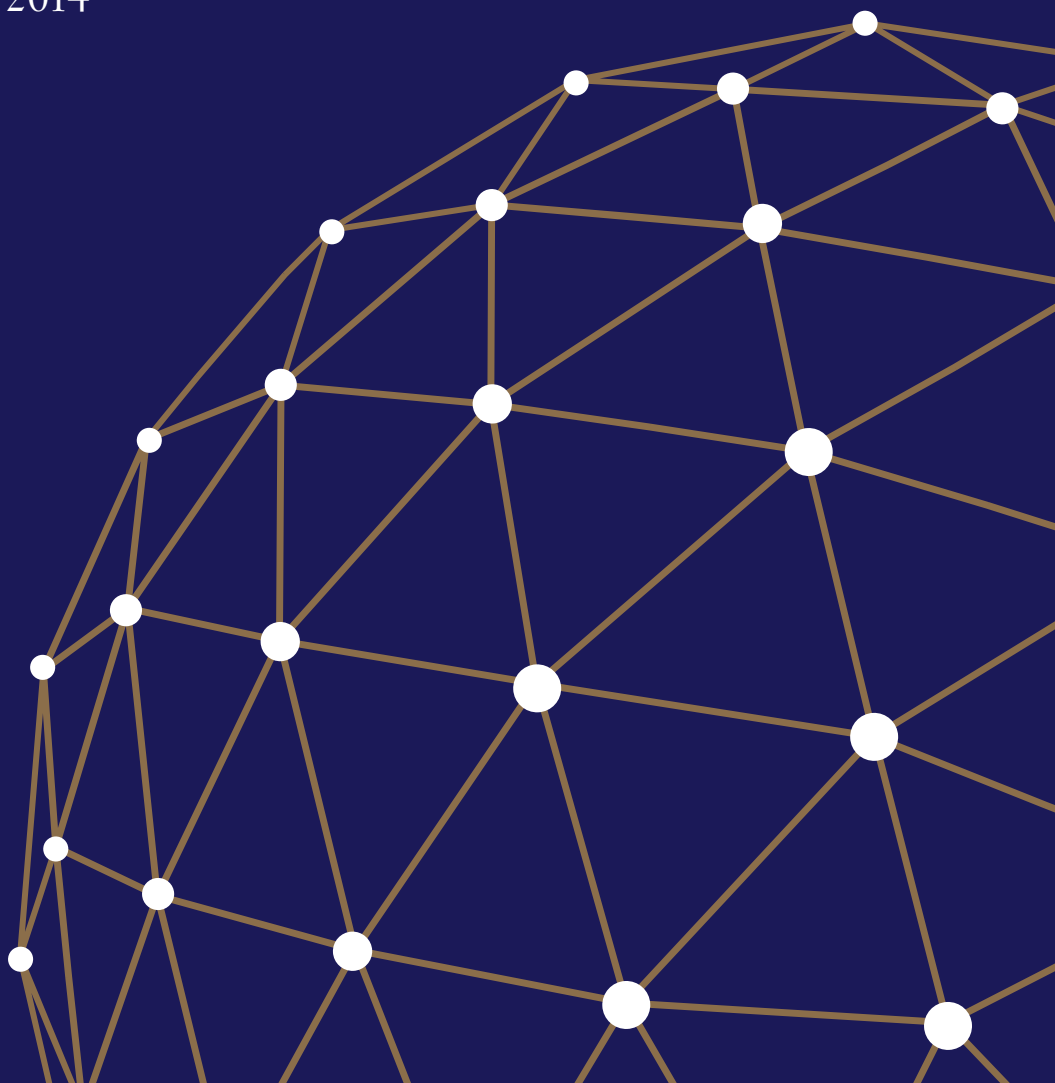
Marianna Endrész, Péter Harasztosi

Corporate Foreign Currency Borrowing and Investment. The Case of Hungary

MNB Working Papers 1

2014



Marianna Endrész, Péter Harasztosi

Corporate Foreign Currency Borrowing and Investment. The Case of Hungary

MNB Working Papers 1

2014

The MNB Working Paper series includes studies that are aimed to be of interest to the academic community, as well as researchers in central banks and elsewhere. Starting from 9/2005, articles undergo a refereeing process, and their publication is supervised by an editorial board.

The purpose of publishing the Working Paper series is to stimulate comments and suggestions to the work prepared within the Magyar Nemzeti Bank. Citations should refer to a Magyar Nemzeti Bank Working Paper. The views expressed are those of the authors and do not necessarily reflect the official view of the Bank.

MNB Working Papers 2014/1

Corporate Foreign Currency Borrowing and Investment. The Case of Hungary*

(Vállalati devizahitelezés és beruházások Magyarországon)

Written by Marianna Endrész, Péter Harasztosi

Published by the Magyar Nemzeti Bank

Publisher in charge: Eszter Hergár

Szabadság tér 8–9., H–1850 Budapest

www.mnb.hu

ISSN 1585-5600 (online)

* We are grateful to Ibolya Schindele and Robert Lieli for their comments and suggestions. All remaining errors are ours.

Contents

Abstract

The paper investigates the impact of foreign currency lending in the Hungarian corporate sector on real investment. Using a rich micro dataset we consider two questions. First we test whether foreign currency (FX) lending – by lowering user cost and easing liquidity constraints – contributed to larger investment before the crisis. The second question focuses on balance sheet effects – whether the large domestic currency depreciation observed during the great recession resulted in lower investment rate for firms with foreign currency loans. We try to separate and measure both the competitiveness and balance sheet effect of depreciation. In order to answer these questions several methods are employed – OLS regression, regression enhanced with interaction-terms, and matching. The uniqueness of the paper lies in its almost full coverage in terms of firms and FX exposures, and the richness of the dataset. The results show that before the crisis FX lending increased investment rates. In addition, evidence is found on the liquidity easing channel being effective, i.e. the effect was larger in the case of smaller and non-traded firms. During the crisis the investment rate of firms with FX loans declined more because of balance sheet effects triggered by the depreciation. More liquidity constrained firms suffered more. On the other hand, the evidence on the competitiveness effect is weaker and less robust. Although one would expect that the effect of the exchange rate is non-linear and heterogeneous, the more general non-parametric approach (matching) yields estimates that do not statistically differ from the simple linear regression coefficients.

JEL: E44, G01, G31, G32.
Keywords: liability dollarization, currency mismatch, investment, balance sheet effects, liquidity constraints.

Összefoglaló

A tanulmány a devizahitelezés reálberuházásokra gyakorolt hatását vizsgálja a magyar vállalati szektorban. Egy gazdag mikroadatbázis segítségével az alábbi két kérdéssel foglalkozunk. Először azt teszteljük, hogy a válság előtt a devizahitelezés – a tőkeköltségek csökkentése és a likviditási korlátok oldása révén – növelte-e a beruházásokat. A második kérdés a mérleghatásokra vonatkozik – vajon a válság alatti jelentős leértékelődés csökkentette-e a devizahitellel rendelkező vállalatok beruházásait. A leértékelődésnek nemcsak a mérlegekre, hanem a versenyképességre gyakorolt hatását is igyekszünk megmérni, illetve elkülöníteni. E kérdések megválaszolásához többfajta módszert alkalmazunk – lineáris regresszió, regresszió kereszthatásokkal, matching. A tanulmány egyik értéke a vállalatok és a devizakitettségek csaknem teljes lefedettsége és az adatbázis részletezettsége. A becslési eredmények szerint a válság előtt a devizahitelezés növelte a beruházási rátákat. A devizahitelezés a likviditási korlátokat is oldotta – a beruházásokra gyakorolt hatás nagyobb volt a kisebb, hazai piacra termelő vállalatok esetében. A válság alatt ugyanakkor a leértékelődés okozta mérleghatások miatt a devizahitellel rendelkező vállalatok beruházása jobban visszaesett. A likviditáskorlátos cégeknél erőteljesebb volt a hatás. Ugyanakkor a versenyképességi hatás jelenlétére vonatkozó eredmények gyengébbek és érzékenyek az alkalmazott becslési módszerekre. Bár azt várnánk, hogy az árfolyam hatása nem lineáris és heterogén, az általánosabb nem parametrikus becslés (matching) és az egyszerű lineáris becslés eredményei statisztikai értelemben nem különböznek.

1 Introduction

Foreign currency borrowing was a major source of vulnerability in Hungary during the recent financial crisis, not just in the household but also in the corporate sector. Depreciation of the local currency increases the debt burden of FX indebted companies. Consequently, their financial performance weakens and their net worth declines which translates into diminished investment. This is often referred to as the balance sheet effect (Aghion et al. 2001, Krugman 1999). While depreciation affects FX indebted firms adversely, export revenues can mitigate the negative effect through improved competitiveness provided by the weaker exchange rate. This suggests that the overall impact of exchange rate depreciation in a dollarized economy depends on the exchange rate sensitivity of the income of indebted firms and the size of exposure. That is, not the extent of liability dollarization is interesting per se, but the size of currency mismatch between income and debt payments. Mismatch can be significant if firms without natural hedge took FX loans extensively, even if at the aggregate level FX borrowing does not seem excessive relative to export.

