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Incidence of Bank Levy and Bank Market Power

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INCIDENCE OF BANK LEVY AND BANK MARKET POWER

Gunther Capelle-Blancard and Olena Havrylchuk

HIGHLIGHTS

- We investigate the incidence of the Hungarian bank tax introduced in 2010
- We rely on difference-in-difference methodology to disentangle the impact of the tax from any other shock that might have occurred simultaneously.
- In line with model predictions, we show that the tax is shifted to customers with the smallest demand elasticity, such as households.

ABSTRACT

This is the first analysis of the incidence of a bank tax that is imposed on banks' balance sheets. Within the framework of an oligopolistic version of the Monti-Klein model, the pass-through of a bank tax levied on loans is stronger when elasticity of credit demand is low. To test this hypothesis, we investigate the incidence of the Hungarian bank tax that was introduced in 2010 on banks' assets. This case is well suited for our analysis because the tax rate is much higher for large banks than for small banks, which allows relying on difference-in-difference methodology to disentangle the impact of the tax from any other shock that might have occurred simultaneously. In line with model predictions, our estimations show that the tax is shifted to customers with the smallest demand elasticity, such as households. In terms of economic policy implications, our results suggest that enhanced borrower mobility could reduce the ability of banks to shift taxes to customers.

JEL Classification: G21, H22, L13.

Keywords: banks, bank levy, tax incidence, market power.



INCIDENCE DES TAXES BANCAIRES ET POUVOIR DE MARCHÉ

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POINTS CLEFS

- Nous étudions l'incidence de la taxe sur les actifs bancaires introduite en Hongrie en 2010.
- Nous utilisons la méthode des doubles-différences afin de distinguer l'impact de la taxe d'un autre choc qui pourrait s'être produit simultanément.
- Conformément à la théorie, nos estimations montrent que la taxe bancaire est transmise aux clients avec la plus petite élasticité de la demande, en particulier donc les ménages.

RÉSUMÉ COURT

Dans cette étude, nous examinons, pour la première fois, dans quelle mesure les banques sont susceptibles de répercuter les taxes sur leurs bilans. Dans le cadre d'une version oligopolistique du modèle Monti-Klein, l'incidence d'une taxe bancaire prélevée sur les prêts est d'autant plus forte que l'élasticité de la demande de crédit est faible. Pour tester cette hypothèse, nous étudions l'incidence de la taxe hongroise sur les actifs bancaires introduite en 2010. Cette taxe est particulièrement bien adaptée, car le taux d'imposition est beaucoup plus élevé pour les grandes banques que pour les petites ce qui permet, par l'approche en double-différence, de distinguer l'impact de la taxe d'un autre choc qui pourrait s'être produit simultanément. Conformément à la théorie, nos estimations montrent que la taxe bancaire est transmise aux clients avec la plus petite élasticité de la demande, en particulier donc les ménages.

Classification JEL : G21, H22, L13.

Mots-clés : banque, taxe sur le secteur financier, incidence fiscale, pouvoir de marché.

INCIDENCE OF BANK LEVY AND BANK MARKET POWER[◇]Gunther Capelle-Blancard^(*) et Olena Havrylchyk^(**)**1. INTRODUCTION**

In the aftermath of the crisis, several projects of the banking sector taxation have emerged.¹ New levies² are imposed on some elements of banks' balance sheets, but their details and objectives differ from one country to another (see Table 1). In Germany and Sweden, the revenues go to a special reserve fund to ensure that taxpayers' money will not be used for future bailouts. In Hungary, France and the UK, the authorities have decided against a resolution fund because of moral hazard concerns and, hence, revenues go to the budget. Many proponents of the bank levy argue that it could be designed as a Pigouvian tax that would serve as a macro-prudential tool to discourage risky activities (Keen, 2011; Devereux, 2012). To this end, in the UK and Germany, the tax is levied on volatile short term funding, while stable funding, such as equity and deposits are excluded. In France, the tax is levied on the regulatory capital and banks can decrease the amount of the tax only by decreasing their risk. Another motivation behind the current tax proposals is related to possible economic rents enjoyed by the financial sector due to implicit and explicit state guarantees. Additional levies could also offset tax distortions due to the fact that financial services are exempt from VAT and lend themselves to fiscal optimization (Huizenga, 2002).

As these new taxes have been introduced as recently as 2009-2011, to our knowledge, our paper is the first attempt to analyze their incidence. In other words, we are interested whether bank levies are shifted to borrowers in terms of higher intermediation costs. This question is important, because imposing a tax on banks does not mean that banks will ultimately pay as they could pass on the burden of the new tax to their customers by raising interest rates on loans. Moreover, tax incidence could depend on the loan type; borrowers that are "locked-in", such as small firms and households, might bear the largest tax burden.

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¹ See good discussion about objectives and design of a bank levy by European Commission (2010) and International Monetary Fund (2010).

² The term levy encompasses taxes and fees. A tax is a financial charge that is imposed upon a bank by the state and whose revenues go to the budget. In contrast, revenues from a fee go to a specialized fund, such as deposit insurance or bank resolution fund. In the present paper, we use words levy and tax interchangeably.

Our paper is related to a small literature on the incidence of the banking taxation. However, none of the earlier papers deal with taxes on balance sheets but, rather, with existing corporate income taxes. Only two papers address the question of incidence of corporate income tax theoretically. Albertazzi and Gambacorta (2010) and Caminal (2003) show that the corporate income tax can have an impact on lending rates if it increases the cost of equity. The empirical literature is only slightly larger. Demirgüç-Kunt and Huizinga (1999, 2001) and Chiorazzo and Milani (2011) analyze bank-level data for a large number of countries and find that corporate income taxes are passed on to banks' customers by increasing net interest margins. Albertazzi and Gambacorta (2010) analyze aggregated data for OECD countries and come to a similar conclusion. In contrast to these findings, Capelle-Blancard and Havrylchyk (2013) argue that corporate income tax is *not* shifted forward to customers, because it does not affect the maximization function of banks. They replicate earlier empirical findings to show that they are driven by endogeneity problems related to simultaneity bias and, once, the problem is addressed, the pass-through cannot be found.

The above studies do not allow us evaluating incidence of new bank levies, because tax incidence depends on the tax base. We believe that our study provides the first analysis of the incidence of a balance sheet levy. First, we explain how a bank levy can be analyzed in the framework of an oligopolistic version of the Monti-Klein model, according to which the incidence of a tax levied on bank loans is negatively correlated with elasticity of credit demand and, hence, is positively correlative with banks' market power. Following Berg and Kim (1998), we assume that banks are multiproduct oligopolies and have substantial market power in the retail market but not over customers in the corporate market.

We test model implications with the data on the Hungarian banking sector. This country has been chosen for a number of reasons. First, Hungary was one of the first countries to put in place a bank levy in 2010. As its rate is the highest in the world, it has more than tripled banks' tax burden. Second, the levy is much higher for large institutions than for small ones and this heterogeneity allows relying on difference-in-difference methodology to disentangle the impact of the tax from any other shock that might have occurred simultaneously. Finally, the Hungarian Central Bank provides access to confidential bank-level data that allows an analysis of interest rates separately for firms and households. Hence, we are able to test model's prediction that customers with smaller elasticity of credit demand will bear higher tax burden than more mobile customers.

