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*The analyses, opinions and findings of these papers represent the views of the authors,
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Counterfactual Analysis of Bank Mergers*

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Abstract

Estimating the impact of bank mergers on credit granted and on interest rates requires a framework that allows to disentangle the effect of changes in market structure generated by mergers from the effects arising from changes in banks' operating environment. However, most of the literature on the impact of bank mergers relies on a simple differential analysis of the relevant variables. We propose a new methodology. It relies on the estimation of a structural model of the credit market. Using this model we are able to derive a counterfactual scenario, considering the pre-merger market equilibrium together with the post-merger environment. The counterfactual analysis makes possible to take into account changes in market structure and conduct, which could affect the results if neglected. We analyze separately two segments of the credit market (households and firms) and take into account two groups of institutions (those that were directly involved in mergers and those that were not). We find that mergers increased the total amount of credit granted to the corporate sector, but had negative impacts on households' access to credit. Moreover, we find that mergers led to a widespread decrease in interest rates.

JEL codes: G21; G34; L10.

Keywords: banks, mergers, competition.

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1 Introduction

In this paper we analyze the effects bank mergers exert on market structure and credit conditions. The conventional approach employed in the literature relies on the comparison of market characteristics before and after the mergers, overlooking changes in market structure in the post-merger industry equilibrium. For example, in order to evaluate the ex-ante potential impact of mergers, competition authorities usually conduct merger simulation analysis¹. In this paper, we present a methodology that allows overcoming this gap in the evaluation of merger impact. By deriving a structural model for the credit market, we are able to perform a counterfactual analysis of mergers, combining the pre-merger equilibrium setting with characteristics of the post-merger environment. Using this procedure we are able to estimate loan flows and interest rates that would be observed if the pre-merger equilibrium was not altered, i.e., if mergers had not occurred. By conducting this analysis, we are able to obtain more accurate estimates of the impact of mergers, given that we are able to take into account the effects associated with changes in conduct and market structure after the mergers take place. These effects are usually ignored in the assessment of merger impact and can lead to a significant bias in the results obtained. Moreover, we are able disentangle the effect of changes in the exogenous environment from changes in market structure resulting from the mergers. Hence, this methodology can be an important additional tool for competition authorities when assessing the impact of mergers, allowing for the estimation of what would have happened if a merger had not taken place.

We apply the proposed methodology to a detailed dataset with unique characteristics. This dataset covers a banking system which went through a wave of mergers, thus constituting an ideal lab to estimate a counterfactual scenario. Our dataset allows to investigate the merger impact on firm and household bank loans separately². Moreover, we are able to analyze the merger effects on both the merged banks and on those banks outside the merging circles,

¹See, for instance, Epstein and Rubinfeld (2000) or, for a more recent approach, Goppelsroeder et al (2008).

²Beck et al (2009) provide evidence regarding the importance of analyzing household and firm loans separately.

taking into account changes in the post-merger market structure. Furthermore, we analyze the resulting changes in local market structure by modelling the effects of changes in local market structure on the aggregate industry configuration.

There is a large literature on the gains banks obtain from merging. For instance, Focarelli et al (2002) find that mergers increase return on equity, but they also lead to a rise in staff costs. In turn, they find that acquisitions generate a long-term reduction in lending, mainly for small firms, and a permanent decrease in bad quality loans, which positively affects long-run profitability. Focusing on European mergers, Altunbas and Marqués (2008) find that improvements in banks' performance subsequent to mergers are more significant if there are strategic similarities between the merging banks. Mergers also generate important changes in market structure, as discussed in Berger et al (2004), Cerasi et al (2010) or in Gowrisankaran and Holmes (2004). Some authors also find that mergers may enhance cost reduction and improve resource allocation³. Moreover, mergers may generate informational gains, which improve banks' screening abilities and customer discrimination (see, for instance, Hauswald and Marquez (2006) or Panetta et al (2009)). In turn, Beck et al (2006) show that bank mergers may have implications on financial stability