At the same time, in the period when vulnerabilities build up, there are channels through which foreign currency (FX) borrowing can lead to larger corporate investment. On the one hand, FX loans can lower the immediate cost of financing. Cheaper financing allows larger leverage for the firms and results in more investment. FX loans can become cheap relative to domestic currency loans when certain financial frictions and policy imperfections are present. One such friction is that foreign owned banks prefer lending in foreign currency because of their easier access to FX funds. Another example might be the existence of an implicit government guarantee to bail out debtors in case of depreciation. For detailed discussion of these mechanisms, see Basso et al. (2007) or Ranciere et al. (2010). The availability of cheaper FX loans also improves the balance sheet of borrowers (see Ranciere et al., 2010). When balance sheet conditions of the firm influence credit standards and the access to loans, the lower expected debt burden of FX loans relaxes borrowing constraints. This channel also contributes to higher leverage and a subsequent increase in investment.

The goal of this paper is to quantify the effects of corporate FX borrowing on investment for Hungary between 2005 and 2010. The Hungarian corporate sector was heavily indebted in foreign currency before the crisis. By the end of 2007, 55% of all corporate domestic loans were denominated in foreign currency. More importantly, unhedged foreign currency borrowers (mismatch) made up two-thirds of the loan portfolio. This widespread dollarization was a result of several phenomena. Among others, a large interest rate differential prevailed between HUF and FX funds, while the exchange rate remained stable.[1] Also, foreign-owned banks, constituting a significant share of the financial sector, were likely to lend in FX using the FX funds readily available through their mother banks. During the crisis large depreciation shocks hit the economy, triggering balance sheet effects, which contributed to the depth of the recession. These pre- and post-crisis experiences make the investigation of the link between FX lending and investment highly relevant for Hungary.

In this study, we investigate the following issues. First, we look into how the widespread availability of FX financing in the pre-crisis period affected corporate investment. Second, we try to the detect balance sheet effect by estimating the impact on investment of the sharp exchange rate depreciation that occurred at the outbreak of the crisis, at end of 2008. We also measure if this has been alleviated by competitiveness gains in the case of exporters. Third, we ask whether the above impacts were more pronounced in the case of firms facing tighter liquidity constraints. The underlying idea is the following. The more liquidity constrained the firm, the stronger the dependence of its investment on its balance sheet. Therefore, for these firms FX lending may lead to a more significant easing of liquidity constraints as well as a larger balance sheet effect caused by depreciation.

[1] Comparing the difference in actual HUF and Euro lending rates with the 1 year ahead exchange rate expectations (Reuters Survey) the euro premium on average was around 400bp in the years preceding the crisis.

To answer these questions, we use a unique Hungarian firm level dataset. In addition to the information on firms' balance sheet and foreign trade activity, the dataset provides detailed accounts on firms' loan contracts including denomination and maturity. These allow us to make comparisons across firms and identify the impact of FX lending on firms' investment. The dataset makes it possible to control for firm characteristics, which is very important to separate the competitiveness and balance sheet effects and also to avoid selection bias.

We apply various statistical methods. Primarily, we rely on OLS estimations and exploit the cross-sectional variation of the data. To assess whether FX loans relax borrowing constraints we interact FX exposure with proxies for credit constraints. We regard smaller, domestic, non-exporting firms as more credit constrained. As a robustness check the methodology of matching is employed. Matching is a non-parametric approach, therefore allows not just for heterogeneous individual effects, but also relaxes the assumption of linearity.

We find that before the crisis FX lending increased investment rates by a significant amount. The investment rate of FX indebted firms would have been more than 10 percentage points lower in the absence of FX borrowing. In addition, evidence points to the liquidity easing channel being effective. The pre-crisis effect of liability dollarization was stronger for firms who were more liquidity constrained. On the other hand, during the crisis the investment rate of firms with FX loans declined more because of the balance sheet effects triggered by the depreciation. The effect did depend on the strength of liquidity constraints. We also measured some positive competitiveness effect, however the estimate is weakly significant and only in the linear estimation.

To our knowledge, this is the first paper aimed at measuring the effect of corporate foreign currency lending on investment using Hungarian micro data. Our research contributes to three strands of literature.

First, our research is related to the results of Ranciere et al. (2010), who investigate the role of FX lending in promoting growth. They use an EBRD survey on 10,000 firms and find that FX borrowing relaxed borrowing constraints and enhanced growth in a sample of Central Eastern European countries and former Soviet republics. The impact is significant only in the group of small non-traded firms, but not in the case of large firms. The first part of our analysis is very similar to their approach. We use similar definition of mismatch and the same estimation methodology (matching and linear regression). At the same time, due to our comprehensive and rich dataset, we are able to control for more firm characteristics (such as export- and import share, productivity, user cost), and use investment instead of sales.[2]

Second, we add to the empirical literature on balance sheet effects. The Emerging Market Review (EMR) devoted a whole issue to the problem in 2003.[3] The results from these studies on the sign and significance of balance sheet effects were mixed. Unsatisfied with the conflicting findings of EMR, Bleakley and Cowan (2008) looked at listed firms of Latin American countries and tried to reconcile results by using the same methodology for all countries. They blame misspecification problems and the mixed treatment of the competitiveness effect for the earlier diverse results. They show that using a standard specification, the net effect of depreciation tends to be positive, while the balance sheet effect is negative but not always significant.

Studies on balance sheet effects vary a lot in terms of coverage of firm population. First, many papers use data on listed firms only, which is a shortcoming, as larger listed firms are less likely to be credit-constrained. An exemption is Fuentes (2007). Second, very few papers cover all FX exposure. The use of derivatives for example may change the results, as shown by Cowan (2005). Others find that the issue of non-linearity is relevant, one needs a large enough depreciation to find a significant impact (see Carranza et al., 2011 and Fuentes, 2007).

Finally, we add to previous firm level empirical findings on the FX exposure of Hungarian firms. Previous papers suggest that FX borrowing was widespread even among small and medium-sized firms and in sectors, which did not have natural hedge in the form of export revenues (see Bodnár, 2006, 2009 and Endrész and Krekó, 2010). More recently, Endrész et al. (2012) used a micro level dataset to investigate the extent and importance of currency mismatch in the Hungarian economy. They

[2] We follow the balance sheet literature here, which rather uses investment.

[3] The studies cover several countries: Argentina (Galiani et al., 2003), Chile (Benavente et al., 2003), Brazil (Bonomo et al., 2003), Colombia (Echeverry et al., 2003), Peru (Carranza et al., 2003) and Mexico (Pratap et al., 2003).

found that before the crisis a significant share of investment and output was attributed to firms with currency mismatch. During the crisis however these firms performed worse than those with natural hedge or those without any FX loans. Their paper investigates balance sheet effects by using correlations. In contrast, we attempt to draw inferences on causality and quantify the exact impact on investment of FX lending, and not just during but also before the crisis.

This introduction is followed by the description of the dataset and the methodology. A separate subsection is devoted to the definition of treatment and control groups, and to the selection of explanatory variables. Then the results regarding the impact of FX lending on investment and the role of liquidity constraints are summarized. Finally we conclude.

2 Data and methodology

In this section we introduce the data and then set out the methodological framework to estimate the effects of loan dollarization. A separate sub-section is devoted to the definition of treatment, and the description of firm characteristics that are controlled for.

2.1 DATA

The paper uses a unique yearly dataset on Hungarian firms between 2004 and 2011. The dataset is compiled from several sources. Information on financial and real performance, on firm characteristics (like size, industry, and ownership) is available for all double-book-keeping firms. Information on international trade at the firm level is provided by the Central Statistical Office. Firm level data on loan contracts, maturity, and denomination is obtained from the Credit Register (CR). Trade and CR data are available at monthly frequency, while observations on firm characteristics are of yearly frequency.

By combining the various sources the dataset provides a wide coverage both in terms of firms, foreign currency exposures, and firm characteristics. These features of the dataset make it exceptionally useful to investigate the questions asked in this paper.[4]

We limit our research to non-financial private firms with 5 employees or more.[5] This sample contains about 99 thousand firms a year, most of them are in Manufacturing (15%), Retail and Wholesale (24%) and in Other services (47%) – see Table 1.

Table 1
The number of observations in selected years

	2004	2007	2010
Agriculture and mining	4,791	4,600	4,488
Manufacturing	15,271	14,525	13,551
Energy and construction	9,931	10,748	10,178
Retail and wholesale	23,093	23,597	22,935
All other services	40,635	45,333	50,584
Total	93,721	98,803	101,736

For further information on the data see Endrész et al. (2012) who provides extensive descriptive statistics and discussion.

2.2 ESTIMATION METHOD

The aim of the estimation is to measure the impact of FX borrowing on investment. We adopt the language and methodology of evaluation studies and estimate the average treatment effect *(ATE)*. The exact definition of treatment *(W)* will depend on the specific question investigated; see section 2.3.1 later. For now, let us define *W* as having FX loan. We choose the firm level period-to-period change in the investment rate as the outcome variable. The potential outcomes are: *Y(1)* if the

[4] The only missing information on FX exposure is the derivative position. However that is not likely to have a major influence on the results, as derivative positions are mainly taken by a few large, foreign owned or exporting companies, which are less liquidity constrained. Moreover the aggregate position in derivatives is negligible compared to the outstanding amount of FX loans.