To preview our results, we find that banks have succeeded to shift the tax burden fully to their customers by increasing the cost of intermediation. However, not all borrowers have seen their interest rates rise. We demonstrate that only households with outstanding loans have seen their interest rates go up, reflecting their low elasticity of credit demand. This is plausible given that the Hungarian retail market is characterized by poor level of competition (Havrylchyk, 2012). At the same time, we show that firms and households applying for new loans have not seen their interest rates rise, reflecting a higher elasticity of credit demand.

The rest of the paper is structured as follows. In section 2, we formulate our testable hypotheses and explain how they can be obtained in a simple extension of the Monti-Klein model. Formal derivations for this extension are given in Appendix A. In section 3, we present the description of the Hungarian levy, our econometric identification strategy and dataset. Section 4 presents econometric results. Section 5 concludes and provides policy recommendations.

2 TESTABLE HYPOTHESES

In the aftermaths of the crisis, few models of bank taxation have been proposed. De Nicolò, Gamba and Lucchetta (2012) compare the effects of an increase of corporate income tax rate with those resulting from the imposition of a tax of non-deposit liabilities and show that the latter generate higher government revenues and entail lower efficiency and welfare costs than the former. Masciandaro and Passarelli (2013) and Coulter, Mayer and Vickers (2013) investigate the respective merits of bank taxation and/or regulation. Keen and De Mooij (2012) explore the impact of the differentially favorable tax treatment of debt over equity on the capital structure of financial institutions. These models, which do not focus on tax incidence, do not formalize explicitly the demand for banking services, nor the market structure.

We can analyze tax incidence of a bank levy within the framework of a standard oligopolistic version of the Monti-Klein model (see Freixas and Rochet (2008) for a simple presentation of the model). We now briefly describe how we adapt this model to incorporate a bank tax. More details on the derivations are given in Appendix A.

The standard result of Cournot models is that in equilibrium market power of banks depends on the elasticity of the demand for loans:

$$\frac{r_L(L^*) - \tilde{\gamma}_L}{r_L(L^*)} = \frac{1}{N \varepsilon_L(L^*)},$$

where $r_L(L)$ represents the interest rate borrowers are willing to pay for a given amount of loans L , with $\tilde{\gamma}_L$ the marginal costs that include a tax on assets, N the number of banks, and $\varepsilon_L(L)$ the elasticity of the demand for loans.

To see the impact of a tax on interest rate, we rewrite this equation as:

$$r_L(L^*) = (\gamma_L + \delta - (1 - \rho)r + \tau) / \left(1 - \frac{1}{N \varepsilon_L(L^*)}\right),$$

where γ_L is the cost ratio for loans, δ the ratio of loan loss provision, ρ the ratio for prudential capital requirement, r the interbank market rate and τ a tax ratio on assets.

Then, the sensitivity of interest rates on loans to the changes in a bank tax is as follows:

$$\frac{\partial r_L}{\partial \tau} = \frac{1}{1 - \frac{1}{N \varepsilon_L(L^*)}}$$

Hence, we can make the following proposition:

Proposition: The sensitivity of interest rates on loans to the introduction of a tax on loans depends negatively on the credit demand elasticity.

Low credit demand elasticity confers market power and, hence, banks that enjoy high market power will be able to shift the tax burden to their clients. In this study, we take the approach that the same bank can have different degrees of market power over different types of borrowers. Hence, we propose to estimate econometrically the impact of the tax on different types of loans and borrowers, because different types of loans and borrowers have, *a priori*, different elasticities of credit demand, leading to different market power of banks.

Berg and Kim (1998) model banks as multiproduct oligopolies and show that banks have substantial market power in the retail market but not over customers in the corporate market. They explain this by limited resources of retail customers to search for the best offer in the market, and by important informational asymmetries on the supply side of the market. In contrast, the mobility of customers within the corporate market is potentially much more important. Kim et al. (2003) estimate switching costs and show that they amount to about one-third of the market average interest rate on loans. Importantly, they show that switching costs, and hence the resulting market power, depend on loan size: switching costs are higher for customers with small loans and amount to zero for customers with large loans. Small loans are most often extended to small enterprises and there is an extensive discussion in recent literature about the importance of “relationship banking” in increasing switching costs and, hence, leading to banks’ market power (James, 1987; Vale, 1993; Petersen and Rajan, 1994; Berger and Udell, 1998; Boot, 2000).

Following the above discussion, we assume that Hungarian market of corporate loans is more competitive than the retail market. Moreover, the potential mobility of clients could be high even for small enterprises due to the existence of credit information sharing with positive and negative information. This decreases informational asymmetries on the supply side of the market by allowing firms to signal their creditworthiness to an outside bank (Brown et al., 2009).

In contrast, the Hungarian retail credit market is characterized by low customer mobility due to lack of transparency between various financial services, lack of positive information sharing and high closing charges when borrowers decide to repay their loans early (Havrylchuk, 2012). In addition, during the analyzed period, Hungarian banks were able to unilaterally modify interest rates on outstanding household loans. Such possibility prevents borrower mobility because it becomes useless to switch a bank in order to obtain a lower interest rate if the new bank has the right to unilaterally raise it in the future (Havrylchuk, 2012). This confers a significant market power to banks and allows them to shift taxes not only to new loans but also to outstanding claims. Not surprisingly, Molnár et al. (2007) analyze consumption loans in Hungary and they document very high price-cost margins, suggesting low elasticity of credit demand and high market power of banks.

Hence, we can formulate the following testable hypotheses:

Testable hypothesis 1: Tax incidence is higher for *household* loans than for loans to *non-financial corporations*.

Testable hypothesis 2: Tax incidence is higher for *outstanding* household loans than for *new* household loans.

3. IDENTIFICATION STRATEGY AND DATA

3.1. Description of the Hungarian bank levy

The bank levy has been introduced in Hungary by a law adopted in July 2010 and has been collected since September 2010. The tax base of the levy consists of assets of credit institutions (commercial and cooperative banks) with the exception of interbank assets that are deducted to avoid double taxation. At the moment of the introduction, the tax was presented as a temporary measure, and hence, the tax base was fixed at the amount of assets at 2009. However, very soon the tax became to be perceived as a permanent measure and banks started to expect that the tax base would be changed in the future to reflect changes in assets. Hence, we believe that our model presented in Section 2 accurately reflects the design of the tax.

The levy is determined as 0.15% of the tax base for *small* credit institutions with assets under EUR 185 million and 0.53% of the tax base for *large* institutions. The levy does not take into account the profitability of individual banks, meaning that loss-making institutions must comply as well. In the wake of the crisis, the profitability and the amount of corporate income taxes have declined, but the new bank levy has increased the overall tax burden of Hungarian banks (Figure 1). In particular, the ratio of total taxes paid by large banks has more than tripled from 0.15% of total assets to 0.55%. Although bank levies have been also put in place in other countries, when compared to GDP, the rate of the Hungarian bank tax by far exceeds other levies (Figure 2).

3.2. Methodology

To identify the impact of the tax on lending rates, we rely on the generalized version of the difference-in-difference (DiD) methodology, and, hence we estimate the following econometric model:

$$I_{it} = \alpha_0 + \alpha_1 D_i + \alpha_2 D_t + \alpha_3 Levy_{it} + \alpha_4 X_{it} + \epsilon_{it}, \quad (8)$$

where I_{it} is a measure of intermediation costs for the bank i at time t , D_i is a bank dummy variable, D_t is a time dummy variable, $Levy_{it}$ is a dummy variable that is equal to 1 for large banks after the introduction of the bank levy in July 2010, X_{it} is a vector of bank- and time-varying controls and ϵ_{it} is an error term.