It is also important to assess the impact of bank mergers on customers with varying characteristics. Several authors conclude that bank mergers may negatively affect borrowers, most notably if they are small and medium size firms, dependent on bank funding and with a limited number of bank relationships. For instance, Bonaccorsi di Patti and Gobbi (2007) find that, for a sample of Italian firms, bank mergers have a negative effect on credit, particularly if the lending relationship comes to an end after the merger, even though this effect should persist only during the three years after the merger. However, this negative effect is not sufficient to generate a negative impact on firms' investment or cash-flow sensitivity. Other authors find mixed evidence regarding the impact of bank mergers. Also using a sample of Italian

³For instance, Carbó Valverde and Humphrey (2004) argue that mergers should reduce costs faced by banks, raise their return on assets and improve general resource utilization. They also find that a merger is more likely to be successful if it is large (scale effect) and also if it is initiated by a bank that has been previously involved in a merger (learning effect).

firms, Sapienza (2002) concludes that in-market mergers benefit borrowers if these mergers involve banks with limited market power. However, as the market share of the acquired bank increases, the efficiency gains are offset by an increase in market power, which may imply a decrease in loan supply, especially to small borrowers. In another study, Scott and Dunkelberg (2003) analyze the results of a survey on US firms and find that bank mergers do not affect loan supply or interest rates, even though there is some deterioration in non-price loan terms, such as fees for specific services. Degryse et al (2009) find that the impact of a bank merger is more negative for smaller borrowers and for single relationship borrowers. Moreover, target bank borrowers should be more harmed by the merger than borrowers of the acquiring bank. Finally, Karceski et al (2005) show that mergers may have impacts on borrowers beyond credit availability and interest rates. These authors show that mergers may in fact have important consequences on firm value, observing that borrowers of the acquiring banks usually benefit from the mergers, whereas firms that borrow from the target bank suffer an opposite impact⁴,⁵.

In the present paper, we use a structural model of equilibrium in credit markets to analyze the impact of changes in market factors due to the merger wave. First we estimate the differential impact of the merger wave, by exploring changes in local competition and in coordination moves between banks. Using the structural model, we are able to go further and estimate a counterfactual scenario for the post-merger period, thus going beyond the simple (and insufficient) comparison of variables before and after mergers occur, which is usually performed for the assessment of merger impact. Using this methodology, we compare the interest rate and credit flows in the post-merger equilibrium setup with the value of these variables under a counterfactual equilibrium. This counterfactual equilibrium is estimated

⁴There is less work done on the impact of bank mergers on depositors. There is some empirical evidence for Italian firms which suggests that bank mergers may have positive consequences for depositors in the long-run, even though there may be some negative effects in the short run (Focarelli and Panetta, 2003). However, Craig and Dinger (2009), using US data, obtain a different result, given that they do not observe any positive long-term effect of mergers on deposit interest rates. Their results are consistent with previous work done by Prager and Hannan (1998).

⁵For a more detailed review of the recent literature on the impact of bank mergers, please see DeYoung et al (2009).

using the after-merger exogenous environment under the pre-merger market structure.

The estimation of counterfactuals to assess the impacts of a merger may be considered an important policy tool. For instance, Ivaldi and Verboven (2005) emphasize that the evaluation of a merger from a policy perspective should not be based solely on a static comparative analysis, but should also consider dynamic effects and alternative merger scenarios. Berry and Pakes (1993) also argue that static models of equilibrium do not take into account the long-run reactions of merging and non-merging firms, thus generating misleading results. In an application to the airline industry, Peters (2006) demonstrates the importance of designing a counterfactual analysis to evaluate the impact of mergers, but is silent regarding the possibility of collusion or strategic interactions between firms. Berger et al (1998) find empirical evidence which supports the view that the dynamic effects of mergers may generate results different from those obtained with static analysis. The authors identify a decrease in lending to small business after a merger, even though this static effect is largely offset by dynamic effects associated with changes in the focus of the merging banks or with the reaction of other banks. Nevertheless, these authors do not consider local changes induced by mergers, neither do they compare the impact on different institutional sectors.

