5 percent, while the euro-Swiss franc is classified as a de facto ±2 percent band. The Central Bank abolished the band in February 2008.

The outbreak of the crisis in September 2008 was followed by a large depreciation in domestic currency. The forint depreciated by 27.5 percent against the euro and 32.3 percent against the Swiss franc between September 2008 and March 2009.

Several factors contributed to the spread of foreign currency loans. The large interest rate differential between local and foreign currency loans (Csajbók et al., 2010), expectations of joining to the euro zone (Fidrmuc et al., 2013) and monetary policy (Gyöngyösi et al., 2019) had an impact on foreign currency denominated lending.

The significant depreciation of the domestic currency was not anticipated. Consensus Economics forecast shows that experts anticipated a stable HUF/EUR exchange rate on one and two years horizon in the months before October 2008 (Figure C.6). Pellényi and Bilek (2009) show using survey data from November 2008 that households did not expect large exchange rate movements either.

Households were not hedged against the depreciation as they had limited foreign cur-

rency wealth.[4] Though Hungary joined the EU in 2004, working abroad and hence foreign currency income was negligible before the crisis.[5] Since the most popular destinations were the UK, Germany and Austria, even foreign currency income did not sheltered FC borrowers from the appreaciation of the Swiss franc.

As Hungarian households had limited savings or income in foreign currency, the unexpected revaluation of debt put a significant burden on households through increases in monthly installments. The increasing share of defaulted households reflect the lack of ability rather than the willingness to pay. Figure C.7 presents the share of defaulted debt by currency denomination and loan type. Until 2008Q3, default rate was close to zero for LC mortgages, FC mortgages and FC home equity loans. With the gradual depreciation of the local currency, default rate increased to more than 20 percent for FC home equities by 2014. Since household debt was recourse and there was no provision of bankruptcy, this reflects the limited ability of households to pay.

Beyond the exchange rate shock, rising interest rates of housing loans also contributed to the financial difficulties of foreign currency debtors. Szigel (2012) quantifies the effect of exchange rate depreciation and interest rate increases on debt burdens using aggregate data. He finds that interest rate increases significantly contributed to the rising debt burdens of FC borrowers.

Though foreign currency loans were banned in 2010, no major policies were implemented until 2011 to alleviate the debt burden of households. Then the government implemented the Early Repayment Program (ERP), which allowed households to repay their foreign currency housing debt at a preferential exchange rate if they can repay the whole outstanding debt.[6] Because of this design of the program, wealthier households were more likely to participate in the program. Close to 25 percent of FC debt was prepaid as a result, and many households borrowed in domestic currency to participate in the program.

[4] Backé et al. (2007) documents using repeated cross section survey data that less than 10 percent of households had foreign currency holdings between 2002 and 2006, and the median holding was around 100 EUR. Moreover, the primary motive for holding foreign currency cash was spending abroad. Feige (2003) calculates that only 6 percent of total cash holdings were denominated in foreign currencies in 2001.

[5] The major destination countries were the UK, Germany and Austria. Though the UK opened its labor market to the Hungarian workers in 2004, only 40,000 people went there officially between 2004 and 2011 (Moreh, 2016). Austria and Germany opened their labor markets to Hungarian citizens completely only in 2011. Hárs (2016) uses census data and shows that less than 2 percent of Hungarian households emmigrated by 2011, and emmigration accelerated only after 2010.

[6] The political economy of the crisis is analyzed in Gyöngyösi and Verner (2020).

10.14754/CEU.2020.11

During the crisis household consumption in Hungary fell significantly. Figure C.3 shows that aggregate consumption fell by 10 percent relative to 2007, and this drop was persistent as consumption started to pick up only after 2013. Moreover, compared to other Central Eastern European countries, where foreign currency borrowing was not as prevalent as in Hungary, the decline in consumption was less pronounced. This suggests that the large increase in households' debt burdens could have played a role in the decline of consumption.

3.3 Data and descriptive statistics

3.3.1 Data

We use the Household Budget and Living Conditions Survey (HKÉF) for Hungary between 2005 and 2012, maintained by the Central Statistical Office. This is a representative household level survey of 8 to 10 thousand households residing in Hungary in every year. The data has a rotating panel structure where the households are followed for four consecutive years.

The survey has two parts, a diary survey and an interview survey. Households are asked to write a consumption diary for a month in which they track and classify their monthly expenditures. Consumption expenditures are classified by their purpose by using the EU's Classification of Individual Consumption by Purpose (COICOP). In the first quarter of the following year, households are surveyed again about their major expenditures in the previous year (excluding food and beverages). This information is used to account for the sparsity of durable consumption.

The second survey contains detailed information on the household as well as every members' socio-economic background. This includes demographics, education (primary, vocational, high school or college) and economic activity. Household members are also surveyed about their income and transfers in the previous year. There are questions on the living conditions as well.

Foreign currency debt exposure The survey contains information on household debt. Throughout our sample period, households report information on housing debt in the consumption diary. This includes the year of origination, maturity, total amount borrowed,

and the monthly payment. From 2009 onwards, the second questionnaire asks the currency denomination of the loan, the type of the housing loan, as well and the total debt service paid in the last year.

Since the currency denomination of debt might be measured with error, we combine two approaches to determine the currency denomination of the debt. First, we use the currency denomination given by the households. This information is collected only from 2009 onwards, and we use the panel structure of the data and backfill the information. Second, we use the shift in the currency composition of lending along the credit boom. In the early phase, only domestic currency loans were available, and after 2004 most of the lending happened in foreign currency (see Figure C.1). Therefore we classify loans as foreign currency if they were originated after 2004. We combine these two approaches by assuming that households know better the time of borrowing than the currency denomination if they are in conflict.[7]

Since households report their yearly payment only from 2009, and potentially with significant measurement error, we calculate the outstanding debt and the monthly payment using an annuity model. This also allow us to calculate the debt burdens even before 2009. We know the year of origination and the maturity of the loans, and we use currency and loan type (mortgage vs. home equity) specific interest rate data, which allows us to determine the debt burdens of the households (see Appendix C.2 for details).

Measures of consumption The survey uses the COICOP classification of consumption expenditures, and contains the expenditure for these groups. This allows us to create different measures of consumption. First we define total consumption which is the expenditure as the sum of all COICOP items.[8] It is important to note that expenditures related to buying a new house are excluded. Second, we define durable consumption which is the sum of expenditures on furniture, household appliances, purchase of vehicles, telephone and other audiovisual equipment as well as other major durables for recreation and culture.

We measure per capita consumption to account for differences in household size across

[7]During the crisis there were many complaints from consumers that banks deceived them about the currency. This suggests that many households did not understand that they actually borrowed in foreign currency.

[8]The main COICOP groups are expenditures on food and beverages, clothing and footwear, housing, health, transport, communication, recreation and culture, education and miscellaneous goods and services.

10.14754/CEU.2020.11

households.

3.3.2 Descriptive statistics

Table C.1 compares the average characteristics of households by the currency denomination of debt in 2008. The first column presents the average characteristics of foreign currency borrowers, the second column is for local currency borrowers, and column three contains the characteristics of non-borrowers. Column 4 shows the difference between FC and LC borrowers, while Column 5 reports the difference between borrowers and non-borrowers.

The table reveals that FC borrowers and LC borrowers are similar along some observable dimensions, for example the households heads have broadly similar educational attainment, but LC debtor households have slightly better educational attainment. For example, for LC debtor households the household head is more likely to have college education than in FC debtor households. There is no significant difference in the age of the household head, household size, consumption to income and debt to income in 2008. FC and LC households differ in household head economic activity, income and consumption. LC debtors are slightly less likely to be unemployed and also have slightly higher income and consumption.

The consumption per income and the debt burden relative to income are similar for the two groups.

When comparing borrowers to non-borrowers, there is a large difference in the age of the household head, as household heads are 10 years older on average in non-borrower households. Comparing the age distributions reveals that there is not much overlap between the two groups when the household head is older than 60 years old (Figure **??**. Because of this, in our analysis, we restrict our sample to households where the age of the household head is less than 60 years.

Borrowers are slightly more educated and are more likely to be employed in comparison to non-borrowers. Borrowers are slighly larger hosueholds and their per capita consumption is lower, also in comparison to their income.

10.14754/CEU.2020.11

3.4 Theory and measurement

3.4.1 Theoretical predictions

What does theory say about the effect of household foreign currency debt on consumption? In a model with complete markets, the currency composition of household debt does not affect consumption.

Even if markets are not complete, households can hedge against a depreciation by having foreign currency income or assets. This implies that households need to have unhedged foreign currency debt position if we expect a depreciation to have an impact on consumption. In this case, a permanent depreciation increases debt service, which translates into lower consumption. The strength of the consumption response may depend on many factors, including precautionary savings, liquidity and debt maturity.

For a better understanding, it is helpful to compare a hand-to-mouth consumer to a permanent income consumer. These two represent two extreme cases, and therefore they can show the potential range of the decline in consumption. For a hand-to-mouth consumer, any increase in debt services translates one-to-one into lower consumption. If the debt is one-period, the consumer has to repay the entire debt in the next period, which is $(1+r)D$, where r is the interest rate, D is the debt in local currency. If the maturity goes to infinity, the hand-to-mouth consumer has to repay the annnuity value of the revalued debt, which is rD.

In case of a permanent income consumer, the decline in consumption is the annuity value of the change in debt, rD (Hall, 1978). This implies that for a non-amortizing perpetual debt the response of the two types of consumer is the same, but for finite maturity the effect is larger for the hand-to-mouth consumer. Using credit registry data Verner and Gyöngyösi (2020) show that the increase in debt service cost is 1.5 to 2 times higher than the annuity value of the increase in debt as housing loans have an average of 18 years remaining maturity in 2008.

Part C of the Data Appendix presents a short model rationalizing our predictions.

10.14754/CEU.2020.11

3.4.2 Empirical approach

We measure the effect of household debt revaluation by comparing the consumption of households borrowing in foreign currency to households borrowing in the local currency and to non-borrower households over time using a difference-in-differences framework. We estimate the following regression:

$$\ln C_{it} = \alpha_i + \delta_t + \beta_{FC} FC_i \times Post_t + \gamma_{LC} LC_i \times Post_t + \Gamma X_{it} + \varepsilon_{it}, \tag{3.1}$$

where $\ln C_{it}$ denotes a measure of household i's consumption such as total consumption or durable consumption, α_i is a household fixed effect and δ_t is a year fixed effect. FC_i and LC_i refer to the currency denomination of the loan for debtors, the omitted category is non-borrowers. FC_i is equal to 1 for FC borrowers and zero otherwise, and LC_i is equal to 1 for LC borrowers and zero otherwise. $X_i t$ are household level control variables from the first sampling period of the household, interacted with $Post_t$. The controls include age of the household head, gender of the household head, educational attainment of the household head, household size, and region (7 units) fixed effect. As Table C.1 suggests, these variables capture observable household characteristics. We also include the contemporaneous per capita net income as a covariate to control for changes in the disposable income of the household. We estimate weighted regressions by using the weights provided by the Statistical Office, and cluster standard errors at the household level.

To assess the dynamic impact of foreign currency debt on consumption by estimating the following regression:

$$\ln C_{it} = \alpha_i + \delta_t + \sum_{k \neq 2008} \beta_k FC_i \times \mathbb{1}\{t = k\} + \sum_{k \neq 2008} \gamma_k LC_i \times \mathbb{1}\{t = k\} + \Gamma X_{it} + \varepsilon_{it}, \tag{3.2}$$

where $\ln C_{it}$ denotes the log consumption per capita of household i in year t, α_i and δ_t are household and year fixed effects, respectively. The currency denomination of debt is denoted by FC_i, which is equal to 1 for FC borrowers and zero otherwise, and LC_i, which is equal to 1 for LC borrowers and zero otherwise. The omitted baseline category is the non-borrowers. X_{it} are household level control variables from the first sampling period of

the household, interacted with a year dummy.

Our identifying assumption is that had the exchange rate shock not been happened, the consumption and the debt services would have evolved similarly for the two groups. The main threats to identification are time-varying household level shocks that affect consumption and are correlated with foreign currency debt status.

The effect of foreign currency debt on the forint value of consumption and debt services Since the reduced form effect of foreign currency debt on consumption is not informative, we compare the change of consumption to changes in debt as well.

We measure the effect of foreign currency debt on the *forint value* of consumption and debt services by estimating equation 3.2 for consumption per capita and debt service per capita. We then divide the effect of foreign currency denomination on consumption by its effect on debt services.[9]

This rescaled measure shows what fraction in the decline of the HUF value of household consumption can be explained by the increase in debt services that is caused by the debt revaluation. We compare the consumption and debt service of FC borrowers to LC borrowers. Since consumption and debt services are flow measures, we measure the cumulative effect of currency denomination on these variables on different horizons. We define this measure from 2009 on horizon k as the following:

$$E(k) = \frac{\sum_{j=2009}^{k} \left(\hat{\beta}_j^{consumption} - \hat{\gamma}_j^{consumption} \right)}{\sum_{j=2009}^{k} \left(\hat{\beta}_j^{debt\ services} - \hat{\gamma}_j^{debt\ services} \right)}. \tag{3.3}$$

We estimate equation 3.2 for consumption and debt services by using seemingly unrelated regression (SUR). The SUR framework allows us to calculate the standard errors for this measure using the delta method.

This approach is similar to an instrumental variable estimation, where the currency denomination is an instrument for the increase in debt burdens. We divide the effect of currency denomination on consumption (reduced form) by the effect of currency denomination on debt burdens (first stage).

[9]This is similar to the approach that estimates the MPC out of liquidity after the bankruptcy flag remova in (Gross et al., 2020).

10.14754/CEU.2020.11

The identifying assumption of the IV approach is that the currency choice of households affects consumption only through its impact on debt services, conditional on covariates.

Though we cannot directly test it, the literature on household foreign currency borrowing suggests that this is a reasonable assumption. These patterns are consistent with existing studies on household FC borrowing in emerging European countries, which find that FC and LC debtors are approximately similar (Pellényi and Bilek, 2009; Beer et al., 2010), or foreign banks that are mostly lending in foreign currencies were cherry-picking the best customers (Beck and Brown, 2015).

3.5 Results

3.5.1 Main result

Table C.2 presents the mains results for total consumption. The first column shows the results when the only explanatory variables are the indicators of currency denomination of debt along with year fixed effects. The consumption of foreign currency borrowers declines by 9 percent after 2008, and local currency debtors' consumption by 6.5 percent relative to non-borrower households.

In the second column we add household fixed effect. The inclusion of the fixed effect decreases the point estimates. The coefficient of FC debtors declines to -0.074, implying that the consumption of FC households declines by 7.5 percent, but it remains significant. At the same time, the coefficient of LC borrowers remains negative, but it becomes insignificant, hence their consumption evolves similarly to non-borrowers.

In column 3, we add household characteristics as control variables to the regression. In the last column we add region fixed effects. The inclusion of these covariates do not change the results to a large extent.

Dynamic impact of foreign currency debt Next, we examine the dynamic impact of having a foreign currency loan on consumption. This also allows us to assess the validity of the parallel trend assumption. Figure C.4 presents the coefficients from estimating equation 3.2 and compares the effect of FC to LC and the effect for non-borrowers to LC borrowers. The point estimates in the years directly preceding the crisis, in 2007 and 2008, are close to

zero and insignificant. In 2006 we can see an uptick in the consumption of FC borrowers. The coefficient for 2005 is also close to zero and insignificant.

The crisis depressed the consumption of FC debtors while it had no significant effect on LC borrowers. After the start of the depreciation, the consumption per capita of FC debtor households started to decline gradually. By 2010 it decreased by around 4 percent relative to non-borrowers, and by 2012 it fell by around 7 percent. The coefficient is significantly different from zero for the years 2010 and 2011. Examining the consumption response of non-borrowers, we find no effect, indicating that non-borrowers did not cut back their consumption. Until 2010 the point estimates are close to zero, and increase sligly afterwards, however, in the entire post-crisis period they are insignificant.

Durable consumption Durable consumption is much more sensitive to economic shocks as households can postpone expenditures. We examine how per capita durable expenditures changed after the crisis. Table C.6 summarizes the results. The point estimate is close to -1, which implies that durable consumption decreased by 63 percent ($100 \times e^{-1} - 1$)after the crisis.