We estimate this model on a sample of commercial and cooperative banks. Our coefficient of interest is α_3 and its positive value would mean that after the introduction of the bank levy interest rates on loans charged by large banks have gone up relative to interest rates charged by small banks. We estimate the equation allowing bank-level clustering of the errors, that is allowing for correlation of the error term over time within banks (Bertrand et al., 2004).

DiD estimation has been often used to analyze the impact of the regulation on banks' behavior because it allows controlling for omitted variable bias (Jayaratne and Strahan, 1996; Beck et al., 2010). The design of the Hungarian bank levy is well suited for this purpose because the authorities have introduced a tax, whose rate is different for large and small banks. Time dummy variables capture all other changes in regulatory and economic environment during

the analyzed period that should have affected large and small banks in a similar manner. Bank dummy variables capture differences between banks that are constant over time. In this way, the DiD methodology allows for differences in intermediation costs charged by large and small banks before the introduction of the bank levy, but its underlying assumption is that these differences would remain constant if the bank levy has not been introduced (“parallel trends” assumption).

The difference-in-difference methodology is supposed to control for any omitted variable bias and hence does not theoretically require control variables. However, one can question whether small banks constitute a good control group. In other words, the assumption that other economic and regulatory changes affect large and small banks in a similar manner might be too strong, because banks might differ in terms of their solvency, liquidity, and risk. Hence, to rule out other time- and bank- varying developments that could have affected large and small banks differently, we add a number of control variables. Following the standard literature on determinants of interest rates and NIM (Claeys and Vander Vennet, 2008; Demirgüç-Kunt and Huizinga, 1999; Hainz and Claeys, 2013; Martinez Peria and Mody, 2004), we include the following variables: costs-to-assets ratio (Cost), logarithm of assets (Size), and a ratio of loan loss reserves to total assets separately for non-financial corporations and for households (LLR).

3.3. Data

To perform estimations, we rely on monthly data on all Hungarian commercial and cooperative banks that has been provided by the Hungarian Central Bank. The dataset contains standard balance sheet and income statement information, as well as confidential information that banks are obliged to report to the central bank, such as interest rates on new and outstanding loans for different types of customers, loan sizes, purposes and currencies. The analysis relies on the period between March 2008 and September 2012, the time around the introduction of the bank levy in 2010.³

The initial database contains all Hungarian commercial and cooperative banks. We exclude foreign development banks, export-import bank and home saving associations, because their business models differ substantially from other banks. We also exclude banks that do not have data both before and after the introduction of the levy, because we rely on difference-in-difference approach that compares lending rates between these two periods. For all variables used in the analysis (with the exception of bank size), we drop observations that are below 1 or above 99 percentiles to ensure that our results are not driven by outliers. The resulting dataset contains 36 commercial and 152 cooperative banks. As mentioned earlier, the rate of the bank levy is different for large banks (whose assets exceed EUR 185 million) and small banks. In our sample, 24 commercial and 4 cooperative banks are classified as large.

To measure banks’ interest setting policy, we create a number of dependant variables. First of all, we compute net interest and fee margin (NIFM)⁴. This variable has been used in previous studies on tax incidence of banks’ taxes. However, NIFM is influenced by loan composition

³ The lower bound of this period has been chosen because frequent changes in data definition do not allow constructing continuous time series with the earlier data.

⁴ We are not able to separate interest margin from fee margin, because the structure of loan pricing has changed over time: banks charge more interests and less fees.

and loan arrears, and hence, does not directly reflect banks' pricing strategy. This is why we also rely directly on interest rates for different types of loans:⁵

- a. New small loans to non-financial corporations (NFC) denominated in HUF
- b. New small loans to non-financial corporations (NFC) denominated in foreign currency
- c. New housing loans to households denominated in HUF
- d. New consumption loans to households denominated in HUF
- e. Outstanding housing loans to households denominated in HUF
- f. Outstanding housing loans to households denominated in foreign currency
- g. Outstanding consumption loans to households denominated in HUF
- h. Outstanding consumption loans to households denominated in foreign currency

Three important remarks should be made. *First*, we do not analyze the impact of the tax on large loans to non-financial corporations, because small banks issue few large loans and, hence, comparison of large loans between large and small banks is not appropriate. *Second*, we analyze interest rates on new housing and consumption loans only in domestic currency, because housing and house equity loans (the latter are part of consumption loans) in foreign currency were virtually banned in 2010, making our DiD approach unreliable for these types of interest rates. *Third*, for the case of household loans, we analyze interest rates not only for new loans, but also for outstanding contracts, because, as it was mentioned above, the Hungarian regulatory environment allowed banks to unilaterally modify interest rates on outstanding loans for households.

Exact variable definitions and descriptive statistics for all variables are provided in Table 2. In Figure 3, we provide figures that show the parallel evolution of net interest and fee margin (NIFM) and interest rates, separately for large and small banks. The figure for NIFM (Panel A) shows that margins charged by large banks were lower than margins charged by small banks, but since the introduction of the bank levy this difference has become smaller. Importantly, the figure shows that before the crisis, margins of large and small banks exhibit parallel trends, albeit NIFM of smaller banks is much more volatile than that of large banks. The observation of such parallel trends before introduction of the tax allows us to make a counterfactual assumption that interest rates would preserve these trends if the tax was not applied. Next, we look at interest rates on loans to non-financial corporations (Panel B and C) and households (Panels D-I). For households, we distinguish between housing and consumption loans. When possible, interest rates are presented separately in foreign currency and in Hungarian forint. For households, for reasons explained in Section 3.3, we present interest rates separately for new loans and outstanding loans. The assumption of parallel trends appears to be largely confirmed for all types of borrowers.

⁵ Unfortunately, the data on fees and commissions is not reported separately for different types of borrowers.

4. EMPIRICAL RESULTS

Table 3 presents results estimated on the sample of commercial banks performed with control variables. Results are reported for several dependent variables. In the first column, we report results regarding the incidence of the bank levy on net interest and fee margin (NIFM). Our findings suggest that, after the introduction of the tax, intermediation margins of large banks have significantly increased relatively to small banks. In other words, we find evidence of tax shifting by banks to their customers. Our results are not only statistically significant, but also economically meaningful. On an annual basis, our findings suggest that the introduction of the bank tax has increased the annual NIFM of large banks by 0.84 percentage points (0.07*12 months) relative to small banks.⁶

Although the NIFM captures the overall intermediation costs, it does not always reflect the interest rate setting policy of banks. First, it is affected by non-repayment of loans that reduce interest income. Second, it can change because the composition of banks' portfolio changes. Finally, it does not allow differentiating between incidences of the bank levy for different customers. To address these problems, we present results for interest rates on loans to non-financial corporations and households (housing and consumer). When applicable, results are presented for new and outstanding loans, as well as in domestic and foreign currency.