[5] Previous experiences with Hungarian firm level data suggest that reliability can be significantly improved by omitting very small firms (See Kátay and Wolf, 2008).

treatment is imposed exogenously on the firm *(W = 1)* and *Y(0)* when no treatment is imposed (W=0). The average treatment effect is defined as

$$ATE = E(Y(1) - Y(0))$$

Note that one cannot observe both *Y(1)* and *Y(0)* for the same firm; the actual outcome is more conveniently summarized as $Y = Y(1)W + Y(0)(1 - W)$

If FX borrowing was random across firms, ATE could be simply estimated as the mean difference of observed outcomes in the treated and control groups. However, this is presumably not the case. The decision on foreign currency borrowing may depend on a variety of characteristics of firms. If we assume that we can control for these characteristics up to random noise then the treatment effect can be estimated with a regression model (control function approach). More specifically, suppose that the potential outcomes *(Y(1), Y(0))* are independent of *W* conditional on a rich enough set of covariates *X*. This assumption is called unconfoundedness. It means that selection to treatment is based on observables, and after controlling for those, treatment assignment is as if it was random. In this case, the measured difference in the conditional mean outcome of the control and treatment groups can be solely attributed to the treatment. Without loss of generality, unconfoundedness allows us to formulate the following regression:

$$E(Y|W,X)= \mu_0 + \mu_1 W + g_0(X)+ W(g_1(X)-g_0(X))$$

where g_0 and g_1 are unknown functions with zero expected value and the coefficient μ_1 captures ATE.

In our benchmark specification we make two additional assumptions: (1) we assume that $g_0(X)$ is linear and can be written as $\beta'X$ plus a constant, (2) we assume that $g_1(X)=g_0(X)$,[6] i.e., the average conditional treatment effect given *X* does not actually depend on *X*. These assumptions imply that

$$E(Y|W,X) = C + \mu_1 W + \beta'X$$

We estimate this model with OLS and define outcome variables and time samples depending on the questions asked. The definitions below are labeled as (1) pre-crisis period effect, (2) balance sheet effect and (3) competitiveness effect.

pre-crisis period effect:

$$d(I_{it}/K_{it-1}) = C + \mu_1 W_{it} + \beta'X_{it-1} + \varepsilon_{it}\text{, where } t = \{2006, 2007, 2008\}$$

balance sheet effect:

$$(I_{it+j}/K_{i,t+j-1} - I_{it-1}/K_{it-2})= C + \mu_1 W_{it^*} + \beta'X_{it-1} + \varepsilon_{it}\text{, where } t = 2008,\ j = \{1,2\} \text{ and } t^* \text{ is the Fall of 2008}$$

competitiveness effect:

$$(I_{it+j}/K_{i,t+j-1} - I_{it-1}/K_{it-2})= C + \mu_1 W_{it} + \beta'X_{it-1} + \varepsilon_{it}\text{, where } t = 2008,\ j = \{1,2\}$$

W is the treatment variable, μ_1 is the coefficient of interest and X_{t-1} is a vector of firm characteristics and I_{it}/K_{it-1} is the investment rate.

The differences across the models are the following. First, the definition of W varies across specification, though in each case, it takes the value 1 for firms which are "treated" and 0 for firms in the control group. These groups are specified separately – see section 2.3.1. Second, we estimate each model on several cross-sections, one at a time. Note the differences in the time indices and lags. The treatment is always observed at time *t,* while firm characteristics are lagged.

[6] These assumptions imply, that ATE is equal to the average treatment effect on the treated (ATT).

In all three models, the benchmark specification assumes that $g_0(X)$ is linear and that $g_1(X) = g_0(X)$. To relax these assumptions, we employ an alternative estimation, propensity score matching. Matching is a non-parametric approach carried out in two steps. First we estimate propensity scores by a logit model. This gives us $P(X)$, the probability of having FX loan. The second step is the calculation of ATE using the identification result

$$ATE = E_X\{ E(Y|W=1, P(X)) - E(Y|W=0, P(X)) \}.$$

Intuitively, matching compares outcomes across firms with similar $P(X)$ but different actual treatment status.[7]

Beyond employing alternative estimation methods, for the pre-crisis period two additional robustness checks are employed. First, we concentrate on long-term loans instead of total loans. In principle one would expect investment to be financed by long-term loans. However for some firms and in certain periods longer-term loans are not accessible, thus short-term loans act as a substitute. This is why we opted to use total loans rather. Nevertheless it is worth running estimation by using long-term loan contracts only.

Second, instead of the change in investment rate, the probability of "large investment" is used as the outcome variable. Large investment is defined as an investment at least twice as big as its average in the past 3 years and at least 10 or 30% of total assets. Similar definition is used by Elsas et al. (2006). The use of large investment helps to differentiate productive capacity expanding investments from pure maintenance.

When the hypothesis on the role of liquidity constraints is tested, the basic OLS specification is augmented with interaction terms. The treatment (W) variable is interacted with firm characteristics like size, ownership, trade-status. The significance of the interaction terms shows the presence of heterogeneity by credit constraints.

Taking the pre-crisis model as an example, the modified equation is the following:

$$d(I_{it}/K_{i,t-1}) = C + \mu_1 W_{it} + \beta' X_{i,t-1} + \lambda W_{it} x_{i,t-1} + \varepsilon_{it}, \text{ where } t = \{2006,2007,2008\}$$

where x is one element of vector X, proxying the firm being credit constrained.

2.3 VARIABLES AND TREATMENT DEFINITIONS

Two key ingredients of the estimation are the definition of treatment and the control variables used. These choices depend on the question investigated, but the general purpose is the same. First we need to separate those who were treated and define the appropriate control group. Second, all the factors which might cause selection bias – influencing both the treatment and the outcome variable – have to be controlled for. In addition, the control variables must not be affected by the treatment. That requirement is ensured in all cases, as the controls are lagged with respect to the time of treatment.

Three questions are investigated, each requiring a different treatment definition and varying control variables.

2.3.1 Treatment definitions

Our first question relates to the *pre-crisis period* and asks whether foreign currency lending had any effect on firm level investment. A firm is considered to be treated, if at time t it took a new FX loan. A careful choice of the control group is key here. Taking an FX loan will affect investment through different channels and firm groups. First, some firms, which would have been able and willing to invest even using a HUF loan, decide to swap to FX financing, because of its lower cost. In this case it suffices to include in the control group those firms which took HUF loan at time t. Treatment in this case is denoted as W_{FX}^{HUF}. Second, FX financing might have made investment possible for certain firms previously unable or unwilling to invest using HUF loans or internal financing, for instance because of the lower return of their investment plan. The control group

[7] We use one-to-one matching algorithm with a caliper of 0.001. This implies that for each treated firm the mechanism tries to find one match in the control group such that the difference between their $P(X)$ values is less than 0.001. See Appendix for further details. We use psmatch2 package in STATA.

for these firms is less easy to indentify. What we can do instead is to assign all firms without an FX loan to the control group, which will cover both control groups of interest but other firms as well – such as firms which were unable or unwilling to invest no matter what financing choices were available. This treatment will be denoted as W_{FX}^{NOFX}. While in case of W_{FX}^{HUF} the effect is underestimated, in case of W_{FX}^{NOFX} the estimation is closer to capturing the full impact, nevertheless it is also contaminated due to the inability to identify properly the control group. The direction and size of potential bias is uncertain. Nevertheless, two features of the methodology may limit the bias. Investment changes are estimated, and unless various groups of firms are hit by different shocks during the investigated period, ATE estimates are fairly reliable. In addition, when matching estimation is done, the matching ensures the similarity of the treated firms and their matches picked from the control group.

The corresponding treatment definitions are the following:

W_{FX}^{HUF} = 1 if firm takes up FX loan at year *t*
= 0 if firm takes up HUF but not FX loan at year *t*

W_{FX}^{NOFX} = 1 if firm takes up FX loan at year *t*
= 0 if firm does not take up FX loan at year *t*

The second and third questions relate to the crisis period and ask if the two effects of depreciation, namely the balance sheet and competitiveness channel can be detected from the data. Here the treatment is the sharp depreciation of the HUF in the Fall of 2008 (see Graph 2 in Appendix), and the firms affected are those exposed to exchange rate changes either because of their FX loans or because of their involvement in foreign trade.

The *balance sheet channel* affects all firms indebted in foreign currency. Accordingly a firm is treated if it had FX loan in the Fall of 2008, and all those who had no FX loan in the Fall of 2008 are included in the control group.