Change in consumption to a unit change in debt burden The consumption of FC debtor households declined significantly in the crisis, but how does it relate to their increased debt burdens due to the revaluation of their debt? To answer this question we estimate the effect of having an FC loan on the forint value of consumption per capita and debt service per capita in a SUR framework. The ratio of point estimate of consumption over the point estimate on debt service shows by how much the consumption declined for every forint increase in debt burdens.

Figure C.5 summarizes the results. We calculate both the cumulative and the current changes in consumption. The estimated cumulative change in consumption is close to minus one, indicating that consumption declines one-to-one for every forint increase in debt service. Though the point estimate is close to minus one, we do not have much statistical power. This implies that we can only say with confidence that the cumulative change is greater than 0.2 in 2012 at the 5 percent level.

The aggregate change in consumption declines slighly over time, suggesting that households entering default might not have had to cut back consumption as much.

10.14754/CEU.2020.11

Next, we examine what fraction of the decline in aggregate consumption can be explained by the increasing debt burdens of households. Between 2009 and 2014 the cumulative increase in debt services was 1,534 billion HUF on 2008 prices. The aggregate consumption in 2008 was 17,633 billion HUF. This indicates that on average, the debt revaluation decreased consumption by 1.7 percentage point in the 2009-2014 period relative to 2008.

3.5.2 Heterogeneities

Effect of debt revaluation by COICOP categories We also report the effect of foreign currency debt on consumption by COICOP categories. Table C.18 summarizes the results. We find that consumption decreased almost in all COICOP categories. For FC borrowers, there is large decrease in alcohol drink consuption, followed, by furnitures, travel, entertainment and food and beverages. The estimated effect is significant at 1 percent for food, alcohol and travel expenditures. For local currency borrowers, the effect is significant for alcohol at 10 percent significance level in the post period.

Effect of debt revaluation by household characteristics We examine whether the effect of the debt revaluation is heterogeneous across households. Table C.19 reports the results for LC and FC borrowers after the crisis by household size, education of household head and location of the household (capital city Budapest or outside of the capital). Our findings suggest that smaller FC borrower households face a larger decrease in consumption after the crisis compared to larger households. [10] By household head education, the effect on consumption is the most negative when the household head has vocational education. The effect is not significant for college educated household head. For households in Budapest, the effect on consumption is more negative, compared to households outside of Budapest.

3.5.3 Robustness checks

Alternative consumption equivalence scale In the main analysis, we used per capita consumption as outcome. But adding one extra member may not decrease consumption

[10] Smaller households are household with below average number of households members. Average hosuehold size is 2 in our sample.

proportionally, as some living cost may be fixed in the short term. For example, rent or heating costs do not depend on the size of the household. This prompts us to examine how our results are affected by using alternative consumption equivalence scales.

We use square root equivalence scale as an alternative. Instead of dividing by the number of household members, we divide by the square root of household size. Table C.17 summarizes the results. The point estimates slightly decrease, however they are significant for FC borrowers, implying that our results are not driven by the choice of consumption equivalence scale.

Comparing foreign currency and local currency borrowers As non-borrowers are more dissimilar from LC and FC borrowers, we rerun our baseline regression and compare the consumption of FC and LC borrowers. Table C.5, column 4 contains the results in our preferred specification and it shows that compared to LC borrowers, the consumption of FC borrowers decreases by 5.3 percent which is a slighly less negative effect than the one obtained by comparing FC borrowers' and non-borrowers' consumption outcomes.

Propensity score matching As a further robustness check we perform propensity score matching for treatment and control households. Treatment household are foreign currency borrowers, while control household are local currency borrowers.Treatment and control households are matched based on their observable characteristics, for the first year when they are in the sample. The observable characteristics are the following: age of the household head, gender of the household head, educational attainment of the household head, household size, and location of the household. Table C.3 in the Appendix gives the results of the propensity score matching. In our preferred specification with year, household and region fixed effects and household level controls the estimated coefficient shows that the consumption of FC borrowers decreases by 8.2 percent, relative to LC borrowers. This is a slighly more negative effect than what we obtained in Table C.5. [11]

Unobservables As there are some observable differences among the types of borrowers, it cannot be excluded that there are differences in unobservables as well and there is selection

[11]Tables C.7, C.8, ..., C.15 in the Appendix provide the comparison of treatment and control groups for the matched samples, by characteristics from the year when the household entered the sample.

10.14754/CEU.2020.11

into foreign currency loans on unobservables. Following Oster (2019), we provide a test for evaluating robustness to omitted variable bias in Table C.16 in the Appendix. We show that ommited variable adjusted effects are very similar to our baseline results, the consumption of FC borrowers decreases by 6.6 (5.4 percent in our baseline) percent compared to local currency borrowers and by 6.5 (7.2 percent in our baseline) percent compared to non-borrowers.

Lagged dependent variable Table C.4 contains the estimates when the lagged dependent variable is used to control for the time-invariant characteristics of the households, instead of the household fixed effect. The point estimate of having a foreign currency debt remains significant at the 5 percent level, though the coefficient becomes smaller in absolute value. The smaller parameter is due to the fact that the lagged dependent variable partly controls for the debt revaluation, as this specification uses variation only in the additional depreciation of the currency, which happened in the previous year. Moreover, the fact that the point estimate is larger than the coefficient using the difference-in-differences specification suggests that selection into having foreign currency debt is positively correlated with the time-invariant unobservables of the households (**?**), indicating that households with better characteristics borrowed in foreign currency.

3.6 Conclusion

This paper studies the effect of increased household debt on consumption by exploiting a foreign currency debt crisis in Hungary. The large and unexpected depreciation of the domestic currency significantly increased the debt burdens of FX borrower households. Using household level panel survey data, we compare the consumption of foreign currency borrowers to local currency borrowers and to non-borrower households.

To measure the effect of the debt revaluation shock, we use a difference-in-differences framework, and compare the consumption of foreign currency borrowers to local currency borrowers and to the rest of the households. The crisis significantly decreased the consumption of FC debtors, in the 2009-2012 period FC borrowers' per capita consumption declined by 7 percent relative to non-borrowers. The estimated change in consumption to a one HUF increase in debt burdens is close to minus one, indicating that consumption declines one

10.14754/CEU.2020.11

to one for increased debt service for FC borrowers. The consumption of LC debtors also decreased, however, the change is not significant. Examining the dynamic impact of debt reveals that FC debtors consumption gradually declined after 2008, by 2012 it was around 7 percent lower than in 2008, in comparison with LC borrowers. Immediately before the crisis the consumption of FC and LC borrowers and non-borrowers evolved similarly, but there was an uptick in FC borrowers' consumption in 2006. Regarding consumption type, we find that durable consumption is much more sensitive to economic shocks as households can postpone expenditures. The effect is significant and large for FC borrowers. Their consumption is also negatively affected in almost each COICOP category, for example food and drinks, travel and alcoholic beverages. FC borrower households, with below average household size, with less educated household head and living in the capital city Budapest are more sensitive to the shock.

10.14754/CEU.2020.11

Bibliography

Agarwal, R. and J. Ann Elston (2001, August). Bank-firm relationships, financing and firm performance in Germany. *Economics Letters 72*(2), 225–232.

Aghion, P., P. Bacchetta, and A. Banerjee (2001). Currency crises and monetary policy in an economy with credit constraints. *European Economic Review 45*(7), 1121–1150.

Aguiar, M. (2005a). Investment, devaluation, and foreign currency exposure: The case of mexico. *Journal of Development Economics 78*(1), 95–113.

Aguiar, M. (2005b). Investment, devaluation, and foreign currency exposure: The case of mexico. *Journal of Development Economics 78*(1), 95–113.

Angrist, J. (2014). The perils of peer effects. *Labour Economics 30*(C), 98–108.

Backé, P., D. Ritzberger-Grünwald, and H. Stix (2007). The Euro on the Road East: Cash, Savings and Loans. *Monetary Policy & the Economy* (1).

Baker, S. R. (2018). Debt and the Response to Household Income Shocks: Validation and Application of Linked Financial Account Data. *Journal of Political Economy 126*(4), 1504–1557.

Banai, A., J. Kiraly, and M. Nagy (2011a, October). Home high above and home deep down below – lending in Hungary. Policy Research Working Paper Series 5836, The World Bank.

Banai, A., J. Kiraly, and M. Nagy (2011b, december). The demise of the halcyon days in Hungary: "foreign" and "local" banks – before and after the crisis. In B. for International Settlements (Ed.), *The global crisis and financial intermediation in emerging*

market economies, Volume 54 of *BIS Papers chapters*, pp. 195–224. Bank for International Settlements.

Bao, Y. (2019). Peer Information in the Cost of Debt.

Basso, H., O. Calvo-Gonzalez, and M. Jurgilas (2011). Financial dollarization: The role of foreign-owned banks and interest rates. *Journal of Banking and Finance 35*(4), 794–806.

Baugh, B., I. Ben-David, H. Park, and J. A. Parker (2018, September). Asymmetric Consumption Smoothing. NBER Working Papers 25086, National Bureau of Economic Research, Inc.

Beck, T. and M. Brown (2015, October). Foreign bank ownership and household credit. *Journal of Financial Intermediation 24*(4), 466–486.

Beer, C., S. Ongena, and M. Peter (2010, September). Borrowing in foreign currency: Austrian households as carry traders. *Journal of Banking & Finance 34*(9), 2198–2211.

Berger, A. (2007). Obstacles to a global banking system: "old europe" versus "new europe". *Journal of Banking and Finance 31*(7), 1955–1973.

Bernile, G., V. BHAGWAT, and P. R. RAU (2017). What doesn't kill you will only make you more risk-loving: Early-life disasters and ceo behavior. *The Journal of Finance 72*(1), 167–206.

Bisztray, M., M. Koren, and A. Szeidl (2018). Learning to import from your peers. *Journal of International Economics 115*(C), 242–258.

Bleakley, H. and K. Cowan (2008). Corporate dollar debt and depreciations: much ado about nothing? *The Review of Economics and Statistics 90*(4), 612–626.

Bodnar, K. (2006). A hazai kis- és középvállalatok árfolyamkitettsége, devizahitelezésük pénzügyi stabilitási kockázatai. egy kérdőíves felmérés eredményei. *MNB Occasional Papers* (53).

Bodnar, K. (2009). Exchange rate exposure of hungarian enterprises-results of a survey. *MNB Occasional Papers* (80).

10.14754/CEU.2020.11

Bolton, P., X. Freixas, L. Gambacorta, and P. E. Mistrulli (2016). Relationship and Transaction Lending in a Crisis. *Review of Financial Studies 29*(10), 2643–2676.

Boot, A. W. A. (2000, January). Relationship Banking: What Do We Know? *Journal of Financial Intermediation 9*(1), 7–25.

Braun, M. and B. Larrain (2005, June). Finance and the Business Cycle: International, Inter-Industry Evidence. *Journal of Finance 60*(3), 1097–1128.

Brevoort, K. P. and J. D. Wolken (2008). Does distance matter in banking?

Broda, C. and J. A. Parker (2014). The Economic Stimulus Payments of 2008 and the aggregate demand for consumption. *Journal of Monetary Economics 68*(S), 20–36.

Cai, J. and A. Szeidl (2018). Interfirm Relationships and Business Performance. *The Quarterly Journal of Economics 133*(3), 1229–1282.

Christelis, D., D. Georgarakos, T. Jappelli, L. Pistaferri, and M. van Rooij (2019, June). Wealth Shocks and MPC Heterogeneity. NBER Working Papers 25999, National Bureau of Economic Research, Inc.

Christiano, L., C. Gust, and J. Roldos (2002). Monetary policy in a financial crisis. (WP-02-05).

Cloyne, J., C. Ferreira, and P. Surico (2018, May). Monetary policy when households have debt: new evidence on the transmission mechanism. Working Papers 1813, Banco de España;Working Papers Homepage.

Coibion, O., Y. Gorodnichenko, and S. Kumar (2018, September). How do firms form their expectations? new survey evidence. *American Economic Review 108*(9), 2671–2713.

Cole, R. (1998). The importance of relationships to the availability of credit. *Journal of Banking and Finance 22*(6-8), 959–977.

Cruijsen, C., J. Haan, and D.-J. Jansen (2016, June). Trust and Financial Crisis Experiences. *Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement 127*(2), 577–600.

Csajbók, A., A. Hudecz, and B. Tamási (2010). Foreign currency borrowing of households in new EU member states. MNB Occasional Paper 2010/87, Magyar Nemzeti Bank (the central bank of Hungary).

Dass, N. and M. Massa (2011). The Impact of a Strong Bank-Firm Relationship on the Borrowing Firm. *Review of Financial Studies 24*(4), 1204–1260.

Degryse, H. and S. Ongena (2002, March). Distance, Lending Relationships, and Competition. CSEF Working Papers 80, Centre for Studies in Economics and Finance (CSEF), University of Naples, Italy.

Degryse, H. and P. Van Cayseele (2000, January). Relationship Lending within a Bank-Based System: Evidence from European Small Business Data. *Journal of Financial Intermediation 9*(1), 90–109.

Dinlersoz, E., S. Kalemli-Ozcan, H. Hyatt, and V. Penciakova (2018, November). Leverage over the Life Cycle and Implications for Firm Growth and Shock Responsiveness. (25226).

Dittmar, A. and R. Duchin (2015, 09). Looking in the Rearview Mirror: The Effect of Managers' Professional Experience on Corporate Financial Policy. *The Review of Financial Studies 29*(3), 565–602.

Dynan, K., A. Mian, and K. M. Pence (2012). Is a Household Debt Overhang Holding Back Consumption. *Brookings Papers on Economic Activity 43*(1 (Spring), 299–362.

ECB (2019, November). Survey on the access to finance of enterprises in the euro area. april to september 2019.

Eichengreen, B., R. Hausmann, and U. Panizza (2007). Currency mismatches, debt intolerance, and the original sin: Why they are not the same and why it matters. In *Capital Controls and Capital Flows in Emerging Economies: Policies, Practices, and Consequences*, pp. 121–170. National Bureau of Economic Research, Inc.

Endrész, M., G. Gyöngyösi, and P. Harasztosi (2012). Currency mismatch and the subprime crisis: firm-level stylised facts from hungary.

Endrész, M. and P. Harasztosi (2014). Corporate foreign currency borrowing and investment: The case of hungary. *Emerging Markets Review 21*, 265–287.

Fafchamps, M. and S. Quinn (2018). Networks and Manufacturing Firms in Africa: Results from a Randomized Field Experiment. *World Bank Economic Review 32*(3), 656–675.

Fagereng, A., M. B. Holm, and G. J. Natvik (2016, November). MPC heterogeneity and household balance sheets. Discussion Papers 852, Statistics Norway, Research Department.

Feige, E. L. (2003, September). Dynamics of Currency Substitution, Asset Substitution and De facto Dollarisation and Euroisation in Transition Countries. *Comparative Economic Studies 45*(3), 358–383.

Ferrando, A., I. Ganoulis, and C. Preuss (2019, December). Firms' expectations on the availability of credit since the financial crisis. (2341).

Ferrando, A. and K. Mulier (2013, August). Firms' financing constraints: do perceptions match the actual situation? (1577).

Fidrmuc, J., M. Hake, and H. Stix (2013, June). Households' foreign currency borrowing in Central and Eastern Europe. *Journal of Banking & Finance 37*(6), 1880–1897.

Galindo, A., U. Panizza, and F. Schiantarelli (2003). Debt composition and balance sheet effects of currency depreciation: a summary of the micro evidence. *Emerging Markets Review 4*(4), 330–339.

Ganong, P. and P. Noel (2018, August). Liquidity vs. wealth in household debt obligations: Evidence from housing policy in the great recession. Working Paper 24964, National Bureau of Economic Research.

Giroud, X. and H. M. Mueller (2016, 10). Firm Leverage, Consumer Demand, and Employment Losses During the Great Recession*. *The Quarterly Journal of Economics 132*(1), 271–316.

Giroud, X. and H. M. Mueller (2018, December). Firm leverage and regional business cycles. (25325).