Our findings indicate that, in response to the introduction of the bank levy, large banks raise interest rates only for certain categories of borrowers. There is no impact on loans to small loans. Concerning loans to households, we show that banks do not raise interest rates on *new* loans, but instead they raised interest rates on *outstanding* loans for housing loans. In contrast, interest rates are not raised for consumption loans. Our findings suggest that after the introduction of the bank levy, large banks have raised interest rates on housing loans in Hungarian forint and foreign currency by 108 and 57 basis points, respectively. Theoretically, this means that these borrowers have low elasticity of credit demand, resulting in high market power of banks. This result is not surprising in the light of the possible unilateral modification of existing loan conditions for outstanding loans for retail customers, discussed in section 3.3.

Tables 4 and 5 present robustness tests. Table 4, we include cooperative banks. On the one hand, this increases number of observations and provides us with a larger control group. On the other hand, the control group is less homogeneous and, moreover, this estimation doesn't allow us to control for Tier 2 capital ratio, because cooperative banks started to report capital ratios only recently. This could bias our results downward if this new regulatory cost was shifted to customers. Indeed, our main findings remain robust, but the magnitude of coefficients is smaller and we even find a negative impact of the bank levy on loans to non-financial corporations in forint. Finally, Table 5 presents results without control variables to show that our findings are not sensitive to the exclusion of control variables.

5. CONCLUSIONS AND POLICY IMPLICATIONS

Our paper is the first attempt to analyze tax incidence of new bank levies that have been introduced in many countries in the wake of the crisis and whose tax base consists of some elements of banks' balance sheets. We explain how within the framework of an oligopolistic version of the Monti-Klein model, banks shift taxes to borrowers with the lowest demand

⁶ Since difference-in-difference methodology relies on the comparison between large and small banks, the increase can be larger if small banks have increased their interest rates as well, a plausible assumption.

elasticity. To test model predictions, we rely on difference-in-difference methodology to estimate the incidence of the bank levy on banks' assets of Hungarian banks.

Our paper produces the following results. First, we show that banks are able to shift the tax burden to their customers by raising interest and fee margins. Second, banks raise interest rates only for borrowers over whom they exercise market power, that is only for borrowers with the lowest credit demand elasticity. For the Hungarian case, we show that only households that already have an outstanding mortgage with a bank are affected, whereas non-financial corporations and households that sign a new loan contract are not affected.

In our view, there are a number of policy measures that can enhance competition by increasing borrower mobility in Hungary. First, banks should be obliged to provide simple loan conditions that are easily comparable between banks in order to increase transparency. Second, switching costs should be lowered by reducing closing charges for repaying a loan earlier. Third, credit bureaus should collect negative and positive information to decrease informational asymmetries between inside and outside bank and improve borrower mobility. Finally, what is the most important in the Hungarian context (but less so in other countries), banks should be forbidden to change loan conditions unilaterally on loans with fixed interest rates (Havrylchuk, 2012).

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Table 1. Examples of new levies on the financial sector’s balance sheets

	France	Hungary	Austria	Germany	Sweden	United Kingdom	United States
Start date	2011	2010	2011	2011	2009	2011	..
Funds raised contribute to	Treasury	Treasury	Treasury	Banking Fund	Banking Fund	Treasury	Funds to recoup costs of TARP
Tax base	Minimum own funds required to comply with capital requirements	Total assets. Interbank loans and securities of credit institutions are excluded	Balance sheet. Insured deposits and capital are excluded	Liabilities. Non-bank liabilities and equity are excluded	Liabilities with some exceptions	Liabilities. Insured deposits and Tier 1 capital are excluded	Liabilities. Tier 1 capital and FDIC-assessed deposits are excluded
Threshold	500 mln EUR of minimal own funds	None	Tax base of EUR 1 billion	None	None	GBP 20 billion of “relevant” liabilities	USD 50 billion of consolidated assets
Rate	0.25% of own funds	0.15-0.53%	0.055-0.085%	0.02-0.04%	0.036%, but reduced rate for 2009-10. Could depend on risk in the future	0.07%. 50% tax rate for “stickier funding” (>1 year maturity)	Not set but expected 0.15% of

Source: KPMG International Cooperative.

Table 2. Descriptive statistics for Hungarian commercial and cooperative banks (monthly data)

	Variable definition	Obs	Mean	S.Dev	Min	Max
<u>Dependant variables</u>						
NIFM	Interest and fee revenue minus interest and fee expenses divided by total assets (in %).	9156	0.50	0.20	0.09	1.65
NFC in HUF	Average interest rate on small loans in Hungarian forint to non-financial corporations (in %).	3,089	11.52	2.04	3.75	19.45
NFC in FX	Average interest rate on small loans in foreign currency to non-financial corporations (in %).	1,018	5.77	1.96	0.77	13.50
Housing in HUF (new)	Average interest rate on new housing loans in Hungarian forint to households (in %).	2,610	12.09	3.08	0.11	28.88
Consumption in HUF (new)	Average interest rate on new consumption loans in Hungarian forint to households (in %).	3,350	17.21	5.09	3.38	38.55
Housing in HUF (outstanding)	Average interest rate on outstanding loans in Hungarian forint to households (in %).	3,579	10.73	2.76	0.25	22.58
Consumption in HUF (outstanding)	Average interest rate on outstanding consumption loans in Hungarian forint to households (in %).	3,656	14.70	3.23	0.50	28.97
Housing in FX (outstanding)	Average interest rate on outstanding loans in foreign currency to households (in %).	2,488	5.49	1.52	1.75	10.98
Consumption in FX (outstanding)	Average interest rate on outstanding consumption loans in foreign currency to households (in %).	2,612	6.62	1.90	0.32	14.65
<u>Independent variables</u>						
Cost	Overhead costs divided by total assets (in %).	9,156	0.15	0.09	0.00	0.53
Capital	Tier 1 capital divided by total risk-weighted assets (in %).	1,409	17.67	9.08	8.11	84.92
LLR NFC	Loan loss reserves accumulated for loans to non-financial corporations (in %).	9,156	8.70	7.36	0.00	46.47
LLR HH	Loan loss reserves accumulated for loans to households (in %).	9,156	7.12	4.33	0.00	20.05

Source: Hungarian Central Bank and authors' calculations.

Table 3. The impact of the bank levy on interest and fee margins (commercial banks only)

The table presents estimates of the impact of the bank levy on the Hungarian banks' intermediation cost. Estimation is performed by relying on difference-in-difference methodology. Bank and time dummies are included. Time period: March 2008 - September 2012. Data on all Hungarian commercial banks has been provided by the Hungarian Central Bank. Standard errors are clustered at the bank level and are presented in parentheses.