W_{bs} = 1 if firm has FX debt in the fall of 2008
= 0 if firm has no FX debt in the fall of 2008

As the depreciation also triggers a competitiveness effect, moreover the exposures to competitiveness and balance sheet effects are likely to be correlated, we include the firms' export- and import share among the control variables.[8]

To measure the *competitiveness channel,* we consider two separate effects. In the case of exporters the competitiveness channel is expected to be positive as the depreciation changes relative prices and increases the competitiveness of the exporter. In contrast, in the case of importers the same exchange rate change weakens their competitiveness; hence a negative effect is expected. To grasp these two groups we define treatment and control firms as follows:

W_{comp}^{EXP} = 1 if firm exports in 2008
= 0 if firm does not export in 2008.

W_{comp}^{IMP} = 1 if firm imports in 2008
= 0 if firm does not import in 2008.

In both cases there is a need to control for the opposing competitiveness and the possible balance sheet effects. E.g, in the case of W_{comp}^{EXP} firms import share must be controlled for to exclude the adverse competitiveness effect and FX indebtedness must be included to control for balance sheet effects.

Changes in competitiveness due to exchange rate fluctuations are important only in a few industries. Therefore we estimate the competitiveness effect only for manufacturing and the retail sector, where the majority of export and import comes from.

[8] Because of the matching motive, we expect a positive correlation between the probability of taking FX loan and the strength of the competitiveness effect (share of net export revenues). Firms which have net export revenues are more likely to take FX loan. And the larger the FX sensitivity of their income (that is the larger the net export share) the larger the FX leverage they take.

Table 2
Number of observations by treatment variables

	Control	Treated
W_{FX}^{HUF}	10,302	2,882
W_{FX}^{NOFX}	83,357	2,882
W_{bs}	73,641	26,161
W_{comp}^{EXP}	8,728	3,003
W_{comp}^{IMP}	13,888	8,868

Note: The table counts the number of observation in the treatment and control group. Pre- and post-crisis values are shown for 2006 and 2008 respectively. Firms are included irrespective of their presence in future samples (missing output variables due to exit).

To summarize, we use 2 treatment measures to assess the pre-crisis effect of FX lending (W_{FX}^{HUF}, W_{FX}^{NOFX}), one measure for the post crisis balance sheet effect, (W_{bs}) and two measures to capture competitiveness effects (W_{comp}^{EXP}, W_{comp}^{IMP}).

2.3.2 Dependent variables

The dependant variable in each case is the change in investment rate due to the treatment. We use change instead of level to control for initial investment positions of the firms. Investment rate was declining in Hungary in the entire period investigated. FX borrowing potentially slowed down the process, while balance sheet effects accelerated it.

Table 3
Descriptive statistics of the dependent variables

	obs.	mean	s. dev.
ΔI/K (2005–2006)	66,494	–0.029	0.403
ΔI/K (2006–2007)	66,682	–0.025	0.403
ΔI/K (2007–2008)	67,195	–0.036	0.396
ΔI/K (2007–2009)	61,579	–0.079	0.400
ΔI/K (2007–2010)	57,568	–0.085	0.398

Note: The table provides descriptives on the dependent variables $(I_{it+j}/K_{i,t+j-1} - I_{it-1}/K_{it-2})$.

2.3.3 Control variables

Control variables should include all those characteristics, which might affect both the decision on taking FX loan and the investment performance of the firm. They are meant to capture the selection bias – firms which tend or able to take FX loan might also tend to have different investment performance. The literature on why firms take FX loan mostly point to factors (like exchange rate volatility relative to inflation volatility, interest rate differential, policy credibility etc.) which can be meaningfully tested when time series and country panel data are used. On the other hand, in a cross-sectional analysis the heterogeneity of firms should be exploited. In this respect the FX rate sensitivity of income (matching or hedging motive) and the liquidity constraint of firms are highlighted as a driver of loan currency composition. The larger the FX rate sensitivity of income (export share) and the looser the liquidity constraint, the higher the share of FX loans. Liquidity constraints are often approximated by firm size, foreign ownership, the firm being part of a large group or operating in the non-traded sector. We use two measures for firm size, the log of sales and the number of employees. To control for ownership, we introduce a foreign ownership dummy, which takes up the value one if more than 10 percent of the company's share capital is foreign owned. To indicate exchange rate sensitivity of income and expenditures, export share and import share are added.

The investment performance and the creditworthiness in general (not just the tendency to take FX loan) depend on other factors as well. Among those, firm's efficiency is controlled by total factor productivity (TFP). The firms' indebtedness is characterized by 2 variables, leverage and FX leverage. Firm specific user cost of capital is taken into account by including various variables – depreciation rate, effective tax rate, industry dummies (using 2 digit industry codes) and leverage. The

age of the firm may also affect both investment and the ability to take a loan. Although investment strongly depends on expected demand, we cannot control for that. The credit history of the firm is confined by the leverage ratio, other information (such as default) are either not available or not reliable for the period in question.

While the proposed control variables can jointly explain investment behavior and FX borrowing, the sign of the influence of these variables is not necessarily obvious. To highlight this, let us look at the possible effect of depreciation rate and effective tax rate. If they are large, the user cost of capital is also high, which lowers investment. On the other hand, the larger user cost of capital may provide an incentive to switch to FX loan, which might increase investment. Moreover, these variables can also capture other features of the firm population. For example firms with low or zero tax rates are either the ones with losses or are exempt from taxes or are efficient optimizers, with differing implications for investment. At the same time, when too many firms make losses, the tax rate may simply reflect the ability to make profit and thereby separate good, profit-making firms from the bad ones. A similar reasoning applies to the depreciation rate. When too many firms are capable or want to do just the necessary maintenance, high depreciation rate may just reflect the composition of capital and positively correlates with investment. In sum, depending on the underlying distribution of firms and the net effect of opposing forces, the effect of tax rate or depreciation can be both positive and negative.

Taking another example, leverage – up to a point – could reflect and go in hand with larger investment and increasing productivity. However, above some threshold, leverage may imply vulnerability, deteriorating creditworthiness, and leads to lower investment.

Note that depending on the treatment definition, some of the control variables are dropped. For example when balance sheet effect is considered, FX leverage is not included. The reason for this is, that FX leverage at time *t–1* is likely to correlate with the treatment (new FX loan at time *t),* which would contaminate the estimation of a treatment effect. The same reasoning applies for competitiveness effect and export share.

Table 4
Descriptive statistics of the main variables

Variable	Calculated as	2005–2007 average			2008–2011 average		
		obs.	mean	sdev	obs	mean	sdev
Labor	*ln (employment)*	82,311	1.927	1.292	80,317	1.891	1.298
Sales	*ln (sales)*	98,483	9.134	4.252	100,552	8.960	4.401
Foreign dummy	*10% foreign own. capital*	98,483	0.116	0.320	100,552	0.124	0.329
Log of TFP	*Levinsohn Petrin (2003)*	70,900	5.962	2.107	68,995	5.948	2.165
Leverage	*debt/total assets*	98,483	0.092	0.294	100,552	0.090	0.307
FX debt in assets	*FX debt/total assets*	98,483	2.022	0.298	100,552	3.317	0.321
Depreciation rate	*amortization/capital*	98,479	0.188	0.181	100,545	0.178	0.185
Effective tax rate	*CIT paid/EBIT*	84,346	0.096	0.076	87,321	0.116	0.053
Export share	*export/sales*	98,483	0.022	0.124	100,552	0.025	0.131
Import share	*import/materials*	98,482	0.275	1.896	100,552	0.225	1.746

Note: The table provides basic descriptive statistics on the explanatory variables used. The first two columns contain the name and the definition of variables. The other two blocks give average number of observations, average mean and average standard deviation for each variable for the 2005–2007 and the 2008–2011 period – to characterize the pre- and post-crisis economy.

Table 4 provides summary statistics on the control variables for two periods: one before the crisis, the averages of the values for the years 2005–2007, and one following the outbreak of the crisis, the averages of the values for the years 2008–2011. The sample contains about 90 thousand firms annually. Note, that in the case of TFP the sample size drops significantly. This happens for two reasons. First TFP cannot be estimated for firms with zero or negative value added. Second, TFP is rendered missing for firms that operate without or do not report fixed assets or number of employees.

3 Results

3.1 THE IMPACT OF FX LENDING ON INVESTMENT BEFORE THE CRISIS

First we investigate whether lending in foreign currency contributed to higher investment before the crisis. In Table 5 we compare the coefficients for the two treatment definitions, W_{FX}^{HUF} and W_{FX}^{NOFX}. The results suggest that FX lending had a significant positive impact on investment in each year and by all treatment definitions. For example, in 2006 the investment rate of firms, who took FX loan to finance their investment in that year, would have been 7 to 10 percentage points lower in the absence of FX loans. As before the crisis the aggregate investment ratio was about 19-20% – calculated from our dataset – this impact is huge. As we explained earlier, W_{FX}^{HUF} and W_{FX}^{NOFX} gives a lower and a rather upper bound for the impact. The former excludes those from the control group, whose investment project would not have been feasible without FX loan. In 2007 and 2008 the impact is even larger, between 13 and 17 percentage point.