Gross, T., M. J. Notowidigdo, and J. Wang (2020). The marginal propensity to consume over the business cycle. *American Economic Journal: Macroeconomics 12*(2), 351–84.

Gyöngyösi, G., S. Ongena, and I. Schindele (2019). The impact of monetary conditions on bank lending to households. Technical report, CEPR Discussion Paper No. DP13616.

Gyöngyösi, G. and E. Verner (2020). Financial crisis, creditor-debtor conflict, and populism. *Available at SSRN 3289741*.

Hall, R. (1978). Stochastic implications of the life cycle-permanent income hypothesis: Theory and evidence. *Journal of Political Economy 86*(6), 971–87.

Harasztosi, P. and A. Lindner (2019, August). Who pays for the minimum wage? *American Economic Review 109*(8), 2693–2727.

Hardy, B. (2018, November). Foreign currency borrowing, balance sheet shocks and real outcomes. (758).

Hárs, A. (2016). EMIGRATION AND IMMIGRATION IN HUNGARY AFTER THE REGIME CHANGE – BY INTERNATIONAL COMPARISON. In Z. Blaskó and K. Fazekas (Eds.), *The Hungarian Labor Market 2016*, pp. 39–54. Budapest: Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences.

Ilzetzki, E., C. M. Reinhart, and K. S. Rogoff (2019, 01). Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold?*. *The Quarterly Journal of Economics 134*(2), 599–646.

Imbens, G. W. and J. M. Wooldridge (2009). Recent developments in the econometrics of program evaluation. *Journal of economic literature 47*(1), 5–86.

Ivashina, V. and D. Scharfstein (2010). Bank lending during the financial crisis of 2008. *Journal of Financial Economics 97*(3), 319 – 338. The 2007-8 financial crisis: Lessons from corporate finance.

Jacobson, T. and E. Schedvin (2015, July). Trade Credit and the Propagation of Corporate Failure: An Empirical Analysis. *Econometrica 83*(4), 1315–1371.

Jappelli, T. and L. Pistaferri (2014, October). Fiscal Policy and MPC Heterogeneity. *American Economic Journal: Macroeconomics 6*(4), 107–136.

Jensen, T. L. and N. Johannesen (2017, November). The Consumption Effects of the 2007–2008 Financial Crisis: Evidence from Households in Denmark. *American Economic Review 107*(11), 3386–3414.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina (2012, May). Credit supply and monetary policy: Identifying the bank balance-sheet channel with loan applications. *American Economic Review 102*(5), 2301–26.

Jiménez, G., S. Ongena, J.-L. Peydró, and J. Saurina (2014). Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking? *Econometrica 82*(2), 463–505.

Kalemli-Ozcan, S., L. Laeven, and D. Moreno (2019, February). Debt overhang, rollover risk, and corporate investment: evidence from the European crisis. (2241).

Kalemli-Ozcan, S., A. Liu, and I. Shim (2018). Exchange rate appreciations and corporate risk taking.

Katay, G. and P. Harasztosi (2017, May). Currency Matching and Carry Trade by Non-Financial Corporations. (2017-02).

Khwaja, A. I., A. Mian, and A. Qamar (2011, March). Bank Credit and Business Networks. Working Paper Series rwp11-017, Harvard University, John F. Kennedy School of Government.

Kiss, G., M. Nagy, and B. Vonnák (2006). Credit growth in central and eastern europe: Convergence or boom? (2006/10).

Knüpfer, S., E. Rantapuska, and M. Sarvimaki (2017). Formative experiences and portfolio choice: Evidence from the finnish great depression. *The Journal of Finance 72*(1), 133–166.

Krugman, P. (1999, November). Balance Sheets, the Transfer Problem, and Financial Crises. *International Tax and Public Finance 6*(4), 459–472.

Kukk, M. (2016). How did household indebtedness hamper consumption during the recession? evidence from micro data. *Journal of Comparative Economics 44*(3), 764–786.

Le Blanc, J. and R. Lydon (2019, December). Indebtedness and spending: What happens when the music stops? (14/RT/19).

Maggio, M. D., A. Kermani, B. J. Keys, T. Piskorski, R. Ramcharan, A. Seru, and V. Yao (2017, November). Interest Rate Pass-Through: Mortgage Rates, Household Consumption, and Voluntary Deleveraging. *American Economic Review 107*(11), 3550–3588.

Malmendier, U. and S. Nagel (2011, 02). Depression Babies: Do Macroeconomic Experiences Affect Risk Taking?*. *The Quarterly Journal of Economics 126*(1), 373–416.

Malmendier, U., G. TATE, and J. YAN (2011). Overconfidence and early-life experiences: The effect of managerial traits on corporate financial policies. *The Journal of Finance 66*(5), 1687–1733.

Manski, C. F. (1993). Identification of Endogenous Social Effects: The Reflection Problem. *Review of Economic Studies 60*(3), 531–542.

Mian, A., K. Rao, and A. Sufi (2013). Household Balance Sheets, Consumption, and the Economic Slump. *The Quarterly Journal of Economics 128*(4), 1687–1726.

Mion, G. and L. D. Opromolla (2014). Managers' mobility, trade performance, and wages. *Journal of International Economics 94*(1), 85–101.

MNB (2006). Report on financial stability. (April).

MNB (2015). Information on the Funding for Growth Scheme Plus.

MNB (2017). Results of the Funding for Growth Program.

Moreh, C. (2016). Hungarian immigrants in the United Kingdom. In Z. Blaskó and K. Fazekas (Eds.), *The Hungarian Labor Market 2016*, pp. 69–72. Budapest: Institute of Economics, Centre for Economic and Regional Studies, Hungarian Academy of Sciences.

Niepmann, F. and T. Schmidt-Eisenlohr (2017). Foreign Currency Loans and Credit Risk: Evidence from U.S. Banks.

Niepmann, F. and T. Schmidt-Eisenlohr (2019). Foreign currency loans and credit risk: Evidence from us banks.

Olley, G. S. and A. Pakes (1996, November). The Dynamics of Productivity in the Telecommunications Equipment Industry. *Econometrica 64*(6), 1263–1297.

Ongena, S. and D. C. Smith (2001, September). The duration of bank relationships. *Journal of Financial Economics 61*(3), 449–475.

Ongena, S., G. Tümer-Alkan, and B. Vermeer (2011, April). Corporate choice of banks: Decision factors, decision maker, and decision process – First evidence. *Journal of Corporate Finance 17*(2), 326–351.

Oster, E. (2019). Unobservable selection and coefficient stability: Theory and evidence. *Journal of Business & Economic Statistics 37*(2), 187–204.

Paravisini, D., S. Philipp, and V. Rappoport (2017, July). Specialization in Bank Lending: Evidence from Exporting Firms. CEPR Discussion Papers 12156, C.E.P.R. Discussion Papers.

Pellényi, G. and P. Bilek (2009). Foreign currency borrowing: The case of hungary. FINESS Working Paper.

Pistaferri, L. (2016, October). Why Has Consumption Remained Moderate after the Great Recession? Working paper.

Price, F., B. Beckers, and G. L. Cava (2019, July). The Effect of Mortgage Debt on Consumer Spending: Evidence from Household-level Data. RBA Research Discussion Papers rdp2019-06, Reserve Bank of Australia.

Rajan, R. G. (1992, September). Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt. *Journal of Finance 47*(4), 1367–1400.

Rajan, R. G. and L. Zingales (1998, June). Financial Dependence and Growth. *American Economic Review 88*(3), 559–586.

Ranciere, R., A. Tornell, and A. Vamvakidis (2010, October). Currency mismatch, systemic risk and growth in emerging Europe. *Economic Policy 25*, 597–658.

10.14754/CEU.2020.11

Sacerdote, B. (2001). Peer Effects with Random Assignment: Results for Dartmouth Roommates. *The Quarterly Journal of Economics 116*(2), 681–704.

Santos, J. A. C. and L. A. Farinha (2000, January). Switching from single to multiple bank lending relationships: determinants and implications. BIS Working Papers 83, Bank for International Settlements.

Szigel, G. (2012). Less known facts about foreign currency lending to households in hungary. foreign currency lending to households in central and eastern europe. MNB Working Paper.

Temesvary, J. and A. Banai (2017). The drivers of foreign bank lending in Central and Eastern Europe: The roles of parent, subsidiary and host market traits. *Journal of International Money and Finance 79*(C), 157–173.

Varela, L. and J. Salomao (2018). Exchange Rate Exposure and Firm Dynamics.

Verner, E. and G. Gyöngyösi (2020). Household debt revaluation and the real economy: Evidence from a foreign currency debt crisis. *Available at SSRN 3241309*.

Vonnák, D. (2018). Why do firms default on their foreign currency loans? the case of hungary. *Journal of International Money and Finance 86*, 207–222.

Vonnák, D. (2018). Why do firms default on their foreign currency loans? the case of hungary. *Journal of International Money and Finance 86*, 207 – 222.

Wolfers, J. (2006, December). Did unilateral divorce laws raise divorce rates? a reconciliation and new results. *American Economic Review 96*(5), 1802–1820.

10.14754/CEU.2020.11

Appendix A

Appendix for Chapter 1

A.1 Tables and Figures

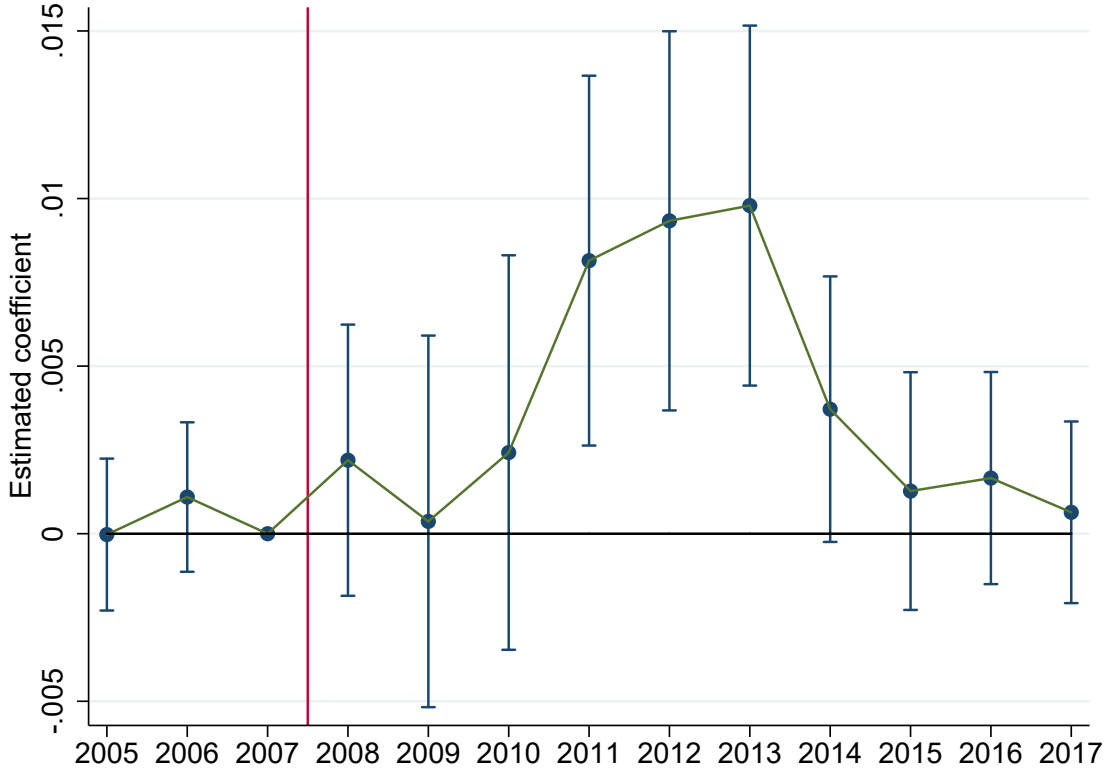
Table A.1: No recovery

	(1)	(2)	(3)	(4)
treatedxafter	0.0061***	0.0046***	0.0045***	0.0035***
	(0.0008)	(0.0009)	(0.0010)	(0.0013)
N	373997	250647	240993	240510
R^2	0.191	0.182	0.184	0.202
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Firm controls	NO	YES	YES	YES
Location	NO	NO	YES	YES
Bank	NO	NO	NO	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. The outcome variables is 1, if the firm is 90 days past due on at least one of its loans. The specification in the first column contains firm and year fixed effects. In addition, in column 2 I control for 2007 firm level characteristics (sales, employment, investment, age, real value added and industry) interacted with year. In column 3 I further control for firm location in 2007, interacted with year. In column 4, I add firm's bank in 2007, interacted with year to the previous set of controls. In all specifications standard errors are clustered at the firm level.

10.14754/CEU.2020.11

Figure A.1: Does the firm have at least one loan which does not recover?



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if for at least one loan contract the delinquency does not end by the end of the year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard error are clustered at the firm level.

A.2 Data Appendix

Corporate credit registry The corporate credit registry is built from four data tables. The first data table contains the matches between contract identifier and firm identifier. The second data table contains all time invarian contract level characteristics such as issue date, maturity date, termination date, amount, denomination, main type (4 categories: in the balance sheet, short or long term, outside the balance sheet, short or long term), secondary

10.14754/CEU.2020.11

Table A.2: Bank loan

	(1)	(2)	(3)	(4)
treatedxafter	-0.0410***	-0.0248***	-0.0272***	-0.0375***
	(0.0044)	(0.0049)	(0.0050)	(0.0062)
N	373997	250647	240993	240510
R^2	0.405	0.433	0.434	0.449
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Firm controls	NO	YES	YES	YES
Location	NO	NO	YES	YES
Bank	NO	NO	NO	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. if the firm borrowed at least one new bank loan in a given year. The specification in the first column contains firm and year fixed effects. In addition, in column 2 I control for 2007 firm level characteristics (sales, employment, investment, age, real value added and industry) interacted with year. In column 3 I further control for firm location in 2007, interacted with year. In column 4, I add firm's bank in 2007, interacted with year to the previous set of controls. In all specifications standard errors are clustered at the firm level.

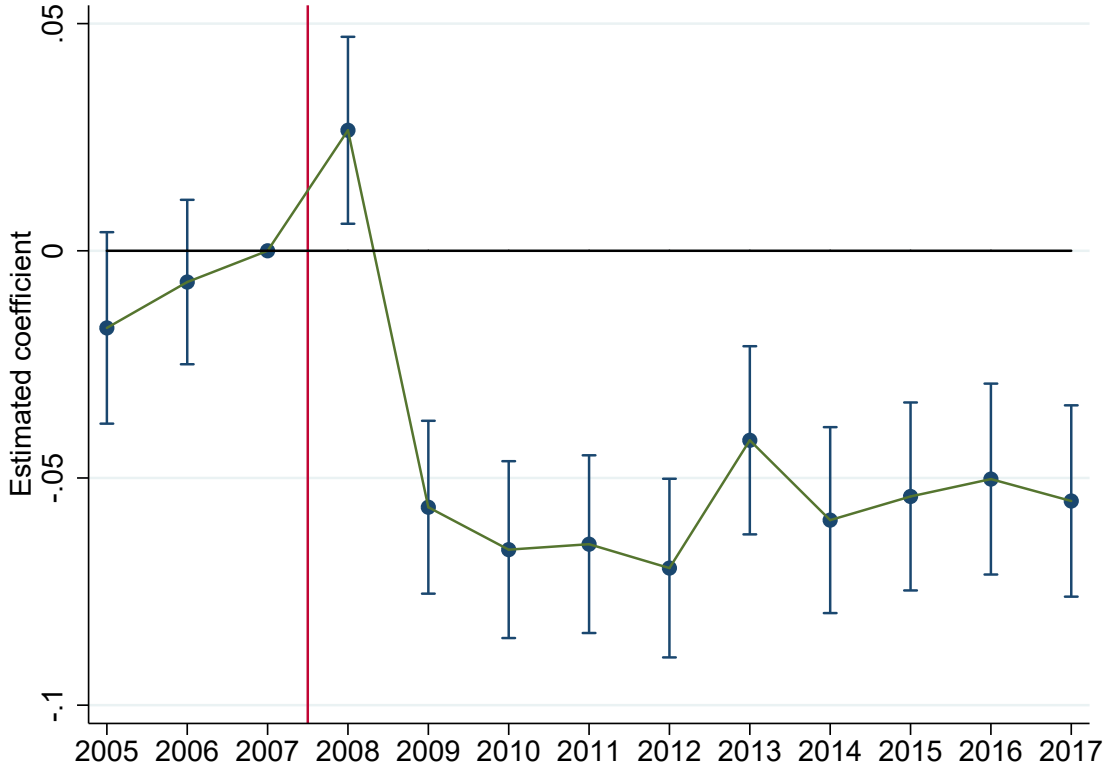
Table A.3: Financing related outcomes when controlling for ability to repay (log sales)

	(1)	(2)	(3)	(4)	(5)
	Delinquency	No recovery	Borrows	New is loan	Same bank
treatedxafter	0.0065***	0.0027**	-0.0288***	-0.0388***	-0.0428***
	(0.0017)	(0.0013)	(0.0058)	(0.0061)	(0.0059)
Log sales	-0.0085***	-0.0047***	0.0793***	0.0555***	0.0238***
	(0.0005)	(0.0004)	(0.0012)	(0.0012)	(0.0010)
N	231799	231799	231799	231799	231799
R^2	0.210	0.215	0.455	0.454	0.508
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Log sales weighted regressions. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. I control for contemporanous sales as a measure of ability to repay. Standard errors are clustered at the firm level.