Dep. Variable	NIMF		Average interest rate						
	Customers	All	NFC		Households				
Type of loans	All loans	Small loans		Housing loans		Consumption loans			
Currency	All	HUF	FX	New loans	Outstanding loans		New loans	Outstanding loans	
				HUF	HUF	FX	HUF	HUF	FX
Levy	0.07** (0.03)	0.02 (0.339)	-0.08 (0.608)	-0.25 (0.61)	1.08** (0.52)	0.57** (0.25)	0.81 (1.23)	1.29* (0.74)	-0.27 (0.29)
Size	-0.11* (0.06)	-0.96 (0.92)	-0.62 (1.43)	-1.07 (1.45)	-0.28 (0.60)	0.09 (0.48)	-0.25 (0.93)	-2.58** (1.26)	-0.01 (0.76)
Capital	0.01** (0.00)	-0.00 (0.01)	-0.02 (0.02)	-0.02 (0.04)	-0.03* (0.02)	0.01 (0.01)	0.00 (0.03)	0.05 (0.03)	0.01 (0.02)
Cost	0.03 (0.11)	-1.23 (1.46)	-0.41 (3.51)	-4.29 (3.48)	5.75 (3.72)	1.38 (1.86)	-0.34 (6.60)	1.69 (4.47)	0.67 (1.76)
LLR NFC	-0.00 (0.00)	-0.02 (0.02)	0.05 (0.07)						
LLR HH	0.00 (0.00)			0.07 (0.05)	0.01 (0.05)	-0.04 (0.03)	-0.04 (0.12)	0.08 (0.11)	-0.05 (0.05)
Constant	1.69** (0.74)	22.04* (11.75)	12.53 (18.68)	23.76 (19.84)	11.59 (7.630)	4.59 (6.15)	22.21* (11.74)	43.48** (16.03)	7.47 (9.79)
R ²	0.15	0.73	0.27	0.40	0.36	0.20	0.22	0.27	0.09
Nb. Obs.	1,409	1,055	663	1,010	1,317	1,106	1,160	1,393	1,096
Nb. Banks	33	31	26	31	33	28	35	34	29

*, **, and *** indicate significance levels at 10%, 5%, and 1%, respectively.

Table 4. Robustness. The impact of the bank levy on interest and fee margins (commercial and cooperative banks)

The table presents estimates of the impact of the bank levy on the Hungarian banks' intermediation cost. Estimation is performed by relying on difference-in-difference methodology. Bank and time dummies are included. Time period: March 2008 - September 2012. Data on all Hungarian commercial and cooperative banks has been provided by the Hungarian Central Bank. Standard errors are clustered at the bank level and are presented in parentheses.

Dep. Variable	NIMF		Average interest rate						
	All	NFC	Households			Consumption loans			
Customers	All	NFC	Housing loans		Households		Consumption loans		
Type of loans	All loans	Small loans	New loans	Outstanding loans	New loans	Outstanding loans	New loans	Outstanding loans	
Currency	All	HUF	FX	HUF	HUF	FX	HUF	HUF	FX
Levy	0.02 [*] (0.01)	-0.49 ^{***} (0.19)	-0.16 (0.39)	-0.22 (0.34)	0.57 ^{**} (0.23)	0.44 ^{**} (0.21)	0.61 (0.58)	0.55 (0.36)	0.04 (0.24)
Size	-0.07 ^{**} (0.03)	-0.54 (0.45)	-0.03 (0.80)	0.19 (0.64)	-0.15 (0.35)	0.57 (0.42)	-0.88 (0.73)	-2.06 ^{**} (0.85)	-0.10 (0.61)
Cost	0.32 ^{***} (0.04)	0.39 (0.43)	-0.03 (1.50)	0.63 (1.24)	0.72 (0.88)	0.33 (0.73)	0.05 (1.56)	0.38 (0.91)	0.70 (0.60)
LLR NFC	-0.00 (0.00)	-0.01 (0.01)	0.03 (0.04)						
LLR HH	-0.01 [*] (0.00)			0.11 ^{***} (0.04)	0.05 (0.03)	0.03 (0.03)	0.07 (0.07)	0.09 (0.07)	0.01 (0.04)
Constant	1.15 ^{***} (0.27)	16.98 ^{***} (4.93)	6.54 (9.65)	8.77 (7.23)	11.82 ^{***} (3.66)	-1.18 (4.55)	26.17 ^{***} (7.94)	35.83 ^{***} (9.12)	7.72 (6.63)
R ²	0.20	0.56	0.22	0.28	0.54	0.05	0.15	0.30	0.06
Nb. Obs.	9,156	3,089	1,018	2,610	3,579	2,488	3,350	3,656	2,612
Nb. Banks	185	79	59	79	81	62	83	82	67

^{*}, ^{**}, and ^{***} indicate significance levels at 10%, 5%, and 1%, respectively.

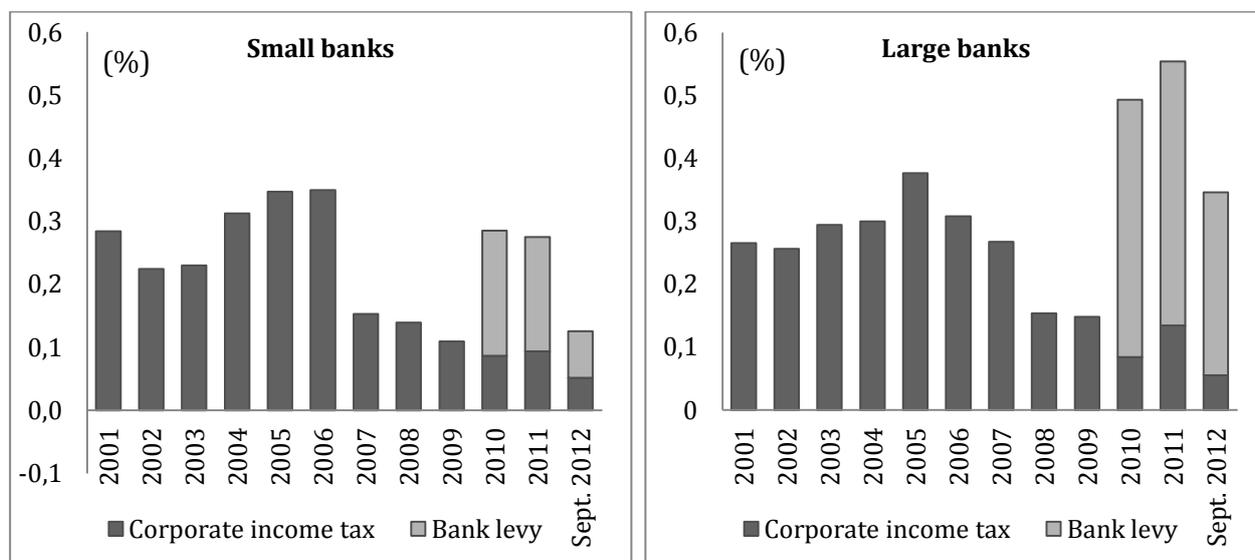
Table 5. Robustness. The impact of the bank levy on interest and fee margins (without control variables)

The table presents estimates of the impact of the bank levy on the Hungarian banks' intermediation cost. Estimation is performed by relying on difference-in-difference methodology. Bank and time dummies are included. Time period: March 2008 - September 2012. Data on all Hungarian commercial and cooperative banks has been provided by the Hungarian Central Bank. Standard errors are clustered at the bank level and are presented in parentheses.