Table 5
Impact of FX loans in various periods – OLS results

	2006	2007	2008
W_{FX}^{HUF}	0.0727***	0.139***	0.126***
	[0.0145]	[0.0119]	[0.0120]
W_{FX}^{NOFX}	0.101***	0.169***	0.149***
	[0.0137]	[0.0112]	[0.0111]

*Note: The table shows results from 6 separate regressions. The first row shows OLS estimations regressing the change in investment rate on the treatment variable W_{FX}^{HUF} and a list of control variables. Only the coefficients on the treatment variables are collected. The second row collects coefficient estimates from three different regressions where the treatment variable is W_{FX}^{NOFX}. Columns correspond to cross sections from 2006 to 2008. Controls include those in Table 5. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Detailed estimation results can be found in Table 13 in the appendix, where the coefficient estimates on all covariates are reported. Several firm characteristics significantly influence investment, however their significance, sometimes even their sign, changes year by year. As we said earlier, in many cases we have no a priori expectation about the sign. Multicollinearity between the variables may also influence the results. Therefore we do not assign particular importance to the evaluation of each estimate, although various interesting underlying stories might be found. From the point of view of our main research questions, the estimates on the parameter of *W* are in the focus.

3.1.1 Robustness

The first robustness check is related to the methodology. Matching[9] is run by using the same control and treatment variables as in the OLS case. Interestingly, matching yields results that are not statistically different from the linear regression estimates – all the ATE estimates form the matching estimation lie in the 2 standard deviation confidence interval of the corresponding OLS estimate.

Next we check whether results change if long-term loans are used to define the treatment. Table 7 collects the results for both treatment definitions – FX borrowing against HUF-, and against any non-FX financing. We find that the results are practically unchanged.

[9] Matching works well on the sample. Using the matching procedure we were able to reduce the differences between the treatment and control groups both in terms of the pscore distribution and in terms of the mean of each control variables. In most cases the remaining difference between the average of the control and treatment group is statistically insignificant. Diagnostic test results are available on request.

Table 6
Impact of FX loan – matching and OLS estimates
(t = 2007)

	OLS results		Matching results	
	W_{FX}^{HUF}	W_{FX}^{NOFX}	W_{FX}^{HUF}	W_{FX}^{NOFX}
Treatment	0.139***	0.169***	0.125***	0.174***
	[0.012]	[0.010]	[0.016]	[0.015]
Obs.	8,573	43,786	1,577	1,697

Note: The table shows results from 4 separate regressions. The first two columns show OLS estimations regressing the change in investment rate from 2006 to 2007 on the treatment variable and a list of control variables. Only the coefficients on the treatment variables are shown. The third and fourth columns are corresponding results from a matching estimator. See Appendix for details on matching. Controls include those in Table 13.
*Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Table 7
Effect of FX loans using long-term loan contracts only

	2006	2007	2008
$W_{FX\text{-}long}^{HUF}$	0.0609***	0.125***	0.130***
	[0.0153]	[0.0128]	[0.0130]
$W_{FX\text{-}long}^{NOFX}$	0.106***	0.172***	0.169***
	[0.0141]	[0.0116]	[0.0116]

Note: The table shows results from 6 separate regressions. All are OLS estimations, regressing the change in investment rate on the treatment variable and on a list of control variables. Only the coefficients on the treatment variables are shown. The results in the first row use $W_{FX\text{-}long}^{HUF}$ and second row uses $W_{FX\text{-}long}^{NOFX}$ as treatment definition. Controls include those in Table 13.
*Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Finally, in Table 8 we show calculations predicting the probability of a relatively large investment in the year 2007. To this end, we define two large-investment dummies. The results reinforce previous findings. They indicate that FX borrowing did boost investment in the pre-crisis period. As the probability of large investment was above 20 percentage point in the pre-crisis year, the estimated coefficient implies an increase of more than 50 percent.

Table 8
Effect of FX loans on the probability of large investments
(t = 2007)

Dep.Var:	[1] High inv. dummy 10	[2] High inv. dummy 30
W_{FX}^{HUF}	0.143***	0.128***
	[0.0111]	[0.0104]
Controls:	yes	yes
Dummy: sector	yes	yes
Observations	9,776	9,776
R-squared	0.109	0.144

Note: The table shows results from 2 separate regressions. Both are OLS estimations regressing dummies indicating high investment on the treatment variable and on a list of control variables. Only the coefficients on the treatment variables are shown. High inv. dummy 10 defines an investment at least twice as big as its average in the past 3 years and at least 10% of total assets. While dummy 30 indicates the investment is at least 30% of the assets. Controls include those in Table 13.
*Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1*

3.1.2 Testing the liquidity easing channel

Two major channels of impact of FX lending are pointed at in the literature. One is the lowering of user cost, the other is the easing of liquidity constraints.[10] The relevance of the latter is tested via allowing heterogeneous effects by various sub-groups of firms with supposedly different level of liquidity constraints. Small, domestic and non-trading firms are usually regarded to be more liquidity constrained. Therefore to test the importance of the liquidity constraint easing channel, estimations are run with interaction terms of the treatment and size, foreign trade status and ownership. Results are reported for W_{FX}^{HUF} and for the year 2007.[11] As Table 9 documents, the effect of FX borrowing on investment depends on the size[12] and trade status of the firm, but not on ownership. FX borrowing raises investment more, if the firm is smaller or not involved in foreign trade. This suggests that the liquidity easing channel was at work. Similar result is found by Ranciere et al. (2010).

Note that the coefficient of *W* in the first column is rather high. This comes from two sources. First, it comes from high variation of sales across firms as indicated in Table 9. Second, it suggests that the effect of FX loan varies considerably across firms of different turnover in favor of small firms.

Table 9
Testing the liquidity easing cannel with interaction terms

Dep.Var: ΔI/K (2007)	[1]	[2]	[3]	[4]
W_{FX}^{HUF}	0.938***	0.318***	0.140***	0.160***
	[0.112]	[0.0366]	[0.0125]	[0.0144]
W x sales	−0.0645***			
	[0.00882]			
W x labor		−0.0644***		
		[0.0118]		
W x dummy: foreign own.			−0.0167	
			[0.0390]	
W x dummy: trader				−0.0711***
				[0.0222]
Controls:	yes	yes	yes	yes
Dummy: sector	yes	yes	yes	yes
Observations	8,573	8,573	8,573	8,573
R-squared	0.086	0.083	0.08	0.081

*Note: This table contains results from 4 separate OLS estimations regressing the change in investment rate on the treatment variable W_{FX}^{HUF} and interactions with treatment variables. Each equation looks at the same cross section of 2007. Only the coefficients on the treatment variables and interaction terms are collected. Controls include those in Table 13. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

3.2 BALANCE SHEET EFFECTS CAUSED BY THE DEPRECIATION

To capture the balance sheet effects caused by currency depreciation during the crisis we calculate ATE to measure the difference in investment performance from 2007 to 2009 and to 2010. Depreciation affects firms through the competitiveness channel as well. To control for that, export- and import share are introduced among the control variables. The inclusion of these control variables ensures that ATE measures the balance sheet effect.

Table 10 shows the results for both OLS and matching estimates of ATE. We find that the depreciation of the HUF lowered the investment of FX indebted firms. The investment rate of FX borrowers was about 4 percentage point lower in 2009, than

[10] Failure of UIP results in lower user cost for FX loan.
[11] Results for the other years and treatment definition are very similar.
[12] Size matters only up to a point. When instead of the continuous sales variables we use dummies to indicate sales threshold of 1, 5 and 10 Million Euro, differences are significant only for the first 2.

would have been in the absence of FX borrowing. Investment rate did not recover even in 2010. The matching estimates, just as before, yield almost identical results.[13]

Table 10
Balance sheet effects – OLS and matching results

Periods	Stat.	OLS	Matching
2007–2009	W_{bs}	–0.045***	–0.05***
	s.e.	[0.005]	[0.007]
	obs	39,831	7,625
2007–2010	W_{bs}	–0.043***	–0.045***
	s.e.	[0.005]	[0.008]
	obs	37,564	7,132

*Note: The table collects results on the coefficient of the treatment variable W_{bs} from 4 separate estimations. The first column shows OLS regressions of the change in investment rate (2007–2009 above and 2007–2010 below) on the treatment variables. Controls include those in Table 15. The second column includes the corresponding matching estimations. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Although the evidence on balance sheet effects per se implies that liquidity constraints matter, still differences can be expected according to the strength of liquidity constraints. OLS with interaction terms (see Table 11) provides support to this hypothesis. Larger, foreign and trading firms suffered smaller decline than their counterparts.