10.14754/CEU.2020.11

Figure A.2: Does the firm take out a bank loan?

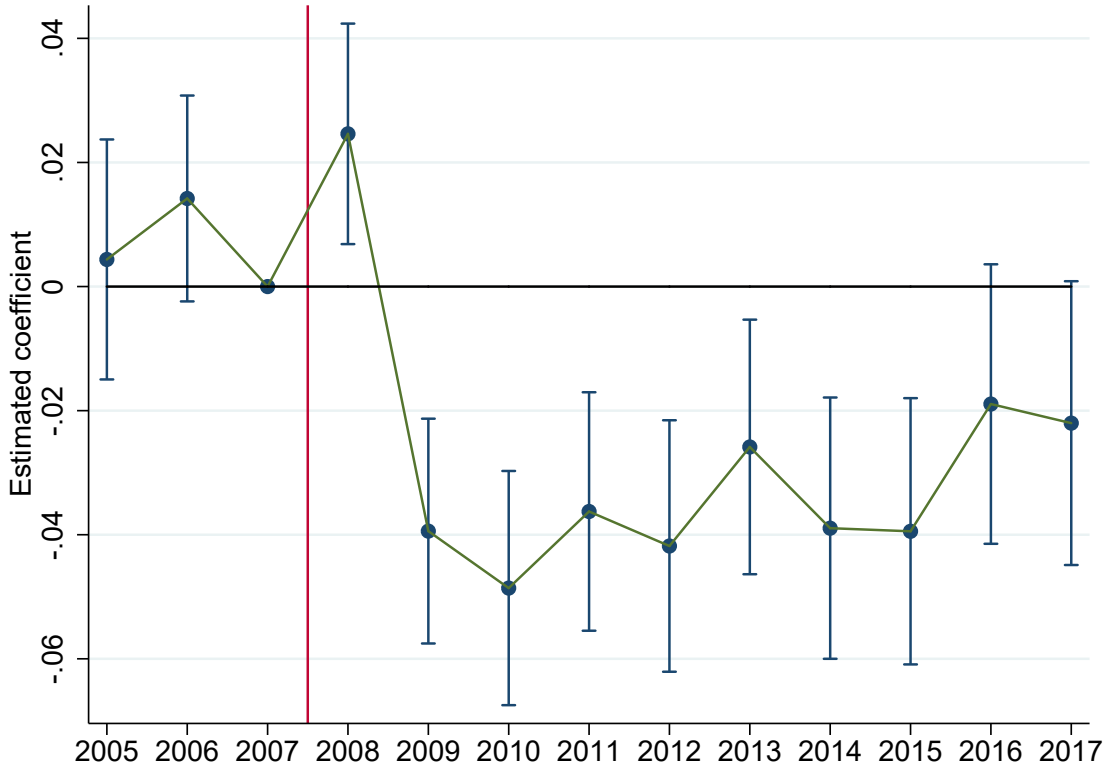


Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the firm borrowed at least one new bank loan in a given year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

type (e.g. bank loan, credit line, financial leasing, documentary letter of credit, etc.) and bank id for the bank of origination. The third data table contains the reference date, outstanding amount in HUF and in foreign currency in case of FX loan, denomination, actual instalment and its denomination, repayment type (e.g. annuity, credit line) and repayment period (e.g mothly). The fourth data table gives on the contract id level 30 days past due date, end of past due date, how delinquency ended (e.g customer payed, someone else payed, ended with change in contract, loss) amount due and currency of denomination.

10.14754/CEU.2020.11

Figure A.3: Does the firm take out a bank loan? Controlling for ability to repay



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the firm borrowed at least one new bank loan in a given year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

This information is reported by banks on a monthly level for the universe of loan contracts from banks and financial institutions operating in Hungary. Beyond ongoing loan contracts, information for each expired loan contract is kept in the registry for five years after contract closure.

The database first became available in January 2010. Due to the time coverage of the database, the credit registry can be reconstructed fully for all contracts existing since January 2005. Given the original amount, issue date and termination date for each contract,

Table A.4: Financing related outcomes when controlling for history

	(1) Delinquency 90d	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
treatedxafter	0.0063***	0.0030**	-0.0258***	-0.0363***	-0.0398***
	(0.0017)	(0.0012)	(0.0060)	(0.0062)	(0.0058)
History	-0.0207***	-0.0078***	-0.0580***	-0.0500***	0.0103***
	(0.0006)	(0.0003)	(0.0037)	(0.0035)	(0.0029)
Bad history	-0.0092***	0.0038***	-0.1308***	-0.1120***	-0.0483***
	(0.0017)	(0.0010)	(0.0054)	(0.0052)	(0.0043)
N	240510	240510	240510	240510	240510
R^2	0.205	0.204	0.447	0.450	0.506
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Log sales weighted regressions. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. History refers to the state of the firm derived from credit registry when in a certain year a bank can observe credit history for a firm, but this history does not contain any negative events. In case of bad history, the bank can observe at least one negative event in a given year for a firm. Omitted category is no history. Standard errors are clustered at the firm level.

we build a monthly contract level database where we calculate the outstanding amount using linear repayment schedule. For this first data reporting, some variables are not reported yet. For instance, the variable indicating the type for contract repayment is missing. However, later data reporting shows that the most likely repayment for firms is linear. In addition, we do not observe the data provider. Also, the delinquenca events up to December 2009 are the last events in time that were registered, which might lead to some loss of information, although defaults very less likely before the crisis. [1]

Since January 2010, the status of all loans is reported monthly. [2] Starting from April

[1] For more details about constructing the database for the period before January 2010 see Endrész et al. (2012).

[2] For variables that are assumed to be unchanged during the contract period, if a change in reporting occurs, we accept the most recent reporting. E.g. an observed change in the original amount is considered as an error correction from the reporter and the latest such information is accepted.

10.14754/CEU.2020.11

Table A.5: Financing related outcomes for a balanced panel sample

	(1) Delinquency 90d	(2) No recovery	(3) Borrows	(4) New is loan	(5) Same bank
treatedxafter	0.0041***	0.0008	-0.0291***	-0.0428***	-0.0416***
	(0.0012)	(0.0007)	(0.0077)	(0.0079)	(0.0075)
N	157352	157352	157352	157352	157352
R^2	0.145	0.118	0.436	0.444	0.496
Firm FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES

Notes: *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level. Log sales weighted regressions. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

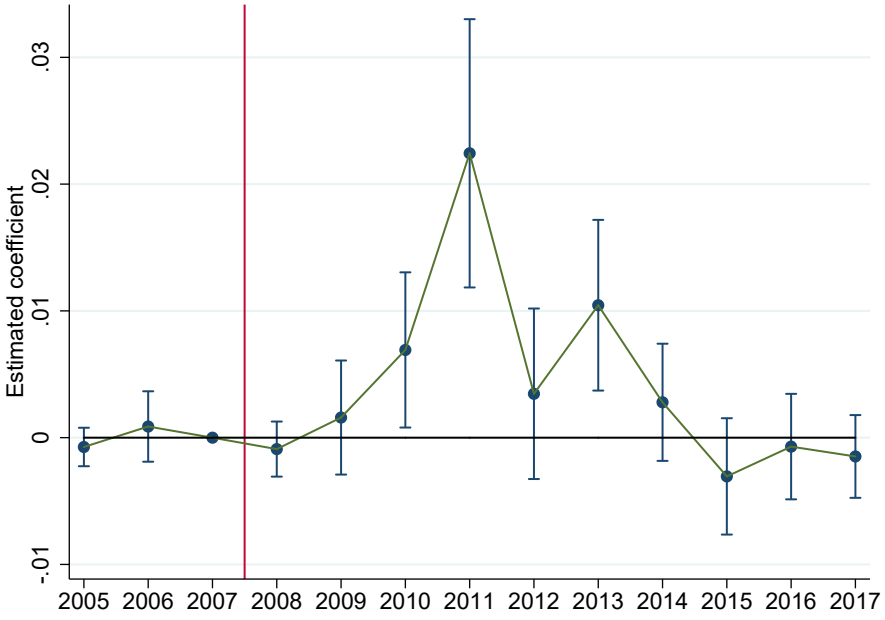
2012, some changes in data reporting occured. For firms and contracts, anonymized identifiers are reported, meaning that the credit registry database can no longer be merged to other firm level data. At the same time, the identity of the data provider is reported. Starting from August 2015, the real firm and contract identifiers are again reported. Based on August 2015 data, we can uncover the real firm and contract id for each firm which had a contract starting from August 2010. For contracts which ended before August 2010, firm and contract identifiers are reconstructed based on contract characteristics, using the earlier provided non-anonymized data.

After combining all the available data for the period 2005-2017, as all firm level data is yearly, I collapse the data from the credit registry for outcome variables of interest to yearly frequency. All outcomes variables are binary and described in Table B.1.

Corporate credit registry query The corporate credit registry query shows the day on which a given bank queried a firm from the credit registry. This dataset is available starting from 2011 on a daily level. I aggregate the query database to the firm-bank-month level and discard those observation where the firm has an existing contract with a given bank. Bank-firm connection information comes from the credit registry. Further on, I merge to the query database new contracts from the credit registry on the firm-bank-month level. I

10.14754/CEU.2020.11

Figure A.4: Does the firm become delinquent? Balanced panel results

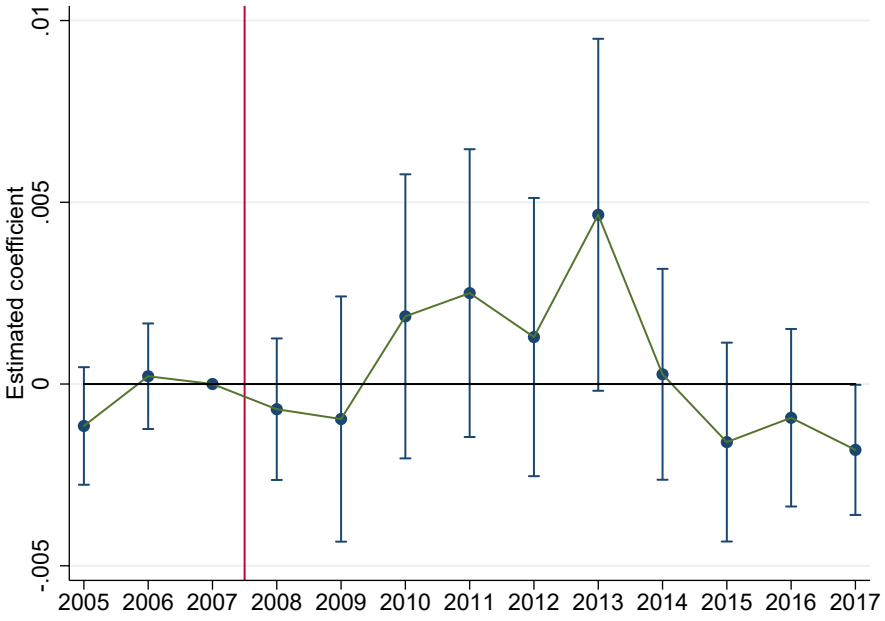


Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variables is 1, if the firm is 90 days past due on at least one of its loans. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

add the number of queries and and the numbber of new loans for a firm in a given year to obtain yearly firm level loan acceptance rate.

10.14754/CEU.2020.11

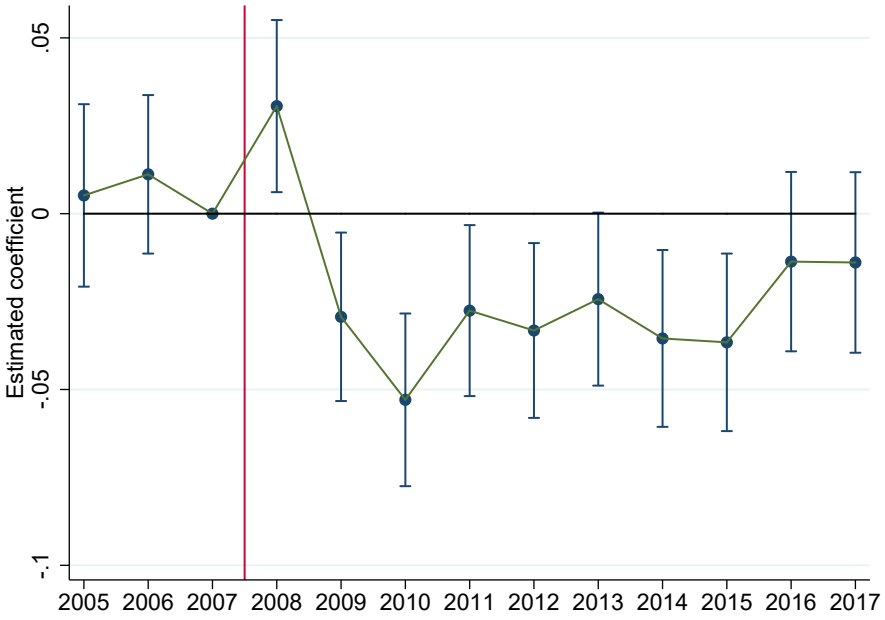
Figure A.5: Does the firm have at least one loan which does not recover? Balanced panel results



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if for at least one loan contract the delinquency does not end by the end of the year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard error are clustered at the firm level.

10.14754/CEU.2020.11

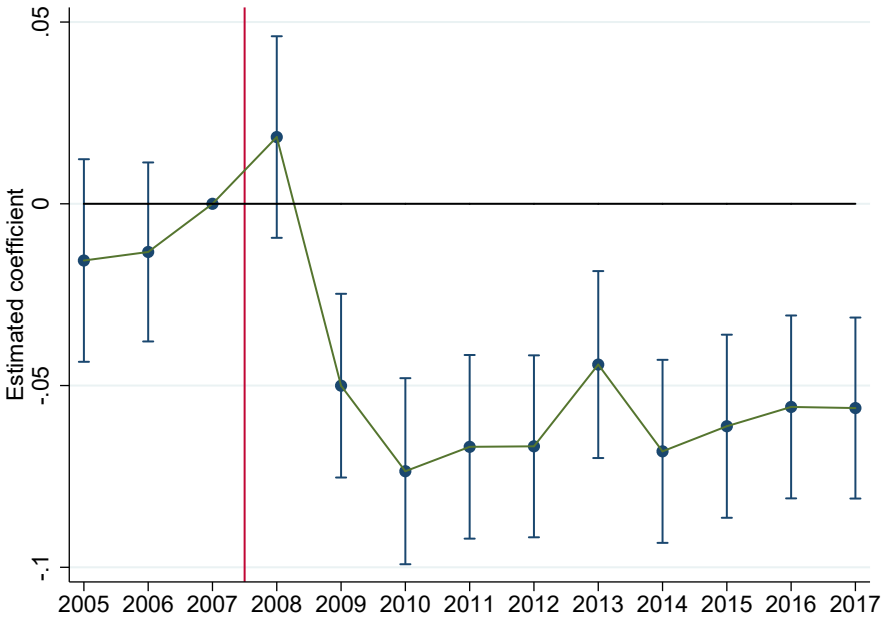
Figure A.6: Does the firm borrow? Balanced panel results



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the firm borrowed at least once in a given year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard error are clustered at the firm level.