Dep. Variable	NIMF		Average interest rate						
	Customers	All	NFC		Households				
Type of loans	All loans	Small loans		Housing loans		Consumption loans			
Currency	All	HUF	FX	New loans	Outstanding loans		New loans	Outstanding loans	
				HUF	HUF	FX	HUF	HUF	FX
Levy	0.03** (0.01)	-0.47*** (0.17)	-0.07 (0.34)	-0.01 (0.37)	0.74*** (0.25)	0.38* (0.21)	0.66 (0.55)	0.64 (0.44)	0.02 (0.27)
Constant	0.49*** (0.007)	11.16*** (0.17)	6.22*** (0.26)	11.39*** (0.24)	10.46*** (0.12)	5.21*** (0.23)	17.11*** (0.44)	14.00*** (0.21)	6.76*** (0.22)
R ²	0.16	0.56	0.21	0.27	0.53	0.03	0.14	0.24	0.05
Nb. Obs.	9,582	3,141	1,034	2,685	3,728	2,589	3,505	3,811	2,727
Nb. Banks	188	79	59	79	81	63	83	83	68

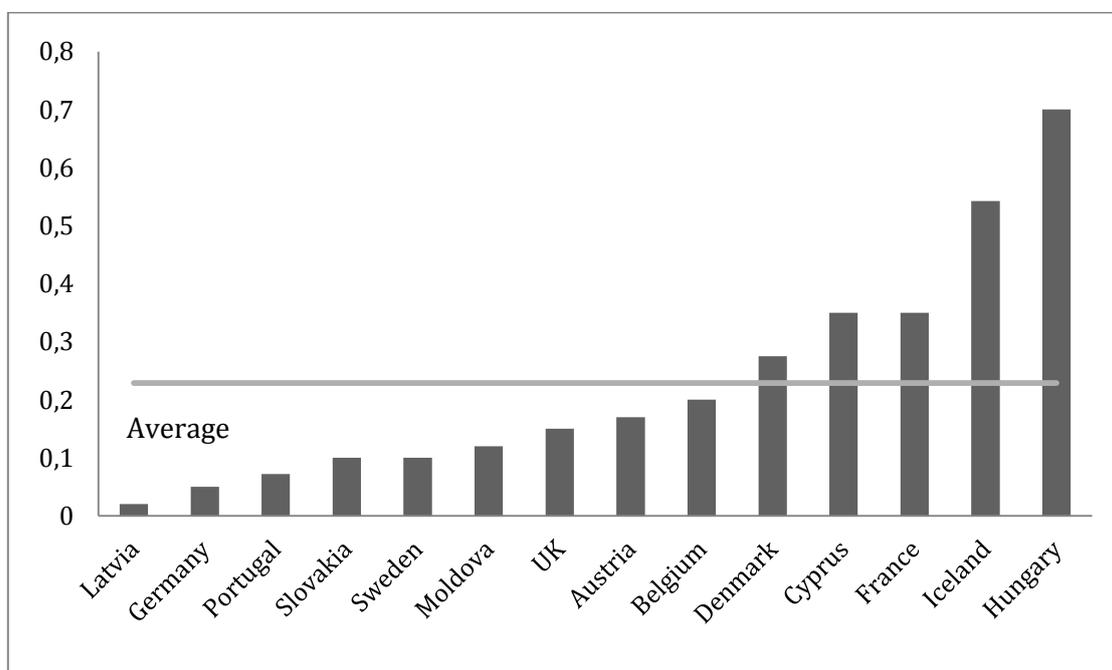
*, **, and *** indicate significance levels at 10%, 5%, and 1%, respectively.

Figure 1. The ratio of bank taxes (corporate income tax and bank levy) to total assets



Source: MNB data and authors' calculations.

Figure 2. Expected revenue from existing financial sector taxes (in % of GDP)



Source: IMF.

Figure 3. Banks' average net interest and fee margins and lending rates

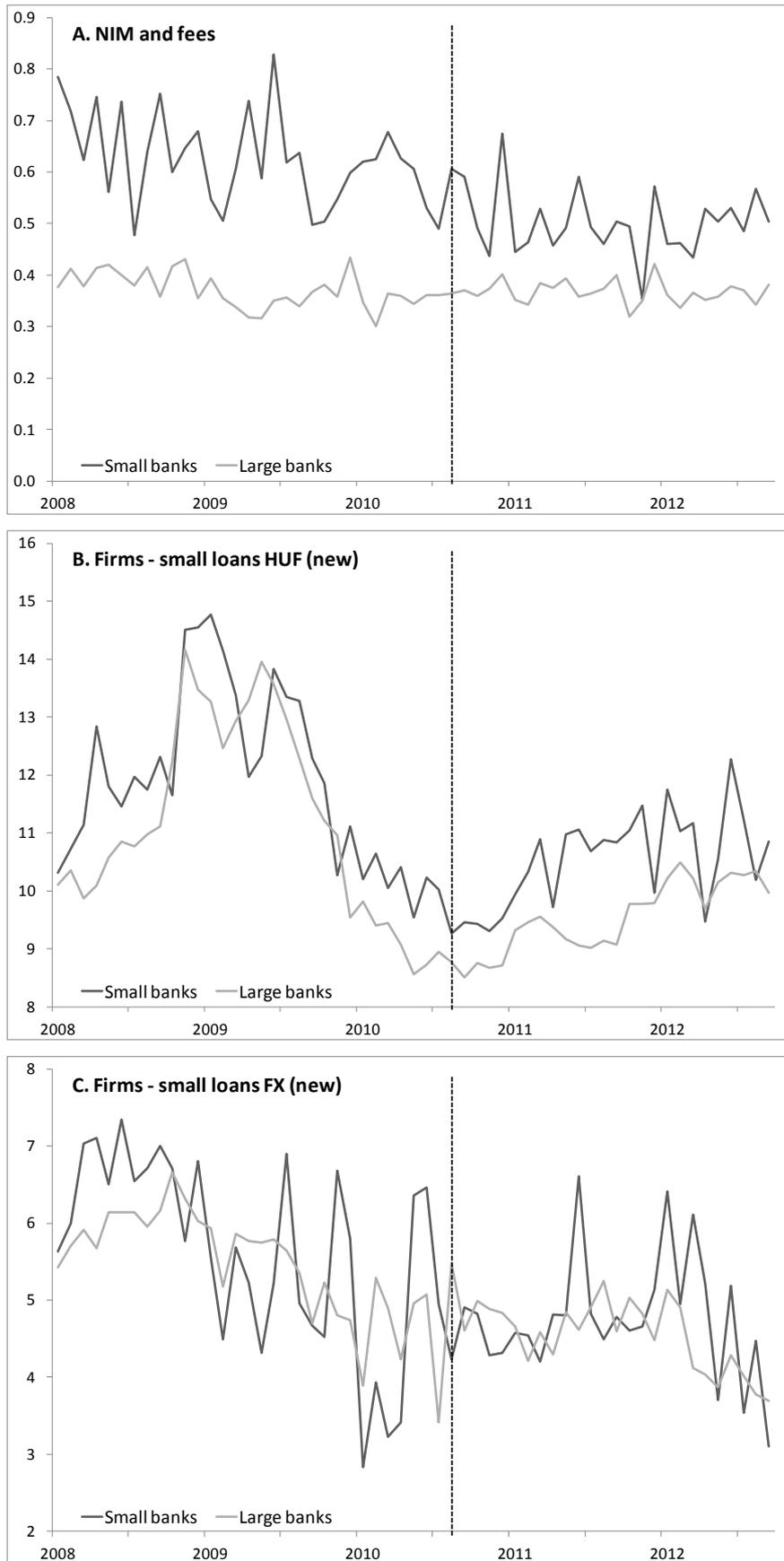


Figure 3. Banks' average net interest and fee margins and lending rates (continued)