Table 11
Balance sheet effects – OLS estimate with interaction terms

Dep.Var: ΔI/K (2007-2009)	[1]	[2]	[3]	[4]
W_{bs}	–0.147*** [0.0336]	–0.0745*** [0.0117]	–0.0477*** [0.00530]	–0.0509*** [0.00588]
x sales	0.00858*** [0.00270]			
x labor		0.0121*** [0.00376]		
x dummy: foreign own.			0.0483*** [0.0133]	
x dummy: trader				0.0336*** [0.0102]
Controls:	yes	yes	yes	yes
Dummy: sector	yes	yes	yes	yes
Observations	44,867	44,867	44,867	44,867
R-squared	0.027	0.027	0.027	0.026

*Note: The table collects results from 4 separate estimations They are OLS regressions of the change in investment rate (2007–2009) on the treatment variables and interaction between treatment variables and selected controls: log of sales, log of size, foreign ownership dummy and variable indicating trade. Additional control variables are the same as in Table 15. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

As we compare the investment performance of different groups of firms during the crisis and with a significant time gap (2 or 3 years), the estimated ATE is not likely to capture the full impact and results can be distorted. First, we cannot exclude that other shocks might have hit asymmetrically the control and the treatment group. For example during the crisis, risk premium shocks hit the economy. Depending on the monetary policy response, risk premium shocks manifest in currency depreciation on one hand and domestic interest rate increase (or more precisely increase in the domestic and foreign interest rate differential) on the other. In case of Hungary during 2009 a large widening – of about 300bp – of the differential

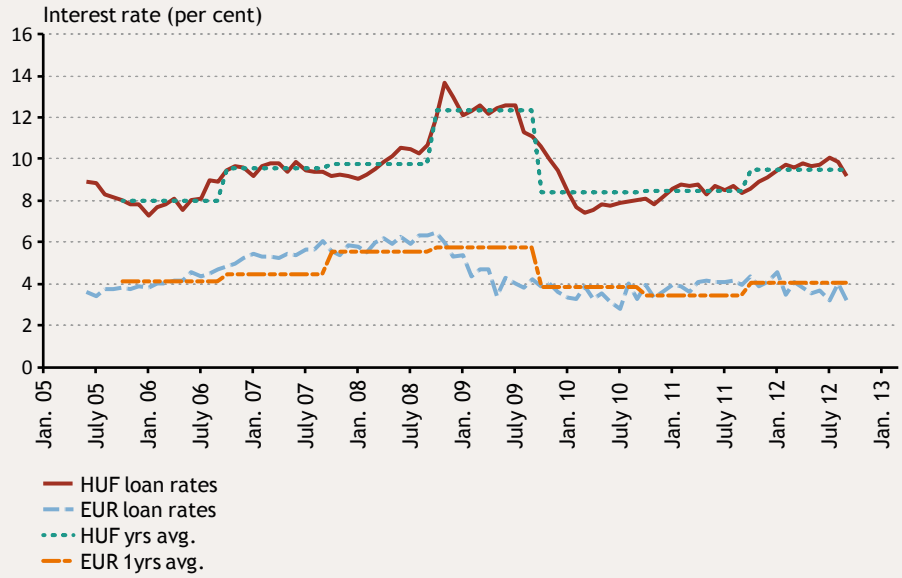
[13] When balance sheet effects are tested there is no need to differentiate between long- and short-term loans. Therefore no robustness check is done using long-term loans only.

of actual lending rates can be observed (see Chart 1).[14] Thus, because of the endogenous monetary policy response, just when the treatment group was hit by a depreciation, some firms in the control group (those with HUF loans) were affected by a relative interest rate shock. The interest rate shock weakened the investment performance of HUF borrowers. As a result – given the huge size of the change in interest rate differential – our estimates is conditional on the monetary policy response.

Second, the analysis measures the real consequences of FX lending on the group of survival firms. However, our previous study (see Endrész, 2012) suggests that the survival rate also depended on whether a firm had FX loans. To capture the full impact of FX lending, one needs to take into account the relative increase in default rates and the corresponding loss of capital too.

In sum the reported estimates are likely to give a lower bound of balance sheet effects due to foreign currency borrowing in the Hungarian corporate sector.

Chart 1
Actual lending rates of Hungarian banks by currency of loan



Note: The chart shows the average monthly corporate loan interest rates for HUF and EUR loans. The dashed lines are 12 month averages from Q4 of year t to Q4 of the next. The last quarter was chosen to pinpoint the outbreak of the crisis.

3.3 COMPETITIVENESS EFFECT

Results regarding the competitiveness channel are not so strong. In the retail sector, where firms are exposed to FX risk through import, the results are not significant although ATE has the expected (negative) sign. In case of manufacturing matching and linear regression provide very similar results – see Table 12 and Table 17. Investment rate was about 2 and 3 percentage points higher in 2009 and 2010, due to the depreciation. Nevertheless the estimate is significant only for the linear regression and at 1 or 5 percent significance level. Moreover, results for 2010 might be distorted by the fact that by that time export has already recovered, while domestic demand was still very weak.

[14] Because of financial stability concerns and the danger of monetary easing becoming contractionary, the Hungarian MPC increased the interest rate, while foreign interest rates headed toward zero to ease the recession. Both contributed to a widening interest rate differential by about 300bp.

In the case of competitiveness we have also looked for signs of heterogeneous effect. We did not find evidence that depreciation changes competiveness differently in various firm groups.

Table 12
Competitiveness effect – OLS results

Sample	[1]	[2]	[3]	[4]
	Manufacturing		Retail	
Dep.Var:	ΔI/K ('07–'09)	ΔI/K ('07–'10)	ΔI/K ('07–'09)	ΔI/K ('07–'10)
W_{comp}^{EXP}	0.0211*	0.0307**		
	[0.0120]	[0.0123]		
W_{comp}^{IMP}			–0.0143	–0.014
			[0.0102]	[0.0106]
Obs.	8870	8,342	12,582	11,843

*Note: The table collects results from 4 separate estimations. The first two are OLS regressions of change in investment rate between 2007–2009 and between 2007–2010 (second column) on treatment variable (W_{comp}^{EXP}) for manufacturing firms. The third and fourth column shows OLS regressions of change in investment rate between 2007–2009 (third) and between 2007–2010 (fourth column) on treatment variable (W_{comp}^{IMP}) for retails sector firms only. Control variables are the same as in Table 16. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

4 Concluding remarks

The paper uses a rich micro dataset on Hungarian firms to investigate the impact of foreign currency lending on real investment. We try to answer the following question: what would have been the investment performance of Hungarian firms in the absence of FX borrowing. The international literature suggests that FX borrowing can enhance investment growth by lowering user costs and easing liquidity constraints. Therefore first we test whether foreign currency lending contributed to investment before the crisis. We also test whether the impact of FX lending varied by the strength of liquidity constraints. There is a much larger literature – both theoretical and empirical – which investigates the role of the balance sheet channel in the unfolding of the financial crises. When FX borrowing is present, in a sudden stop-type crisis depreciation can trigger balance sheet effects with potentially detrimental real consequences and very deep recession. Our second question therefore focuses on balance sheet effects – whether the large depreciations observed during the great recession resulted in lower investment rate of firms with foreign currency loans. We try to separate and measure both the competitiveness and balance sheet effect of depreciation.

The dataset covers all double-bookkeeping firms between 2004 and 2010, and include information on financial and real performance, firm characteristics (size, industry and ownership), debt and its currency composition, export and import. This way the dataset provides a wide coverage both in terms of firms included, their characteristics, and items which entail foreign currency exposure. As FX lending become widespread in Hungary, and liquidity constraints might play an important channel through which the impact on investment materializes, it is necessary to extend the analysis beyond large, listed (i.e. less liquidity constrained) firms. Moreover, the inclusion of all major FX exposures and firm characteristics is required in order to separate and measure the balance sheet effects and to avoid missing variable bias.

The results show that before the crisis FX lending increased investment rates by a significant amount, more than 10 percentage point. We find evidence for balance sheet effects as well during the crisis. Firms with FX loan at the end of 2008 had an investment rate 4-5 percentage point lower than would have had in the absence of FX debt. The impact of FX lending was stronger for more liquidity constrained firms, both in the pre- and the post-crisis period. As to the competitiveness effect, the evidence is weaker, only the linear regression gives significant estimates. Most of the results are robust to changes in methodology or the definition of treatment.

5 References

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

Aguiar, M. (2005), "Investment, devaluation, and foreign currency exposure: The case of Mexico", *Journal of Development Economics,* vol. 78 no. 1, pp. 95–113.

Agustinus, P. (2007), "Corporate Responses to Currency Depreciations: Evidence from Indonesia", *MPRA Paper,* 6502, University Library of Munich.

Allayannis, G., G. W. Brown, and L. F. Klapper (2003), "Capital Structure and Financial Risk: Evidence from Foreign Debt Use in East Asia", *Journal of Finance,* vol. 58 no. 6, pp. 2667–2710.

Basso, H.S., O. Calvo-Gonzalez, and M. Jurgilas (2007), "Financial Dollarization. The role of Banks and Interest Rates", *Working Papers Series,* No. 748, European Central Bank.

Benavente, J. M., C. A. Johnson, and F. G. Morande (2003), "Debt composition and balance sheet effects of exchange rate depreciations: a firm-level analysis for Chile", *Emerging Markets Review,* vol. 4 no. 4, pp. 397–416.

Bleakley, H., and K. Cowan (2008), "Corporate Dollar Debt and Depreciations: Much Ado About Nothing?", *The Review of Economics and Statistics,* vol. 90 no. 4, pp. 612–626.

Bodnár K. (2006), "A hazai kis- és középvállalatok árfolyamkitettsége, devizahitelezésük pénzügyi stabilitási kockázatai: Egy kérdőíves felmérés eredményei", *MNB Műhelytanulmányok,* 53, Magyar Nemzeti Bank.