10.14754/CEU.2020.11

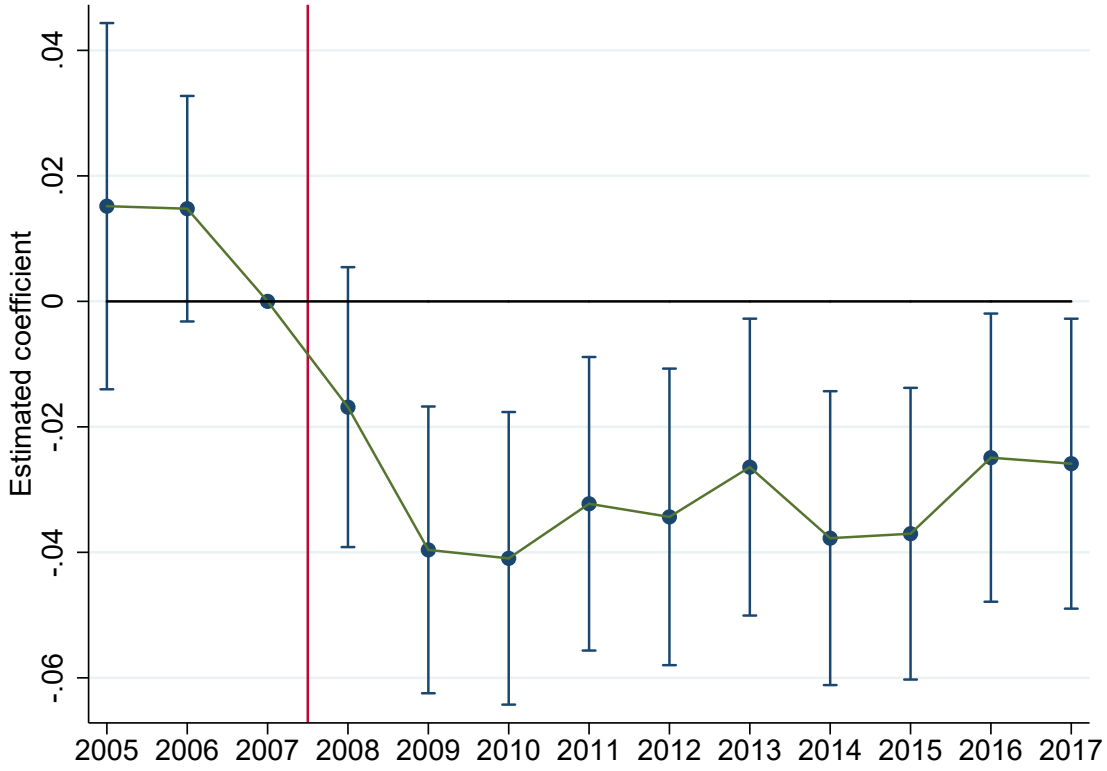
Figure A.7: Does the firm take out a bank loan? Balanced panel results



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the firm borrowed at least one new bank loan in a given year. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

10.14754/CEU.2020.11

Figure A.8: Does the firm take out a loan from its pre-crisis bank?



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1, if the bank from which the new loan is obtained coincides with at least one of the banks of the firm in 2007. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard error are clustered at the firm level.

10.14754/CEU.2020.11

Table A.6: Correlates of foreign currency borrowing on the firm level for the subsample of firms in manufacturing

		(1) 0		(2) 1	T-test Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Employment	2796	11.040	1431	13.379	-2.338***
		(0.426)		(0.694)	
Sales	2940	109.851	1486	141.479	-31.627***
		(6.408)		(11.368)	
Assets	2940	82.108	1486	102.331	-20.223**
		(4.633)		(7.410)	
Investment	2940	9.292	1486	11.415	-2.123
		(1.700)		(1.271)	
Productivity	2795	4.054	1430	4.204	-0.150
		(0.108)		(0.159)	
Leverage	2581	0.407	1363	0.613	-0.206*
		(0.059)		(0.117)	
Age	2940	7.853	1486	7.963	-0.110
		(0.085)		(0.120)	
Foreign	2940	0.012	1486	0.014	-0.002
		(0.002)		(0.003)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms in manufacturing. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

Table A.7: Correlates of foreign currency borrowing on the firm level for the subsample of firms in services

		(1)		(2)	T-test
		0		1	Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Employment	13200	8.830	6527	8.728	0.101
		(0.534)		(0.344)	
Sales	14317	179.916	6964	160.805	19.111
		(20.470)		(8.722)	
Assets	14317	93.902	6964	97.844	-3.942
		(8.822)		(4.743)	
Investment	14317	7.989	6964	11.733	-3.744***
		(0.521)		(0.989)	
Productivity	13199	4.127	6526	4.126	0.001
		(0.089)		(0.084)	
Leverage	12279	2.529	6136	3.667	-1.138
		(0.965)		(2.547)	
Age	14317	7.006	6964	7.152	-0.146**
		(0.036)		(0.053)	
Foreign	14317	0.022	6964	0.017	0.005**
		(0.001)		(0.002)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms in services. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

Table A.8: Correlates of foreign currency borrowing on the firm level for the subsample of firms in construction

		(1) 0		(2) 1	T-test Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Employment	3604	8.052	1618	9.686	-1.634***
		(0.206)		(0.359)	
Sales	3837	116.285	1716	152.347	-36.062***
		(6.401)		(11.306)	
Assets	3837	85.088	1716	107.900	-22.811*
		(6.572)		(9.606)	
Investment	3837	7.987	1716	8.656	-0.669
		(1.741)		(0.779)	
Productivity	3604	3.628	1618	4.066	-0.438*
		(0.146)		(0.167)	
Leverage	3306	2.176	1524	2.101	0.075
		(0.941)		(1.092)	
Age	3837	6.403	1716	6.794	-0.391***
		(0.069)		(0.104)	
Foreign	3837	0.007	1716	0.015	-0.008***
		(0.001)		(0.003)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms in services. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

Table A.9: Correlates of foreign currency borrowing on the firm level for the subsample of firms less than 6 years

	(1) 0		(2) 1		T-test Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Employment	9927	6.120	4630	6.092	0.028
		(0.554)		(0.235)	
Sales	11014	101.479	5060	92.300	9.179
		(19.882)		(9.184)	
Assets	11014	73.890	5060	57.293	16.597
		(16.545)		(2.621)	
Investment	11014	20.471	5060	9.543	10.928
		(12.125)		(0.597)	
Productivity	9926	3.611	4630	3.727	-0.116
		(0.075)		(0.093)	
Leverage	8934	3.429	4261	5.365	-1.936
		(1.314)		(3.669)	
Age	11014	3.424	5060	3.438	-0.014
		(0.012)		(0.017)	
Foreign	11014	0.014	5060	0.013	0.001
		(0.001)		(0.002)	
Manufacturing	11014	0.111	5060	0.118	-0.007
		(0.003)		(0.005)	
Construction	11014	0.190	5060	0.176	0.015**
		(0.004)		(0.005)	
Service	11014	0.625	5060	0.642	-0.018**
		(0.005)		(0.007)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms younger than 6 years. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

Table A.10: Correlates of foreign currency borrowing on the firm level for the subsample of firms 6-15 years old

	(1) 0		(2) 1		T-test Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Employment	9958	10.777	4916	11.944	-1.167*
		(0.381)		(0.427)	
Sales	10540	204.872	5123	197.870	7.002
		(19.520)		(8.691)	
Assets	10540	132.543	5123	142.554	-10.011
		(6.150)		(7.094)	
Investment	10540	10.232	5123	14.382	-4.150***
		(0.734)		(1.298)	
Productivity	9957	4.405	4914	4.390	0.015
		(0.097)		(0.104)	
Leverage	9589	1.139	4747	1.383	-0.244
		(0.381)		(0.541)	
Age	10540	9.479	5123	9.598	-0.119**
		(0.028)		(0.039)	
Foreign	10540	0.021	5123	0.016	0.004*
		(0.001)		(0.002)	
Manufacturing	10540	0.132	5123	0.141	-0.009
		(0.003)		(0.005)	
Construction	10540	0.141	5123	0.135	0.006
		(0.003)		(0.005)	
Service	10540	0.609	5123	0.625	-0.016*
		(0.005)		(0.007)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms 6-15 years old. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

Table A.11: Correlates of foreign currency borrowing on the firm level for the subsample of firms older than 15 years

		(1) 0		(2) 1	T-test Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Employment	1860	20.589	925	17.261	3.328
		(1.574)		(1.121)	
Sales	1919	378.021	940	279.485	98.536
		(64.162)		(17.964)	
Assets	1919	331.894	940	221.883	110.011
		(77.167)		(13.186)	
Investment	1919	-6.477	940	18.446	-24.923
		(28.273)		(2.101)	
Productivity	1859	3.931	925	4.287	-0.356
		(0.379)		(0.227)	
Leverage	1771	0.734	893	0.366	0.368
		(0.345)		(0.030)	
Age	1919	16.000	940	16.000	N/A
		(0.000)		(0.000)	
Foreign	1919	0.027	940	0.028	-0.001
		(0.004)		(0.005)	
Manufacturing	1919	0.166	940	0.176	-0.009
		(0.009)		(0.012)	
Construction	1919	0.132	940	0.140	-0.009
		(0.008)		(0.011)	
Service	1919	0.530	940	0.547	-0.016
		(0.011)		(0.016)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms older than 15 years. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

Table A.12: Correlates of foreign currency borrowing on the firm level for the subsample of firms with less than 10 employees

		(1) 0		(2) 1	T-test Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Employment	16961	3.323	7776	3.582	-0.259***
		(0.018)		(0.027)	
Sales	16961	66.175	7776	69.848	-3.673
		(1.380)		(1.514)	
Assets	16961	46.971	7776	50.651	-3.680*
		(1.126)		(1.302)	
Investment	16961	5.331	7776	7.254	-1.923***
		(0.266)		(0.386)	
Productivity	16958	4.037	7775	4.196	-0.160
		(0.080)		(0.085)	
Leverage	14918	2.020	6984	3.460	-1.441
		(0.757)		(2.249)	
Age	16961	6.651	7776	6.806	-0.154***
		(0.032)		(0.048)	
Foreign	16961	0.014	7776	0.014	0.000
		(0.001)		(0.001)	
Manufacturing	16961	0.113	7776	0.115	-0.001
		(0.002)		(0.004)	
Construction	16961	0.160	7776	0.145	0.016***
		(0.003)		(0.004)	
Service	16961	0.640	7776	0.661	-0.021***
		(0.004)		(0.005)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms with less than 10 employees. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

Table A.13: Correlates of foreign currency borrowing on the firm level for the subsample of firms with 10 to 49 employees

		(1) 0		(2) 1	T-test Difference
Variable	N	Mean/SE	N	Mean/SE	(1)-(2)
Employment	4286	19.240	2442	19.301	-0.061
		(0.145)		(0.194)	
Sales	4286	310.013	2442	310.995	-0.982
		(7.406)		(8.555)	
Assets	4286	220.240	2442	218.650	1.590
		(8.349)		(7.876)	
Investment	4286	20.582	2442	24.677	-4.095
		(2.173)		(2.202)	
Productivity	4286	3.853	2441	3.771	0.082
		(0.078)		(0.081)	
Leverage	4125	0.190	2378	0.315	-0.125**
		(0.007)		(0.071)	
Age	4286	9.560	2442	9.262	0.297**
		(0.071)		(0.092)	
Foreign	4286	0.022	2442	0.019	0.003
		(0.002)		(0.003)	
Manufacturing	4286	0.185	2442	0.199	-0.014
		(0.006)		(0.008)	
Construction	4286	0.195	2442	0.192	0.003
		(0.006)		(0.008)	
Service	4286	0.491	2442	0.516	-0.025*
		(0.008)		(0.010)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms with with 10 to 49 employees. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

10.14754/CEU.2020.11

Table A.14: Correlates of foreign currency borrowing on the firm level for the subsample of firms with more than 49 employees

Variable	N	(1) 0 Mean/SE	N	(2) 1 Mean/SE	T-test Difference (1)-(2)
Employment	498	135.631	253	110.300	25.330
		(13.354)		(7.355)	
Sales	498	3010.210	253	1712.159	1298.051
		(634.274)		(222.301)	
Assets	498	2000.168	253	1096.014	904.154
		(474.110)		(118.535)	
Investment	498	269.928	253	82.565	187.363
		(289.094)		(15.888)	
Productivity	498	4.102	253	3.807	0.295
		(0.397)		(0.472)	
Leverage	484	0.143	251	0.226	-0.083**
		(0.008)		(0.045)	
Age	498	10.715	253	10.818	-0.103
		(0.206)		(0.282)	
Foreign	498	0.084	253	0.028	0.057***
		(0.012)		(0.010)	
Manufacturing	498	0.165	253	0.217	-0.053*
		(0.017)		(0.026)	
Construction	498	0.096	253	0.103	-0.006
		(0.013)		(0.019)	
Service	498	0.476	253	0.490	-0.014
		(0.022)		(0.031)	

Notes: Correlates for 2007 foreign currency debt exposure and 2007 firm level characteristics for the subsample of firms with more than 49 employees. Control firms are those which have only HUF denonimated debt in September 2008, the month prior the depreciation starts. Treatment firms are those firms which have some CHF exposure in September 2008. Employment is number of employees. Sales, assets, investment, productivity and debt are in million HUF. Productivity is defined as real value added per employment. Leverage is defined as debt to sales. Foreign, manufacturing, construction and service are indicator variables taking value 1 for the respective categories.

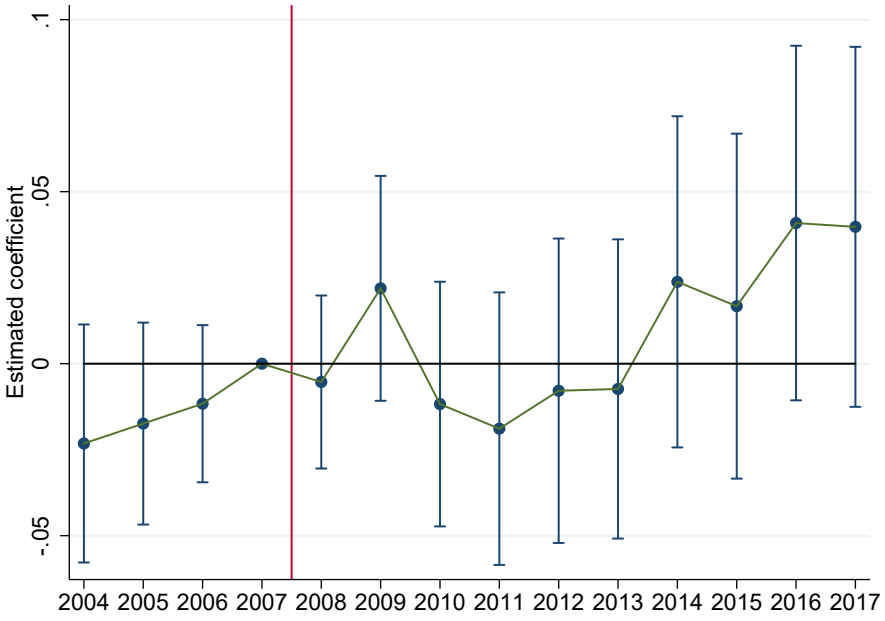
Table A.15: Unobservable selection

	Delin-quency	No recovery	Borrows	New is loan	Same bank
Full model					
R-squared	0.0055	0.0027	0.0177	0.0197	0.0185
Beta	0.0070	0.0035	-0.0272	-0.0375	-0.0418
Partial model					
R-squared	0.0002	0.0001	0.0003	0.0005	0.0007
Beta	0.0115	0.0056	-0.0371	-0.0476	-0.0453
Beta*	0.0056	0.0028	-0.0242	-0.0345	-0.0408