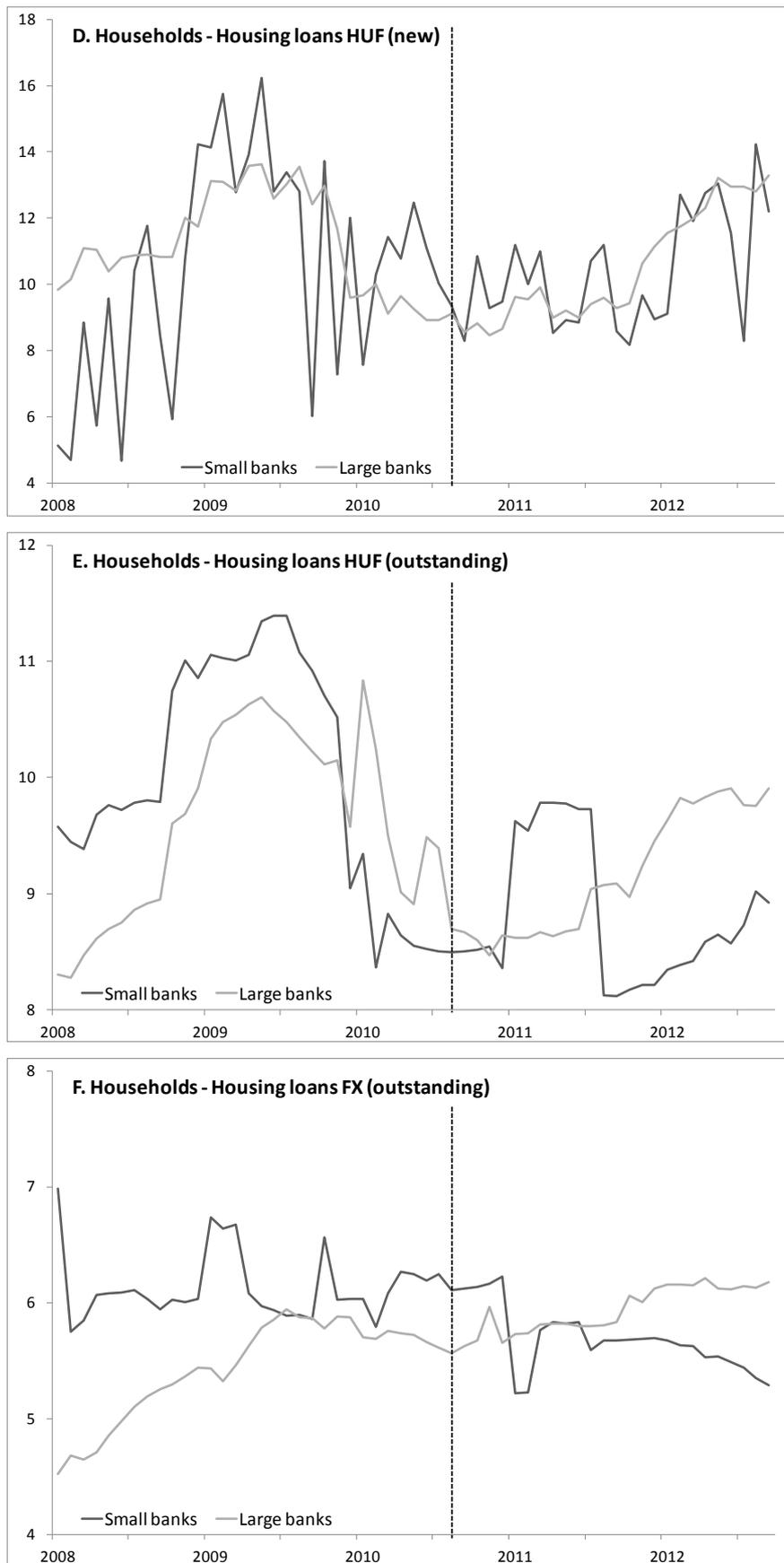
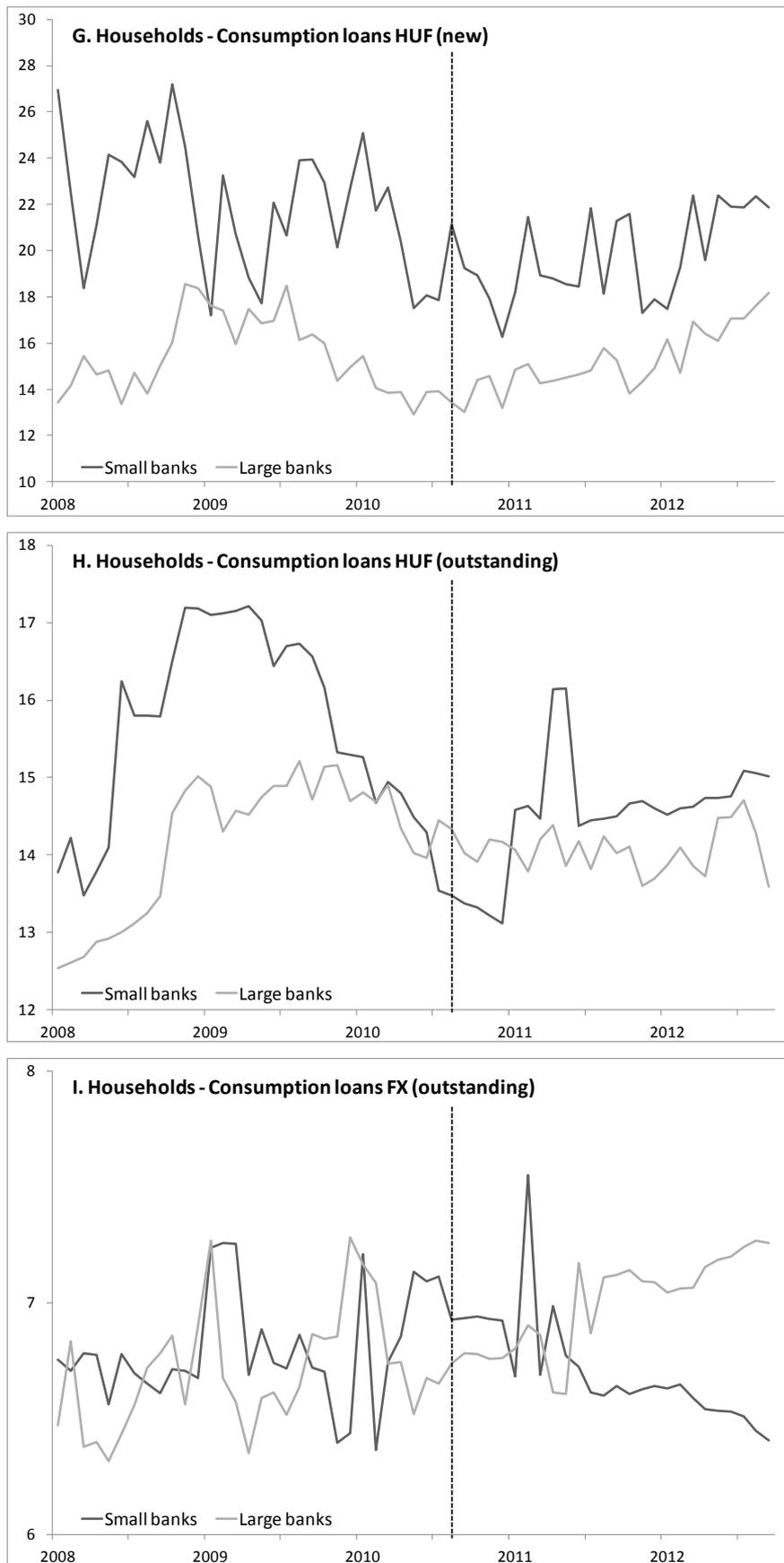


Figure 3. Banks' average net interest and fee margins and lending rates (continued)



Note: The horizontal line indicates the introduction of the bank levy.