Bodnár, K. (2009), "Exchange rate exposure of Hungarian enterprises: results of a survey", *MNB Occasional Papers,* 80, Magyar Nemzeti Bank.

Bonomo, M., B. Martins, and R. Pinto (2003), "Debt composition and exchange rate balance sheet effect in Brazil: a firm level analysis", *Emerging Markets Review,* vol. 4 no. 4, pp. 368–396.

Carranza, L. J., J. M. Cayo, and J. E. Galdon-Sanchez (2003), "Exchange rate volatility and economic performance in Peru: a firm level analysis", *Emerging Markets Review,* vol. 4 no. 4, pp. 472–496.

Carranza, L. J., J. E. Galdon-Sanchez, and J. Gomez-Biscarri (2011), "The relationship between investment and large exchange rate depreciations in dollarized economies. ", *Journal of International Money and Finance,* 30.

Cowan, K., E. Hansen, and L. O. Herrera (2005), "Currency Mismatches, Balance-Sheet Effects and Hedging in Chilean Non-Financial Corporations", *RES Working Papers,* 4387, Inter-American Development Bank.

Echeverry, J. C., L. Fergusson, R. Steiner, and C. Aguilar (2003), "'Dollar' debt in Colombian firms: are sinners punished during devaluations?", *Emerging Markets Review,* vol. 4 no. 4, pp. 417–449.

Elsas, R., Flannery , M. J., and Garfinkel, J. A. (2006), "Major Investments, Firm Financing Decisions, and Long-Run Performance", *EFA Conference 2004 Maastricht.*

Endrész, M., Gy. Gyöngyösi, and P. Harasztosi (2012), "Currency mismatch and the sub-prime crisis: firm-level stylised facts from Hungary", *MNB Working Papers,* 2012/8, Magyar Nemzeti Bank.

Endrész, M., and J. Krekó (2010), "The role of foreign currency lending in the impact of the exchange rate on the real economy", *MNB Bulletin,* vol. 5 no. 1, pp. 29–38.

Fuentes, M. (2007), "Dollarization of Debt Contracts: Evidence from Chilean Firms", *Documento de Trabajo,* No. 336.

Galiani, S., E. Levy Yeyati, and E. Schargrodsky (2003), "Financial dollarization and debt deflation under a currency board", *Emerging Markets Review,* vol. 4 no. 4, pp. 340–367.

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,* vol. 4 no. 4, pp. 330–339.

Gelos, G. (2003), "Foreign currency debt in emerging markets: firm-level evidence from Mexico", *Economics Letters,* vol. 78 no. 3, pp. 323–327.

Gilchrist, S., and J. W. Sim (2007), "Investment during the Korean Financial Crisis: A Structural Econometric Analysis", *NBER Working Papers,* 13315, National Bureau of Economic Research.

Janot, M. M., M. G. P. Garcia, and W. Novaes (2008), "Balance Sheet Effects in Currency Crises: Evidence from Brazil", *Textos para discussão,* 556, Department of Economics PUC-Rio (Brazil).

Kalemli-Ozcan, S., H. Kamil, and C. Villegas-Sanchez (2011), "What Hinders Investment in the Aftermath of Financial Crises: Insolvent Firms or Illiquid Banks?", *CEPR Discussion Papers,* 8543, Centre for Economic Policy Research.

Kamil, H. (2012), "How Do Exchange Rate Regimes Affect Firms' Incentives to Hedge Currency Risk? Micro Evidence for Latin America", *IMF Working Papers,* 12/69, International Monetary Fund.

Kandilov, I. T., and A. Leblebicioglu (2011), "The impact of exchange rate volatility on plant-level investment: Evidence from colombia", *Journal of Development Economics,* 94 (2), pp. 220-230.

Kátay, G., and Z. Wolf (2008), "Driving factors of growth in Hungary - a decomposition exercise", *MNB Working Papers,* 2008/6, Magyar Nemzeti Bank.

Kesriyeli, M., E. Ozmen, and S. Yigit (2005), "Corporate Sector Debt Composition and Exchange Rate Balance Sheet Effect in Turkey", *ERC Working Papers,* 0507, Economic Research Center, Middle East Technical University.

Krugman, P. (1999), "Balance Sheets, the Transfer Problem, and Financial Crises", *International Tax and Public Finance,* vol. 6 no. 4, pp. 459–472.

Pratap, S., I. Lobato, and A. Somuano (2003), "Debt composition and balance sheet effects of exchange rate volatility in Mexico: a firm level analysis", *Emerging Markets Review,* vol. 4 no. 4, pp. 450–471.

Ranciere, R., A. Tornell, and A. Vamvakidis (2010), "Currency mismatch, systemic risk and growth in emerging Europe", *Economic Policy,* vol. 25 no. 64, pp. 597–658.

Schneider, M., and A. Tornell (2004), "Balance Sheet Effects, Bailout Guarantees and Financial Crises", *Review of Economic Studies,* 71, pp. 883–913.

Appendix

Chart 2
The depreciation of HUF against CHF and EUR

(January 2005 = 100)

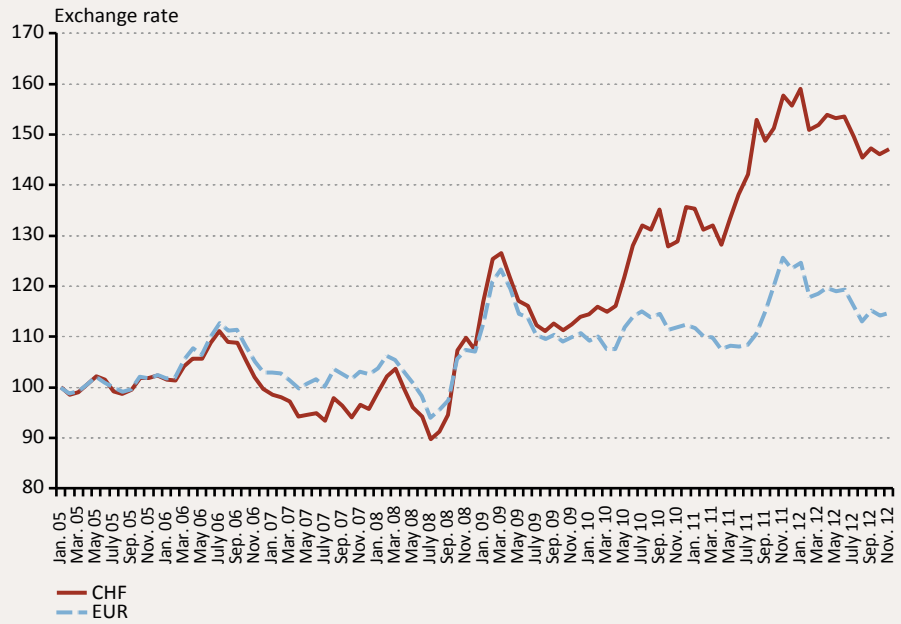


Table 13
Detailed pre-crisis OLS estimation results with W_{FX}^{HUF}

Dep.Var: ΔI/K (t–t–1)) t=	(1) 2006	(2) 2007	(3) 2008
W_{FX}^{HUF}	0.0727***	0.139***	0.126***
	[0.0145]	[0.0119]	[0.0120]
Labor	0.00642	–0.0134*	0.00262
	[0.00837]	[0.00786]	[0.00802]
Sales	–0.0229***	–0.00666	–0.0221***
	[0.00722]	[0.00698]	[0.00687]
Age	0.00613***	0.00673***	0.00593***
	[0.00141]	[0.00127]	[0.00119]
Dummy: foreign own.	–0.0289	–0.0403**	–0.0590***
	[0.0208]	[0.0185]	[0.0205]
TFP	0.00254	–0.0131	0.00522
	[0.00807]	[0.00823]	[0.00827]
Export share	0.00685	–0.0766**	0.0735*
	[0.0376]	[0.0343]	[0.0403]
Import share	–0.00321	0.00326	0.00156
	[0.00286]	[0.00216]	[0.00253]
Leverage	–0.122***	–0.135***	–0.0914***
	[0.0307]	[0.0231]	[0.0238]
FX loan in assets	0.0121	0.0548***	–0.00519
	[0.00909]	[0.0101]	[0.00633]
Depreciation rate	0.957***	1.000***	0.801***
	[0.0619]	[0.0583]	[0.0571]
Effective taxrate	0.209***	0.300***	0.218***
	[0.0744]	[0.0742]	[0.0812]
Dummy: sector	yes	yes	yes
Observations	7,982	8,573	9,026
R-squared	0.063	0.080	0.067