Notes: Following Oster (2019), omitted variable bias adjusted effects, beta, are provided in the last line of the table. The full model refers to the original model as presented in Equation 1.1, while the partial model refers to the model in Equation 1.1 without controls. R_{max} from the formula from the paper is taken to be equal to 1.3 times the R-squared from the full model.*

10.14754/CEU.2020.11

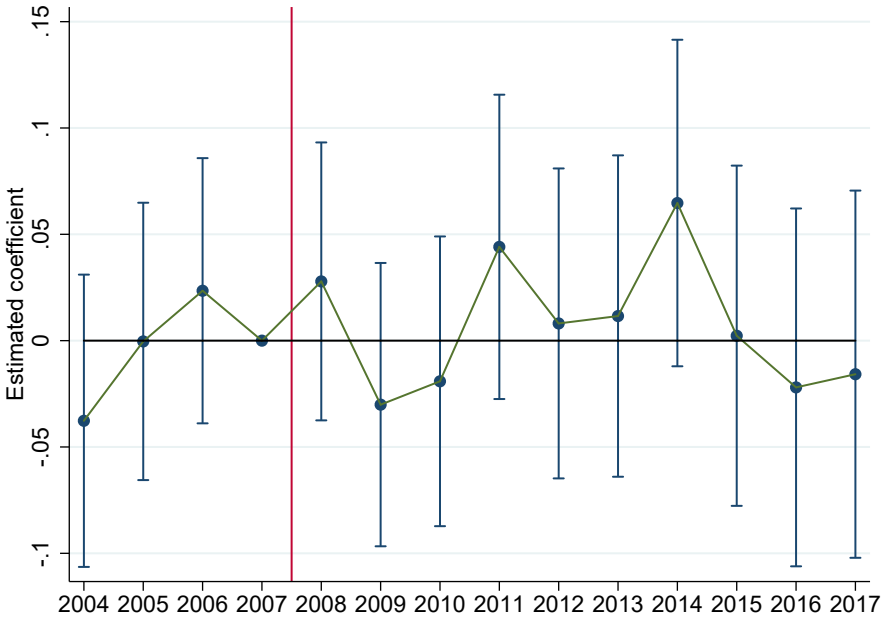
Figure A.9: Own capital



Notes: The figure shows estimated β coefficients from Equation 1.2. The outcome variable is log own capital. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

10.14754/CEU.2020.11

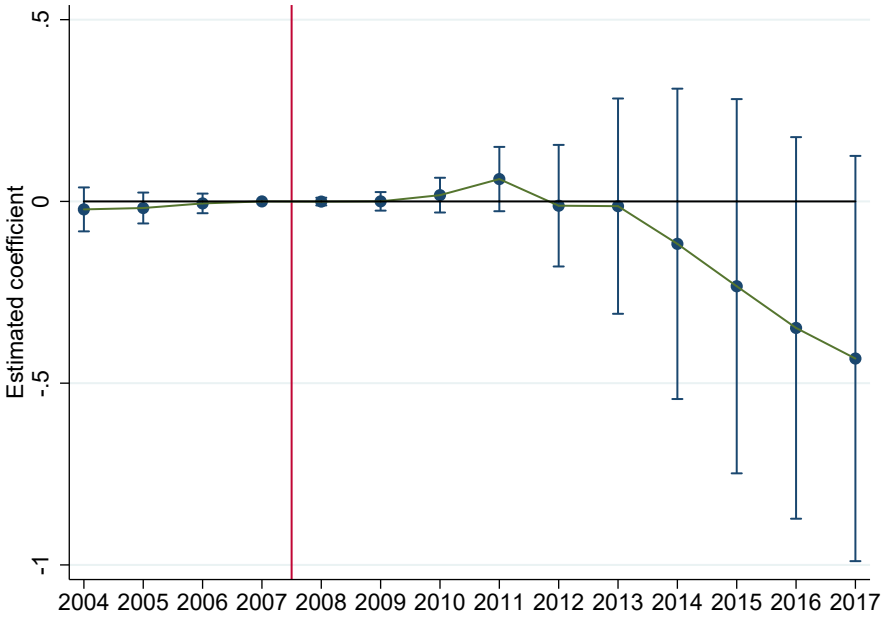
Figure A.10: Cash flow



Notes: The figure shows estimated β coefficients from Equation 1.2. The outcome variable is log cash flow. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

10.14754/CEU.2020.11

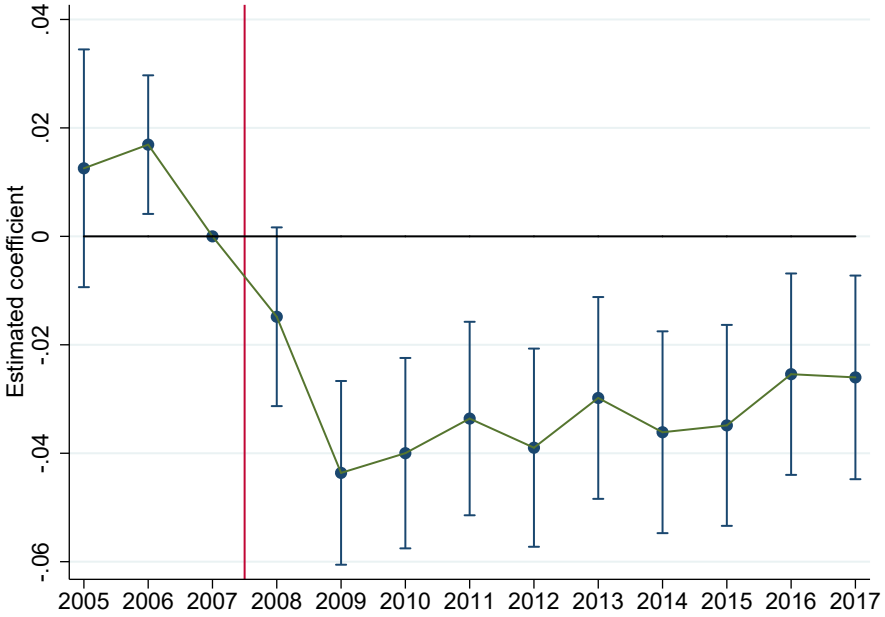
Figure A.11: Own capital to total assets



Notes: The figure shows estimated β coefficients from Equation 1.2. The outcome variable is own capital to assets. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

10.14754/CEU.2020.11

Figure A.12: Borrowing from other banks



Notes: The figure shows estimated β coefficients from equation 1.2. The outcome variable is 1 if the firm borrowed from at least one bank which is different from its (main) bank in 2007. Firm and year fixed effects are included in the regression, as well as 2007 firm characteristics (sales, real value added, investment, employment, age, industry, bank, location and end of year debt) interacted with year. Standard errors are clustered at the firm level.

10.14754/CEU.2020.11

Table A.16: Variable definition

Delinquency 90d	1, if the firm is delinquent beyond 90 days on at least one of its loans in a given year.
No recovery	1, if at least one of loan of the firm does not recover from delinquency in a given year.
Borrows	1, if the firm forms at least one new banking relationship in a given year. This new banking relationship can be bank guarantee, documentary letter of credit, bank loan, credit line, financial leasing or loan guarantee.
New is loan	1, if at least one new banking relationship is bank loan.
Same bank	1, if the firm borrows at least one loan from its bank in 2007 in a given year.
Loan acceptance rate	The number of new loans divided by the number of queries for a firm in a given year.
Bank	For 2007, the bank of the firm is its main bank by exposure (if multiple banks).
Exporter	Export sales larger than 0.
Location	County of the headquarter of the firm.
Sales	Revenues from sales.
Employment	Headcount of the number of employees.
Assets total	Total assets refer to the sum of current and fixed assets.
Investment	Capital less depreciation, calculated with the perpetual inventory method.
Leverage	End of year debt to sales.
Value added	Revenue less intermediates used for production.
Foreign	1, if foreign ownership share is larger than 50 percent.
Age	Age of the firm in years.
Manufacturing industry	Based on 2-digit NACE Rev. 2 classification those firms which belong to industries 10-33.
Construction industry	Based on 2-digit NACE Rev. 2 classification those firms which belong to industries 41-44.
Services industry	Based on 2-digit NACE Rev. 2 classification those firms which belong to industries 45-82, with the exception of industries 64, 65 and 66.

10.14754/CEU.2020.11

Appendix B

Appendix for Chapter 2

B.1 Tables and Figures

Table B.1: Variable definition

Productivity	Productivity is estimated using the Olley and Pakes (1996) method.
Employment	Headcount of the number of employees.
Assets total	Total assets refer to the sum of current and fixed assets.
Value added	Revenue less intermediates used for production.
Sales	Revenues from sales.
Export sales	Revenue from selling abroad.
Age	Age of the firm in years.
Exporter	A firm is exporter if at least 10 percent of its sales are from selling abroad.
Manufacturing industry	Based on 2-digit NACE Rev. 2 classification those firms which belong to industries 10-33.
Construction industry	Based on 2-digit NACE Rev. 2 classification those firms which belong to industries 41-44.
Services industry	Based on 2-digit NACE Rev. 2 classification those firms which belong to industries 45-82, with the exception of industries 64, 65 and 66.

10.14754/CEU.2020.11

Table B.2: Baseline regression without controls

	(1) All	(2) All	(3) All
connected	0.40***	0.42***	0.36***
	(0.01)	(0.02)	(0.02)
Bank FE	No	No	Yes
firmyq	No	Yes	Yes
R-squared	0.0005	0.1354	0.1383
Number of observations	5,644,537	5,644,537	5,644,537

Notes: SThe sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. Dependent variable is an indicator that equals one if firm i obtained a new loan from bank b at quarters *t+1, t+2, t+3 or t+4*. The main explanatory variable is also an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b in quarters *t-1, t-2, t-3 or t-4*. The coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) is 0.52. Robust standard errors are shown in parentheses. Standard errors are clustered at the firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

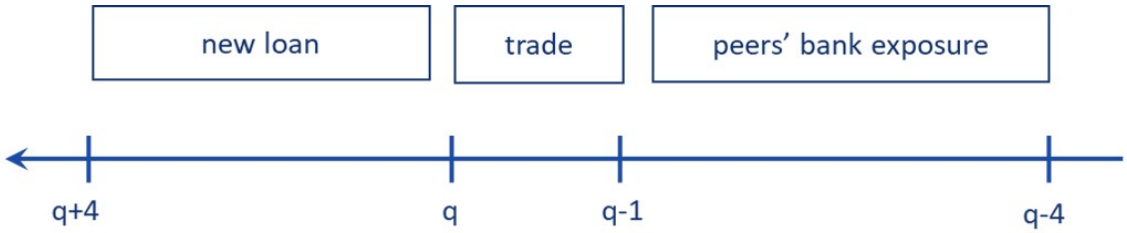
10.14754/CEU.2020.11

Table B.3: Baseline regression for different new loan and connected definitions

	(1) All	(2) All	(3) All
connected	0.13***	0.12***	0.34***
	(0.01)	(0.01)	(0.02)
Bank FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
R-squared	0.1356	0.1356	0.1383
Number of observations	5,660,964	5,660,964	5,644,537

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a new loan from bank b for column 1 and 2 at quarter *t+1* and for column 3 at quarters *t+1, t+2, t+3 or t+4*. The main explanatory variable is also an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b for column 1 in quarter *t-1*, for column 2 in quarters *t-1, t-2, t-3 or t-4* and for column 3 in quarters *t-1, t-2 ... or t-8*. The coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) is 0.16, 0.16 and 0.55. Robust standard errors are shown in parentheses. Standard errors are clustered at the firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

Figure B.1: Timeline of identification



10.14754/CEU.2020.11

Table B.4: Firms located in Budapest or Pest county

	(1) Budapest	(2) Budapest and Pest county
connected	0.36***	0.36***
	(0.03)	(0.03)
Bank FE	Yes	Yes
Firm FE	Yes	Yes
R-squared	0.1391	0.1387
Number of observations	2,006,228	2,789,416

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a new loan from bank b in quarters *t+1, t+2, t+3 or t+4*. The main explanatory variable is also an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b in quarters *t-1, t-2, t-3 or t-4*. In column 1, only those i firms are included which are located in Budapest. In column 2, only those i firms are included which are located in Budapest or Pest county. The coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) for the columns are respectively: 0.50 and 0.53. Robust standard errors are shown in parentheses. Standard errors are clustered at the firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

10.14754/CEU.2020.11

Table B.5: Baseline regression for different bank samples

	(1)	(2)	(3)	(4)
connected	0.28***	0.46***	0.28***	0.52***
	(0.03)	(0.05)	(0.03)	(0.04)
Bank FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R-squared	0.2177	0.3593	0.2148	0.2728
Number of observations	3,543,865	2,099,987	3,554,219	2,790,496

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a new loan from bank b in quarters *t+1, t+2, t+3 or t+4*. The main explanatory variable is also an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b in quarters *t-1, t-2, t-3 or t-4*. In column 1, only banks 1,2,3,4,5 are in the sample. In column 2, only banks 2,6,8 are in the sample. In column 3, banks 4,6,8 are excluded from the sample. In column 4, banks 1,2,6,7 are are excluded from the sample. The coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) for the columns are respectively: 0.51, 0.68, 0.40 and 0.74. Robust standard errors are shown in parentheses. Standard errors are clustered at the firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

10.14754/CEU.2020.11

Table B.6: Spillover effect by the number of peers' different banks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
connected	0.61***	0.32***	0.25***	0.19***	0.23***	0.23**	0.10
	(0.04)	(0.04)	(0.05)	(0.06)	(0.07)	(0.10)	(0.11)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.1364	0.1361	0.1376	0.1423	0.1422	0.1440	0.1462
Number of observations	1,319,354	531,507	271,999	155,730	104,049	92,489	112,453

Notes: The sample includes firm-bank pairs for which the firm has no exposure with that specific bank in the previous quarters. The dependent variable is an indicator that equals one if firm i obtained a new loan from bank b in quarters *t+1, t+2, t+3 or t+4*. The main explanatory variable is also an indicator that equals one if there is at least one firm in the peer group of firm i which had an outstanding exposure with bank b in quarters *t-1, t-2, t-3 or t-4*. In column 1, only firms with peers having outstanding exposure exactly from 1 bank in quarters *t-1, t-2, t-3 or t-4* are included. Similarly, in column 2,3,4,5,6 and 7 firms with peers having outstanding exposure exactly from 2,3,4,5,6 and 7 banks in quarters *t-1, t-2, t-3 or t-4* are included. The coefficients are multiplied by 100 to read as percentage point marginal effects. The baseline hazard (in %) for the columns are respectively: 0.53, 0.64, 0.60, 0.70, 0.64, 0.62, 0.68. Robust standard errors are shown in parentheses. Standard errors are clustered at the firm level. *** = significant at 1-percent level; ** = significant at 5-percent level; * = significant at 10-percent level.

10.14754/CEU.2020.11

Appendix C

Appendix for Chapter 3

10.14754/CEU.2020.11

C.1 Tables and Figures

Table C.1: Balance test of foreign currency debt exposure

	FC mean/sd	LC mean/sd	Non-borr. mean/sd	FC-LC difference b/t	Borrower-non-borr. difference b/t
Household head: primary school	0.16	0.11	0.26	0.05**	-0.12**
	0.37	0.31	0.44	2.85	-11.60
Household head: vocational school	0.42	0.36	0.30	0.06*	0.08**
	0.49	0.48	0.46	2.07	5.66
Household head: high school	0.30	0.28	0.28	0.03	-0.00
	0.46	0.45	0.45	1.23	-0.32
Household head: college	0.13	0.25	0.16	-0.14**	0.04**
	0.34	0.44	0.37	-6.03	3.56
Household head employed	0.74	0.82	0.45	-0.09**	0.32**
	0.44	0.38	0.50	-3.74	24.13
Age of household head	42.22	43.08	55.91	-0.52	-12.46**
	12.21	10.84	15.17	-0.83	-34.19
Household size	3.33	3.37	2.45	0.04	0.88**
	1.33	1.29	1.34	0.57	21.05
Log income	14.73	14.82	14.50	-0.09**	0.29**
	0.43	0.47	0.54	-3.66	20.05
Consumption per capita	761308.31	827810.81	870528.77	-85706.28**	-71664.58**
	439771.04	486410.83	515111.22	-3.15	-4.76
Debt per capita	112111.63	126183.23	0.00	-20795.14**	121279.19**
	104584.71	108761.44	0.00	-3.32	38.63
Consumption per income	0.85	0.86	0.87	-0.00	-0.02^{+}
	0.34	0.33	0.34	-0.10	-1.70
Debt per income	0.12	0.13	0.00	-0.01^{+}	0.13**
	0.09	0.09	0.00	-1.75	51.06
Observations	646	625	6377	1271	7648

Notes: The first column shows the average characteristics of foreign currency borrower households, the second column presents the average characteristics of local currency debtors. The third column shows the average characteristics for non-borrowers. The fourth column compares the average characteristics of foreign and local currency borrowers.