APPENDIX

THE EXTENTION OF THE MONTI-KLEIN MODEL THAT INCLUDES A TAX ON BANK ASSETS

The economy is populated by N identical banks (indexed by $n = 1, \dots, N$). For a typical bank, assets comprise loans, L_n , plus net interbank assets, M_n , while liabilities include deposits, D_n , and equity, E_n . Thus, the balance sheet constraint is given by:

$$L_n + M_n = D_n + E_n \quad (1)$$

Banks face a downward-sloping demand for loans $L(r_L)$ and an upward-sloping supply of deposits $D(r_D)$. As usual, we consider the inverse functions: $r_L(L)$ represents the interest rate borrowers are willing to pay for a given amount of loans and $r_D(D)$ the interest rate required by households to supply a given amount of deposits. Moreover, banks propose fee-generating services; similarly, the inverse demand function is noted $f(S)$ where S is the quantity and f are the fees. On the income side, the first derivatives are assumed to be negative⁷, $r'_L(L) < 0$ and $f'(S) < 0$, whereas on the expenditure side $r'_D(D) > 0$. M_n is positive when the bank n lends at the rate r on the interbank market and we assume that this rate is given, either because it is fixed by the Central Bank or because it is determined on the international capital market. The prudential regulation imposes that the amount of equity should be, at least, equal to a given fraction $0 < \rho < 1$ of loans. As usual, we assume that the prudential capital requirements are binding, that is $E_n = \rho L_n$. We also consider that provisions are a constant fraction $0 < \delta < 1$ of loans.

Each bank n maximizes its profits and chooses the amount of loans, L_n , the amount of deposits, D_n , and the amount of fee-generating services, S_n . The cost function is the same for each bank which is assumed to be linear and separable with γ_D , γ_L , and γ_S are all positive parameters:

$$C_n = \gamma_D D_n + \gamma_L L_n + \gamma_S S_n, \quad (2)$$

Assume now that the government imposes a specific tax on one element of banks' assets or liabilities. Note that a tax on profit, like the corporate income tax (CIT), will not have any effect in this framework, as it does not change the maximization program of the banks. The profit function for the bank n is therefore:

$$\pi_n = r_L(L) L_n - r_D(D) D_n - r M_n + f(S) S_n - \delta L_n - C_n - Tax_n \quad (3)$$

We consider a model of competition à la Cournot, where each bank n takes the strategy of the other banks $m \neq n$ as given. We note $L_{-n} = \sum_{m=1, m \neq n}^N L_m$, $D_{-n} = \sum_{m=1, m \neq n}^N D_m$, $S_{-n} = \sum_{m=1, m \neq n}^N S_m$ and $L = L_n + L_{-n}$, $D = D_n + D_{-n}$, $S = S_n + S_{-n}$.

⁷ Albertazzi and Gambacorta (2010) also consider an adapted version of the Monti-Klein model, but the aim of their paper is to examine the impact of a change in the corporate income tax rate. Statutory corporate tax apply to all firms, consequently, a change in the tax rate may impact the inverse demand functions for loans and fee-generating services. Indeed, for a higher corporate income rate, fewer investment projects have a positive net present values, so the demand for loans and fee-generating services will decrease. This effect is not considered here since we focus on a sector-specific bank tax.

Hence, the maximization problem can be written as:

$$\max_{L_n, D_n, S_n} \{\pi_n = r_L(L)L_n - r_D(D)D_n - rM_n + f(S)S_n - \delta L_n - C_n - Tax_n\} \quad (4)$$

Here, we are concerned by a tax $0 < \tau < 1$ on loans, as the one designed by the Hungarian government: $Tax_n = \tau L_n$. Combining and simplifying the previous equations, we obtain:

$$\max_{L_n, D_n, S_n} \{\pi_n = (r_L(L) - \tilde{\gamma}_L)L_n - (r_D(D) - \tilde{\gamma}_D)D_n + (f(S) - \gamma_S)S_n\} \quad (5)$$

with $\tilde{\gamma}_L = \gamma_L + \delta - (1 - \rho)r + \tau$ and $\tilde{\gamma}_D = \gamma_D + r$.

In such model, there is a unique equilibrium in which each bank sets the following optimal quantities: $D_n^* = \frac{D^*}{N}$, $L_n^* = \frac{L^*}{N}$, $S_n^* = \frac{S^*}{N}$.

The resolution of the maximization problem is then straightforward. First-order conditions state that marginal revenues equate marginal costs.

Using the elasticities of the demand for loans, $\varepsilon_L = -r_L L'(r_L)/L(r_L)$, and fee-generating services, $\varepsilon_S = -fS'(f)/S(f)$, and the elasticity of the supply of deposits, $\varepsilon_D = r_D D'(r_D)/D(r_D)$ with $\varepsilon_L, \varepsilon_D, \varepsilon_S > 0$, we obtain⁸:

$$\frac{r_L(L^*) - \tilde{\gamma}_L}{r_L(L^*)} = \frac{1}{N\varepsilon_L(L^*)} \quad (6a)$$

$$\frac{r_D(D^*) - \tilde{\gamma}_D}{r_D(D^*)} = \frac{1}{N\varepsilon_D(D^*)} \quad (6b)$$

$$\frac{f(S^*) - \gamma_S}{f(S^*)} = \frac{1}{N\varepsilon_S(S^*)} \quad (6c)$$

As usual in standard Cournot models, the equilibrium depends on the elasticity of the demand for loans and fee-generating services, and the elasticity of the supply of deposits. Number of banks matters as well: \therefore , when $N \rightarrow \infty$, marginal revenues converge to the adjusted marginal costs. Concerning the effect of a tax, note that since the cost function is supposed to be linear, the optimal quantity of loans, L_n^* , deposits, D_n^* , and fee-generating services, S_n^* , are chosen independently. As a consequence, a tax on loans has no influence on the market for deposit and fee-generating services.

To see the impact of a tax on interest rate, we rewrite (eq. 6a) as:

$$r_L(L^*) = (\gamma_L + \delta - (1 - \rho)r + \tau) / \left(1 - \frac{1}{N\varepsilon_L(L^*)}\right)$$

and then:

$$\frac{\partial r_L}{\partial \tau} = \frac{1}{1 - \frac{1}{N\varepsilon_L(L^*)}} \quad (7)$$

⁸ As usual we assume that elasticities are greater than 1; otherwise the bank's problem may not have a solution.

Given that the cost function is supposed to be linear, $\frac{\partial r_D}{\partial \tau} = \frac{\partial f}{\partial \tau} = 0$, so the sensitivity of interest rates to the introduction of a tax on loans τ is simply $\partial r_L / \partial \tau$. Therefore, we obtain two intuitive results. First, the tax pass-through depends on N , which is a proxy for the intensity of competition ($N = 1$ may be interpreted as pure cartelization or monopoly, whereas $N = +\infty$ corresponds to perfect competition). Second, the tax pass-through depends on demand elasticity and, hence, banks will shift their bank levy to customers in less elastic markets. In our paper, we measure empirically the second impact. As the number of banks has remained virtually constant during the analyzed period, we cannot measure the impact of bank competition, measured by number of banks.