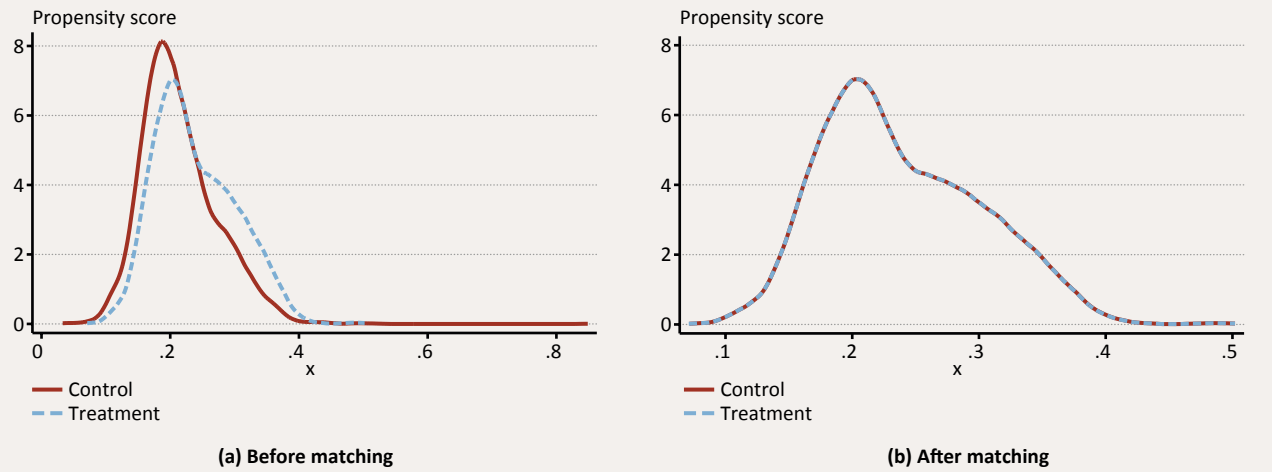
*Note: This table contains results from three separate OLS estimations regressing the change in investment rate on the treatment variable W_{FX}^{HUF} and a list of control variables. Each equation looks at a different cross section from 2006 to 2008. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

On matching estimations

This section provides diagnostics on the matching estimations. According to the diagnostic tests matching works well in each case. For brevity, we provide an in-depth analysis of the results for I/K change from 2006 to 2007 when treatment is defined as W_{FX}^{HUF}. Results for the other years and treatment definition are very similar and are available on request.

To evaluate the goodness of matching we rely on two approaches. First by looking at the distribution of the propensity score (pscore) – see Chart 1 on the base case. While before matching the pscore distribution in the control and treatment group do differ, after matching they almost coincide.

Chart 3
Propensity score kernel distributions before and after matching



(a) Before matching **(b) After matching**

Second, we evaluate whether matching was able to reduce the differences between the treatment and control group not just in terms of the probability of taking FX loan (pscore), but also according to each control variables. To see this, in Table 14 we provide test statistics for the differences of means by each control variable and for the remaining bias after the match. We find that matching reduces the difference in the means of variables; in most cases the remaining difference is statistically insignificant. We prefer to use the relative bias in the mean difference to be below 5 percent after matching, as a rule of thumb. We accept higher bias if the result is economically insignificant. [15]

[15] This is the case with sales and depreciation rate.

Table 14
Comparing averages of the treated and control group before and after match
(W_{FX}^{HUF} 2006–2007)

Variable	Unmatched Mean		Control	%bias	%reduct	t-test	
	Matched Mean	Treated			bias	t	p>t
Labor	Unmatched	2.811	2.639	17.4		6.560	0.000
	Matched	2.808	2.757	5.2	70.2	1.510	0.132
Sales	Unmatched	12.469	12.100	26		9.450	0.000
	Matched	12.460	12.312	10.4	60	3.070	0.002
Foreign dummy	Unmatched	0.071	0.062	3.7		1.420	0.156
	Matched	0.069	0.069	0	100	0.000	1.000
TFP	Unmatched	6.540	6.498	3.4		1.270	0.204
	Matched	6.532	6.495	3.1	9.7	0.900	0.367
Export share	Unmatched	0.039	0.030	5.8		2.220	0.026
	Matched	0.038	0.036	1.6	72.8	0.450	0.655
Import share	Unmatched	0.543	0.468	3.1		1.210	0.227
	Matched	0.547	0.502	1.8	40.1	0.520	0.600
Leverage	Unmatched	0.167	0.167	0.1		0.030	0.977
	Matched	0.167	0.165	0.9	–960.1	0.250	0.804
Share of FX debt	Unmatched	0.045	0.037	2.7		0.830	0.409
	Matched	0.045	0.039	1.8	33.6	0.590	0.555
Depreciation	Unmatched	0.146	0.161	–15.8		–5.610	0.000
	Matched	0.145	0.155	–10.2	35.1	–3.080	0.002
Effective tax rate	Unmatched	0.119	0.115	6.4		2.360	0.018
	Matched	0.119	0.119	–0.3	95	–0.100	0.923

Table 15
Balance sheet effects – detailed OLS results

Dep.Var:	ΔI/K (2007-2009) [1]	ΔI/K (2007-2010) [2]
W_{bs}	–0.0422***	–0.0408***
	[0.00501]	[0.00512]
Labor	0.000469	0.00619**
	[0.00290]	[0.00301]
Sales	–0.0137***	–0.0158***
	[0.00254]	[0.00266]
Age	0.00800***	0.00804***
	[0.000479]	[0.000493]
Dummy: foreign own.	–0.0211***	–0.00509
	[0.00649]	[0.00696]
TFP	–0.00359	–0.00252
	[0.00286]	[0.00299]
Leverage	–0.0572***	–0.0706***
	[0.0107]	[0.0116]
Export share	0.0560***	0.0468***
	[0.0132]	[0.0135]
Import share	0.000822	0.00210**
	[0.000841]	[0.000873]
Depreciation rate	0.102***	0.0525***
	[0.0182]	[0.0190]
Effective tax rate	0.0219	–0.0434
	[0.0318]	[0.0329]
Dummy: sector	yes	yes
Observations	44,867	42,111
R-squared	0.027	0.022

*Note: The table collects results from 2 separate estimations The first column shows OLS regressions of change in investment rate (2007–2009) on the treatment variables. While the second column regresses the change in investment rate 2007–2010 on the treatment variable. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Table 16
Competitiveness effect – detailed OLS results

Sample	[1]	[2]	[3]	[4]
	Manufacturing		Retail	
Dep.Var:	ΔI/K ('07-'09)	ΔI/K ('07-'10)	ΔI/K ('07-'09)	ΔI/K ('07-'10)
W_{comp}^{EXP}	0.0211*	0.0307**		
	[0.0120]	[0.0123]		
W_{comp}^{IMP}			−0.0143	−0.014
			[0.0102]	[0.0106]
Labor	0.0069	0.00317	−0.00895	−0.00153
	[0.00663]	[0.00749]	[0.00551]	[0.00547]
Sales	−0.00823	−0.0019	−0.00842**	−0.0104**
	[0.00610]	[0.00700]	[0.00423]	[0.00424]
Age	0.00783***	0.00607***	0.00920***	0.00892***
	[0.00103]	[0.00104]	[0.000926]	[0.000953]
Dummy: foreign own.	−0.02	−0.0116	−0.0327***	−0.00648
	[0.0123]	[0.0129]	[0.0126]	[0.0137]
TFP	−0.0169**	−0.0241***	−0.00207	−0.000409
	[0.00706]	[0.00779]	[0.00521]	[0.00546]
Leverage	−0.0731***	−0.0866**	−0.0603*	−0.0823***
	[0.0276]	[0.0345]	[0.0315]	[0.0256]
FX loan in assets	−0.00426	−0.00937	−0.0125	−0.0129
	[0.0146]	[0.0180]	[0.0152]	[0.0144]
Depreciation rate	0.247***	0.173***	0.0878***	0.0515
	[0.0449]	[0.0464]	[0.0341]	[0.0352]
Effective taxrate	0.106	0.0816	−0.00865	0.0169
	[0.0672]	[0.0700]	[0.0620]	[0.0649]
Import share	0.00121	0.00211		
	[0.00142]	[0.00158]		
Export share			0.0396	0.0362
			[0.0396]	[0.0402]
Dummy: sector	yes	yes	yes	yes
Observations	8,870	8,342	12,582	11,843
R-squared	0.027	0.022	0.015	0.014

*Note: The table collects results from 4 separate estimations. The first two are OLS regressions of change in investment rate 2007–2009 and rates between 2007–2010 (second column) on treatment variable (W_{comp}^{EXP}) for manufacturing firms. The third and fourth column shows OLS regressions of change in investment rate 2007–2009 (third) and rates between 2007–2010 (fourth column) on treatment variable (W_{comp}^{IMP}) for retails sector firms only. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Table 17
Competitiveness effect – Matching results

Sample	[1]	[2]	[3]	[4]
	Manufacturing		Retail	
Dep.Var:	ΔI/K ('07-'09)	ΔI/K ('07-'10)	ΔI/K ('07-'09)	ΔI/K ('07-'10)
W_{comp}^{EXP}	0.0310	0.029		
	[0.0239]	[0.0243]		
W_{comp}^{IMP}			−0.0199	0.01
			[0.0182]	[0.088]
Obs.	655	608	1130	1041

MNB Working Papers 2014/1

Corporate Foreign Currency Borrowing and Investment. The Case of Hungary

Print: D-Plus

H–1037 Budapest, Csillaghegyi út 19–21.