10.14754/CEU.2020.11

Table C.2: Baseline regressions

	(1)	(2)	(3)	(4)
$LC \times POST$	-0.0650**	-0.0204	-0.0195	-0.0171
	(0.0237)	(0.0140)	(0.0134)	(0.0134)
$FC \times POST$	-0.0899**	-0.0741**	-0.0729**	-0.0720**
	(0.0232)	(0.0171)	(0.0161)	(0.0162)
Year FE	Yes	Yes	Yes	Yes
Household FE		Yes	Yes	Yes
Household controls			Yes	Yes
Region FE				Yes
R^2	0.0228	0.896	0.902	0.902
N	50922	42810	42807	42807

Notes: Standard errors are clustered at household level. ** = significant at 1-percent level; * = significant at 5-percent level; + = significant at 10-percent level. Household fixed effects and time fixed effects are included in the regressions. Consumption refers to the consumption of food, clothing, healthcare, transport, culture and other consumption. Housing related expenditure refers to expenditure related to house maintenance and excludes mortgage repayment or other expeditures related to buying a house. Controls include age of the household head, gender of the household head, educational attainment of the household head, household size, and region (7 units) fixed effect. We also include the contemporaneous per capita net income as a covariate to control for changes in the disposable income of the household. We estimate weighted regressions by using the weights provided by the Statistical Office, and cluster standard errors at the household level.

Table C.3: Baseline regressions, propensity score matching

	(1)	(2)	(3)	(4)
$FC \times POST$	-0.0695^{+}	-0.0937**	-0.0862**	-0.0844**
	(0.0406)	(0.0295)	(0.0264)	(0.0251)
Year FE	Yes	Yes	Yes	Yes
Household FE		Yes	Yes	Yes
Household controls			Yes	Yes
Region FE				Yes
R^2	0.00697	0.861	0.870	0.870
N	6991	6236	6236	6236

Notes: Standard errors are clustered at household level. ** = significant at 1-percent level; * = significant at 5-percent level; + = significant at 10-percent level. Household fixed effects and time fixed effects are included in the regressions. Consumption refers to the consumption of food, clothing, healthcare, transport, culture and other consumption. Housing related expenditure refers to expenditure related to house maintenance and excludes mortgage repayment or other expeditures related to buying a house. Controls include age of the household head, gender of the household head, educational attainment of the household head, household size, and region (7 units) fixed effect. We also include the contemporaneous per capita net income as a covariate to control for changes in the disposable income of the household. We estimate weighted regressions by using the weights provided by the Statistical Office, and cluster standard errors at the household level.

10.14754/CEU.2020.11

Table C.4: Baseline regressions, lagged dependent variable

	(1)	(2)	(3)	(4)
$LC \times POST$	-0.0650**	-0.00542	-0.00366	-0.00234
	(0.0237)	(0.0105)	(0.0107)	(0.0107)
$FC \times POST$	-0.0899**	-0.0123	-0.0318*	-0.0288*
	(0.0232)	(0.0155)	(0.0144)	(0.0145)
Year FE	Yes	Yes	Yes	Yes
Lagged consumption		Yes	Yes	Yes
Household controls			Yes	Yes
Region FE				Yes
R^2	0.0228	0.737	0.781	0.781
N	50922	28599	28598	28598

Notes: Standard errors are clustered at household level. ** = significant at 1-percent level; * = significant at 5-percent level; + = significant at 10-percent level. Household fixed effects and time fixed effects are included in the regressions. Consumption refers to the consumption of food, clothing, healthcare, transport, culture and other consumption. Housing related expenditure refers to expenditure related to house maintenance and excludes mortgage repayment or other expeditures related to buying a house. Controls include age of the household head, gender of the household head, educational attainment of the household head, household size, and region (7 units) fixed effect. We also include the contemporaneous per capita net income as a covariate to control for changes in the disposable income of the household. We estimate weighted regressions by using the weights provided by the Statistical Office, and cluster standard errors at the household level.

Table C.5: Baseline regressions, only for LC and FC borrowers

	(1)	(2)	(3)	(4)
$LC \times POST$	0	0	0	0
	(.)	(.)	(.)	(.)
$FC \times POST$	-0.0405	-0.0535**	-0.0563**	-0.0539**
	(0.0312)	(0.0206)	(0.0193)	(0.0193)
Year FE	Yes	Yes	Yes	Yes
Household FE		Yes	Yes	Yes
Household controls			Yes	Yes
Region FE				Yes
R^2	0.0119	0.874	0.885	0.885
N	9849	8689	8687	8687

Notes: Standard errors are clustered at household level. ** = significant at 1-percent level; * = significant at 5-percent level; + = significant at 10-percent level. Household fixed effects and time fixed effects are included in the regressions. Consumption refers to the consumption of food, clothing, healthcare, transport, culture and other consumption. Housing related expenditure refers to expenditure related to house maintenance and excludes mortgage repayment or other expeditures related to buying a house. Controls include age of the household head, gender of the household head, educational attainment of the household head, household size, and region (7 units) fixed effect. We also include the contemporaneous per capita net income as a covariate to control for changes in the disposable income of the household. We estimate weighted regressions by using the weights provided by the Statistical Office, and cluster standard errors at the household level.

10.14754/CEU.2020.11

Table C.6: Durable consumption

	(1)	(2)	(3)	(4)
$LC \times POST$	-0.310	-0.0403	-0.0342	-0.0138
	(0.191)	(0.282)	(0.286)	(0.289)
$FC \times POST$	-0.921**	-1.010**	-1.063**	-1.065**
	(0.204)	(0.303)	(0.310)	(0.311)
Year FE	Yes	Yes	Yes	Yes
Household FE		Yes	Yes	Yes
Household controls			Yes	Yes
Region FE				Yes
R^2	0.0127	0.533	0.535	0.535
N	50922	42810	42807	42807

Notes: Standard errors are clustered at household level. ** = significant at 1-percent level; * = significant at 5-percent level; + = significant at 10-percent level. Household fixed effects and time fixed effects are included in the regressions. Controls include age of the household head, gender of the household head, educational attainment of the household head, household size, and region (7 units) fixed effect. We also include the contemporaneous per capita net income as a covariate to control for changes in the disposable income of the household. We estimate weighted regressions by using the weights provided by the Statistical Office, and cluster standard errors at the household level.

Table C.7: Balance test for matched sample, 2004

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.49	13.51	-0.02	0.17	-0.04
HH head primary education	0.27	0.47	-0.20	1.15	-0.30
HH head vocational education	0.36	0.26	0.10	0.70	0.15
HH head secondary education	0.20	0.21	-0.01	0.07	-0.02
HH head tertiary education	0.17	0.06	0.11	1.12	0.25
Household size	3.09	2.60	0.49	1.10	0.28
Age of household head	42.20	48.01	-5.81	0.94	-0.29
Gender of household head	1.31	1.31	-0.00	0.02	-0.01

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2004. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X}_1 - \overline{X}_0}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

10.14754/CEU.2020.11

Table C.8: Balance test for matched sample, 2005

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.43	13.52	-0.09	0.95	-0.13
HH head primary education	0.23	0.20	0.03	0.32	0.05
HH head vocational education	0.40	0.50	-0.10	0.89	-0.14
HH head secondary education	0.24	0.22	0.02	0.25	0.04
HH head tertiary education	0.13	0.08	0.05	0.95	0.11
Household size	3.69	3.45	0.24	1.12	0.15
Age of household head	42.51	43.40	-0.88	0.33	-0.05
Gender of household head	1.17	1.17	-0.00	0.01	-0.00

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2005. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X_1} - \overline{X_0}}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

Table C.9: Balance test for matched sample, 2006

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.59	13.56	0.03	0.43	0.04
HH head primary education	0.23	0.26	-0.03	0.42	-0.05
HH head vocational education	0.31	0.25	0.06	0.91	0.09
HH head secondary education	0.32	0.34	-0.02	0.29	-0.03
HH head tertiary education	0.14	0.14	-0.00	0.09	-0.01
Household size	3.32	3.30	0.02	0.07	0.01
Age of household head	42.70	43.52	-0.81	0.40	-0.05
Gender of household head	1.20	1.25	-0.05	0.77	-0.09

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2006. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X_1} - \overline{X_0}}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

10.14754/CEU.2020.11

Table C.10: Balance test for matched sample, 2007

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.59	13.56	0.03	0.40	0.04
HH head primary education	0.15	0.15	0.00	0.05	0.01
HH head vocational education	0.43	0.38	0.04	0.56	0.06
HH head secondary education	0.28	0.32	-0.04	0.57	-0.06
HH head tertiary education	0.14	0.14	-0.00	0.04	-0.00
Household size	3.28	3.41	-0.13	0.60	-0.07
Age of household head	41.45	40.09	1.36	0.84	0.08
Gender of household head	1.18	1.18	-0.01	0.09	-0.01

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2007. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X_1} - \overline{X_0}}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

Table C.11: Balance test for matched sample, 2008

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.61	13.52	0.08	1.40	0.12
HH head primary education	0.11	0.16	-0.05	1.13	-0.11
HH head vocational education	0.44	0.39	0.05	0.91	0.08
HH head secondary education	0.33	0.33	-0.01	0.10	-0.01
HH head tertiary education	0.12	0.11	0.00	0.14	0.01
Household size	3.24	3.31	-0.07	0.50	-0.04
Age of household head	40.41	41.71	-1.30	0.94	-0.08
Gender of household head	1.13	1.10	0.02	0.74	0.05

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2008. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X_1} - \overline{X_0}}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

10.14754/CEU.2020.11

Table C.12: Balance test for matched sample, 2009

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.61	13.52	0.08	1.40	0.12
HH head primary education	0.11	0.16	-0.05	1.13	-0.11
HH head vocational education	0.44	0.39	0.05	0.91	0.08
HH head secondary education	0.33	0.33	-0.01	0.10	-0.01
HH head tertiary education	0.12	0.11	0.00	0.14	0.01
Household size	3.24	3.31	-0.07	0.50	-0.04
Age of household head	40.41	41.71	-1.30	0.94	-0.08
Gender of household head	1.13	1.10	0.02	0.74	0.05

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2009. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X_1} - \overline{X_0}}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

Table C.13: Balance test for matched sample, 2010

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.64	13.59	0.05	0.98	0.07
HH head primary education	0.15	0.16	-0.02	0.33	-0.03
HH head vocational education	0.43	0.33	0.11	2.19	0.16
HH head secondary education	0.31	0.38	-0.07	1.32	-0.11
HH head tertiary education	0.11	0.13	-0.02	0.64	-0.04
Household size	3.37	3.38	-0.01	0.06	-0.00
Age of household head	43.45	44.50	-1.05	0.90	-0.07
Gender of household head	1.14	1.15	-0.01	0.41	-0.03

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2010. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X_1} - \overline{X_0}}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

10.14754/CEU.2020.11

Table C.14: Balance test for matched sample, 2011

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.63	13.72	-0.09	0.96	-0.12
HH head primary education	0.13	0.08	0.06	1.44	0.13
HH head vocational education	0.40	0.38	0.02	0.23	0.03
HH head secondary education	0.31	0.33	-0.02	0.22	-0.03
HH head tertiary education	0.16	0.22	-0.06	0.82	-0.10
Household size	3.37	3.27	0.09	0.28	0.04
Age of household head	44.08	44.19	-0.11	0.05	-0.01
Gender of household head	1.18	1.22	-0.04	0.47	-0.08

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2011. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X_1} - \overline{X_0}}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

Table C.15: Balance test for matched sample, 2012

	Treatment	Control	Treatment-Control Diff.	t-statistic	Normalized Diff.
Log income per capita	13.68	13.56	0.12	1.04	0.17
HH head primary education	0.12	0.12	0.00	0.03	0.00
HH head vocational education	0.41	0.49	-0.08	0.73	-0.11
HH head secondary education	0.29	0.29	0.00	0.02	0.00
HH head tertiary education	0.18	0.11	0.07	1.03	0.15
Household size	3.28	3.33	-0.04	0.15	-0.02
Age of household head	43.33	41.81	1.52	0.88	0.11
Gender of household head	1.13	1.21	-0.08	0.82	-0.16

Notes: Treatment and control households are matched based on their characteristics in the first year of entering the sample, in this case 2012. Treatment household are foreign currency borrowers, while control household are local currency borrowers. The normalized difference refers to $\Delta X = \frac{\overline{X_1} - \overline{X_0}}{\sqrt{S_0^2 + S_1^2}}$ recommended by Imbens and Wooldridge (2009). This difference is a scale free measure of difference in distributions and as suggested by the authors, as a rule of thumb, it should be below 0.25.

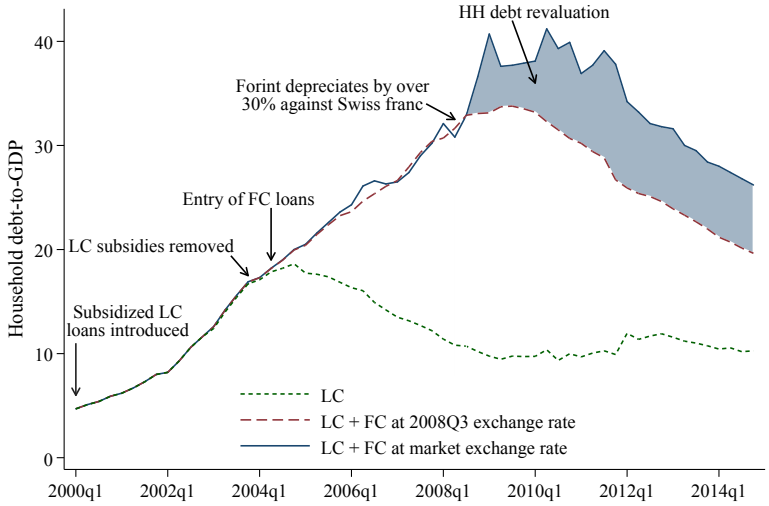
10.14754/CEU.2020.11

Table C.16: Selection on unobservables

	LC	Non-borrowers
Full model		
R-squared	0.1127	0.1127
Beta	-0.0549	-0.0719
Partial model		
R-squared	0.0227	0.0227
Beta	-0.0249	-0.0899
Beta*	-0.0661	-0.0652

Notes: The first column shows the effect of FC borrowing on consumption per capita in comparison with LC borrowers, while the second column in comparison with non-borrowers. Following Oster (2019), omitted variable bias adjusted effects, beta, are provided in the last line of the table. The full model refers to the original model as presented in Equation 1.1, while the partial model refers to the model in Equation 1.1 without controls. R_{max} from the formula from the paper is taken to be equal to 1.3 times the R-squared from the full model.*

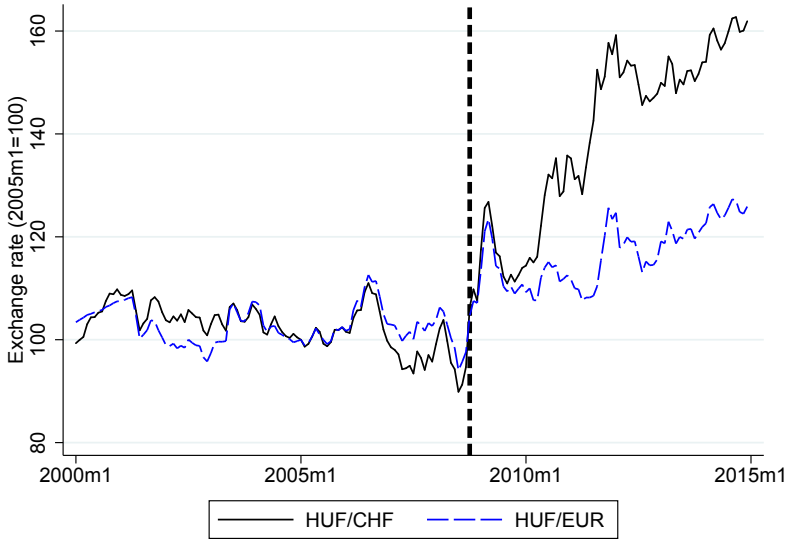
Figure C.1: Household debt and the debt revaluation



Note: The figure shows the household debt relative to GDP. The shaded area is the revalatution of household debt triggered by the depreciation.

10.14754/CEU.2020.11

Figure C.2: Exchange rate



Note: The figure plots the HUF/EUR and HUF/CHF exchange rates relative to January 2005. The vertical line represents September 2008.

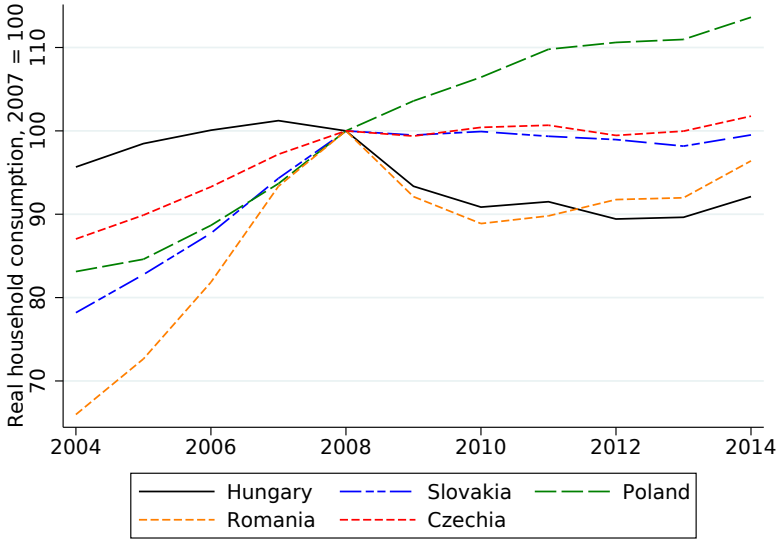
Table C.17: Robustness: alternative consumption equivalence scale: square root

	(1)	(2)	(3)	(4)
$LC \times POST$	-0.0650**	-0.0204	-0.0195	-0.0171
	(0.0237)	(0.0140)	(0.0134)	(0.0134)
$FC \times POST$	-0.0899**	-0.0741**	-0.0729**	-0.0720**
	(0.0232)	(0.0171)	(0.0161)	(0.0162)
Year FE	Yes	Yes	Yes	Yes
Household FE		Yes	Yes	Yes
Household controls			Yes	Yes
Region FE				Yes
R^2	0.0228	0.896	0.902	0.902
N	50922	42810	42807	42807

Notes: Standard errors are clustered at household level. ** = significant at 1-percent level; * = significant at 5-percent level; + = significant at 10-percent level.

10.14754/CEU.2020.11

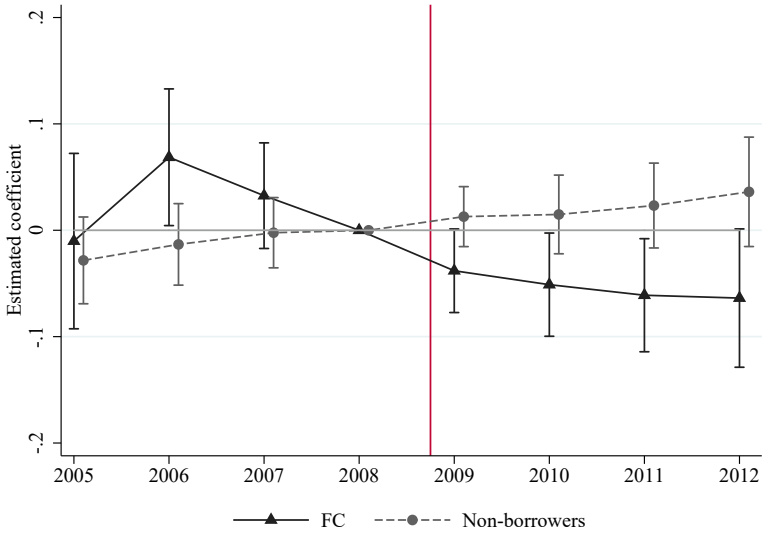
Figure C.3: Aggregate consumption in Central European countries



Note: The figure plots real household consumption relative to 2008. The data source is the PWT 9.1 National Accounts data.

10.14754/CEU.2020.11

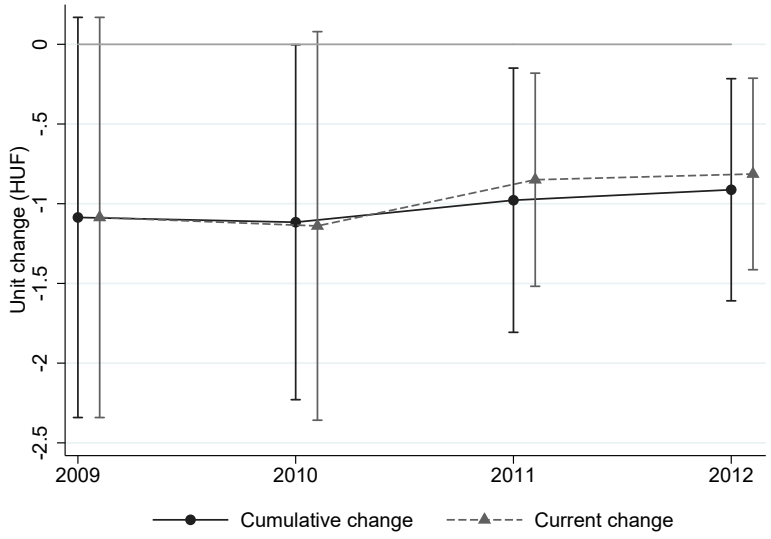
Figure C.4: Dynamic impact of foreign currency debt on consumption



Note: This figure plots the coefficients of interest from equation 3.2, by comparing the effect of FC to LC and the effect for non-borrowers to LC borrowers. Controls include age of the household head, gender of the household head, educational attainment of the household head, household size, and region (7 units) fixed effect. We also include the contemporaneous per capita net income as a covariate to control for changes in the disposable income of the household. We estimate weighted regressions by using the weights provided by the Statistical Office, and cluster standard errors at the household level.

10.14754/CEU.2020.11

Figure C.5: Change in consumption to changes in debt burden



Note: This figure plots the coefficients of interest from equation 3.3. The current change gives the HUF change in consumption to a one HUF increase in foreign currency debt. The cumulative change gives the across-time added up change in consumption to a one HUF increase in debt.

Table C.18: Consumption by COICOP categories

	(1) Food & non-alc	(2) Alcohol	(3) Clothes	(4) House maintenance	(5) Furnitures	(6) Health care	(7) Travel	(8) Entertainment	(9) Other
$LC \times POST$	-0.0194	-0.604*	-0.129	-0.0213	-0.0889	0.0998	0.262*	0.0622	-0.103
	(0.0331)	(0.260)	(0.0841)	(0.0184)	(0.125)	(0.218)	(0.133)	(0.0537)	(0.0980)
$FC \times POST$	-0.0896+	-0.398+	-0.131	-0.0661**	-0.273*	-0.188	-0.265+	-0.236*	-0.119
	(0.0492)	(0.213)	(0.112)	(0.0209)	(0.118)	(0.218)	(0.155)	(0.0948)	(0.0992)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.651	0.649	0.604	0.852	0.514	0.632	0.781	0.722	0.706
N	42807	42807	42807	42807	42807	42807	42807	42807	42807

Notes: Weighted regression. Standard errors are clustered at household level. ** = significant at 1-percent level; * = significant at 5-percent level; + = significant at 10-percent level.

10.14754/CEU.2020.11

Table C.19: Consumption by household type

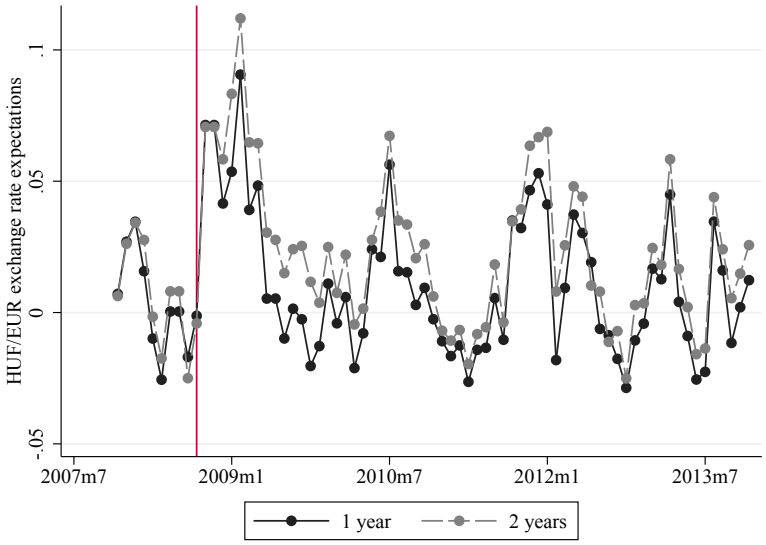
	(1) Small HHs	(2) Large HHs	(3) HH head: college	(4) HH head: secondary	(5) HH head: vocational	(6) HH head: primary sch	(7) Live in: Budapest	(8) Live in: not Budapest
$LC \times POST$	0.0218	-0.0219	-0.0179	-0.00681	-0.00354	-0.0546	-0.0511*	-0.00442
	(0.0267)	(0.0155)	(0.0253)	(0.0265)	(0.0221)	(0.0404)	(0.0257)	(0.0156)
$FC \times POST$	-0.109**	-0.0606**	-0.0125	-0.0492^{+}	-0.100**	-0.0770*	-0.0808*	-0.0670**
	(0.0334)	(0.0185)	(0.0396)	(0.0281)	(0.0276)	(0.0361)	(0.0366)	(0.0174)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.876	0.879	0.889	0.874	0.863	0.885	0.906	0.893
N	17691	25116	8565	11827	15260	7155	10117	32690

Notes: Weighted regression. Standard errors are clustered at household level. ** = significant at 1-percent level; * = significant at 5-percent level; + = significant at 10-percent level.

10.14754/CEU.2020.11

10.14754/CEU.2020.11

Figure C.6: Exchange rate expectations from Consensus Economics



Note: The figure plots the HUF/EUR exchange rate expectations on a 1 year and 2 years horizon. The vertical line represents September 2008.

C.2 Data appendix

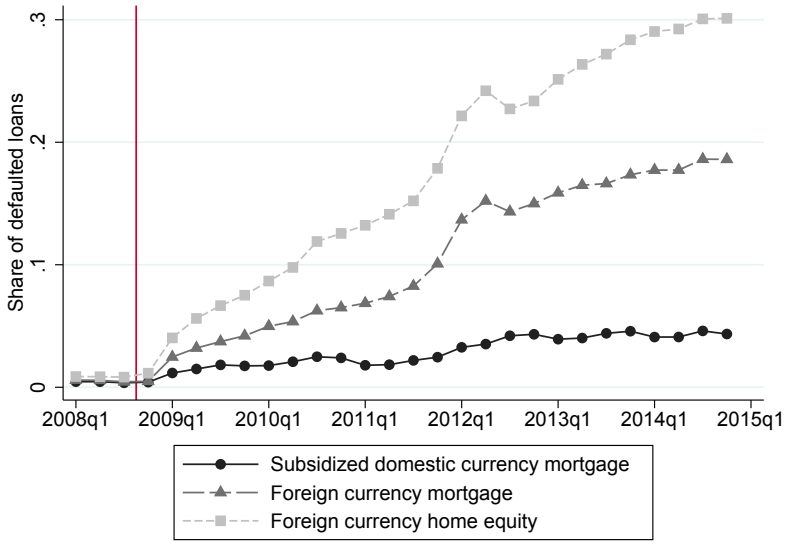
C.2.1 Household debt

Determining the currency denomination of debt We have two sets of information on household debt. First, every year households are surveyed whether they have debt obligations. From this we know whether they have debt obligations, what is the year of borrowing, what is the amount borrowed, what is the maturity of debt, and what is the monthly installment.

From 2009 onwards, households are also surveyed about the housing debt. This gives us whether they have housing debt, the type of debt (mortgage vs home equity), year of origination, the currency denomination of debt (with information also on the conversion), the total amount payed in the year as installment, does any of the household members have any other loan from a financial institution.

10.14754/CEU.2020.11

Figure C.7: Default rate by currency denomination and loan type



Note: This figure shows the aggregate default rate by currency denomination and loan type.

To determine the currency denomination we exploit that households borrowed in local currency only before the end of 2004, and mostly in Swiss franc after 2004 (see Figure C.1).

Annuity model We calculate households' debt burdens by using loan characteristics: the year of origination, maturity, type of loan and currency denomination.

With this information we use an annuity formula to impute the monthly payment and remaining balance for each loan. Specifically, for each loan i in currency c of type k originated at time t_0 with maturity m and remaining periods $n = t_0 + m - t + 1$, we denote the imputed values of the monthly payment and remaining loan balance as $\tilde{P}_{it}$ and $\tilde{D}_{it}$. These are computed as

$$\tilde{P}_{it} = \tilde{D}_{it} \left(\frac{1 - R_{ckmt}^{-n}}{R_{ckmt} - 1} \right)^{-1}$$
$$\tilde{D}_{it} = \tilde{D}_{i,t-1} \cdot R_{ckm,t-1} - P_{i,t-1},$$

where $D_{it_0} = \tilde{D}_{it_0}$ is the originated amount. R_{ckmt} is the average monthly gross interest rate charged for that specific loan product (currency, loan type) in period t.

This formula hence calculates the sequence of payments and outstanding debt that we would observe in the absence of default, assuming that loan i pays the average variable rate charged for that loan product. We do not believe that the assumption that loans remain current is severe drawback for this methodology because default rates were very low before the 2008 crisis (see Figure C.7).[1]

C.3 Model

In this section, we derive the consumption response of an unanticipated revaluation of household debt on consumption for a permanent income consumer.

Following the model of Hall(1978), a permanent income consumer maximizes her quadratic utility given her income, y_t:

$$\max_C = E\left(\sum_{t=1}^{\infty}(C_t - \frac{\alpha}{2}C_t^2)\right)$$

$$s.t. \quad \sum_{t=1}^{\infty} C_t \leq A_0 + \sum_{t=1}^{\infty} Y_t$$

The first order condition for C_1 is given by

$$\frac{\partial \mathcal{L}}{\partial C_1} = 1 - \alpha C_1 - \lambda = 0$$

The first order condition for C_t where $t \geq 2$:

$$\frac{\partial \mathcal{L}}{\partial C_t} = E(1 - \alpha C_t) - \lambda = 0$$

Combining the first order conditions we arrive to the Euler equation:

$$C_1 = E_1(C_2) = \ldots = E_1(C_t)$$

[1]Statistics from the National Bank of Hungary show that the fraction of non-performing loans was below 1 percent for both local currency loans and foreign currency housing loans in 2008Q3.

10.14754/CEU.2020.11

Using the budget constrait, C_t can be written as the function of assets available at the beginning of period t and the expected discounted value of future income stream:

$$C_t = \frac{r}{1+r}\left(A_{t-1} + \sum_{j=t}^{\infty} \frac{E_t(Y_j)}{(1+r)^j}\right)$$

where the assets available depend on the past income and consumption:

$$A_{t-1} = (A_{t-2} + Y_{t-1} - C_{t-1})(1+r)$$

Define debt as negative assets before interest rate payment: $D_t = -(A_{t-2}+Y_{t-1}-C_{t-1})$. Then

$$C_t = -rD_t + \frac{r}{1+r}\left(\sum_{j=t}^{\infty} \frac{E(Y_j)}{(1+r)^j}\right)$$

An unexpected, zero probability exchange rate shock leads to a ΔD_t increase in household debt, which in turn depresses consumption by $r\Delta D_t$.