Our paper contributes to the literature on merger impact in banking markets by presenting a counterfactual analysis, based on a structural model of equilibrium that clearly disentangles the effects of bank mergers on loan flows and interest rates and takes into account changes in market structure and conduct that may occur after the merger takes place. Our analysis is based on loan flows, as opposed to outstanding amounts, thus allowing us to better capture changes in credit markets over time. Moreover, the data used allows us to discriminate effects among corporate and household borrowers, and to simulate the counterfactual equilibrium to the mergers that occurred. This approach lends itself to the reporting of intuitive measures of merger impact upon the degree of competition in the market. The use of a counterfactual scenario becomes necessary, as mergers change the market structure underlying bank competition. In particular, as borrowers' choices among alternative banks often take place in small local markets (even though banks' policies can be national), the softening of competition in

local markets resulting from a merger may be larger than an estimate based on aggregate, country-wide, figures.

We are able to make use of a significant change in market structure in the Portuguese banking market. Portugal is a small economy participating in the European Union, and joined the euro area at its inception. Like in the other European Union countries, it experienced a wave of mergers in the banking sector. The most significant changes occurred in 2000, with the merger of several financial institutions. The almost simultaneous nature of these mergers provides a natural break point in time, allowing us to define a pre- and a post-merger period. Hence, we divide the 1995-2002 period in two: the pre-merger 1995-1999 period and the post-merger 2000-2002 period. Four out of the seven major financial groups were directly involved in those changes, either by selling or by acquiring at least one financial institution. In this paper, we analyze two different products (credit to households and to firms), two different groups of institutions (those that are directly involved in the mergers and those that are not) and consider two different periods (pre- and post-mergers).

Several interesting findings emerge from our analysis. We find that the 2000 merger wave globally increased total credit granted and decreased interest rates. However, the analysis of aggregate credit flows hides important differences between institutional sectors. In fact, we find that the amount of credit flow granted to the household sector decreased, while the amount of credit granted to the corporate sector increased during the same period. The changes in credit flows affected both the banking groups involved in the mergers and the groups not involved. In fact, all financial institutions experienced an increase in the corporate credit sold following the merger and a decrease in the interest rate charged. However, the banks directly involved in the merger recorded a larger increase in corporate credit than the banks that were not directly involved in the merger. The decline in credit granted to the household sector after the merger period, which was concentrated in banks not involved in the merger wave, suggests that households may be more sensitive to changes in local market competition. These results show that mergers may actually affect the degree of competition in the market, through the changes in the local market structure, to a larger extent than

predicted by aggregate market analysis.

The results we derive from the counterfactuals are qualitatively consistent with those obtained by estimating the differential impact of the mergers. In sum, we observe that potential efficiency gains generated by the mergers seem to have been transmitted to customers through lower lending rates⁶. Moreover, access to credit improved significantly for firms after the mergers, though the same was not observed for households. However, even though the results are qualitatively similar in both methodologies, the counterfactual estimation allows for a more precise quantification of these impacts, while isolating changes in the exogenous environment from changes in market structure. The results obtained suggest that changes in banks' exogenous environment were behind most of the changes in interest rates and loan flows after the merger.

The paper proceeds as follows. Section 2 develops the model of the equilibrium in the credit market. Section 3 describes the data and the major corporate changes in the banking system in 2000. Section 4 estimates the structural model of equilibrium in the credit market and section 5 analyzes the impact of the merger wave. We first analyze the differential impact of the merger wave, and then compare those results with the estimation of a counterfactual scenario. Section 6 presents some concluding remarks.

2 The Analytical Framework

2.1 Demand Equation

Given our purpose of assessing the market equilibrium effects of bank mergers, our approach to estimation has to rely on a minimum structure, such that alternative market equilibria can be computed. At the same time, the model needs to be parsimonious and flexible. Moreover, changes in competition should be analyzed at the most disaggregated level possible. Even though there is no information on the local market operations of each bank, we do have information on the location of branches and on characteristics of local markets (such as pop-

⁶For a discussion on efficiency gains arising from bank mergers, see Sapienza (2002).

ulation), thus allowing us to consider differences in local bank competition. In fact, as local market competition certainly depends on the number and location of branches, the relative position of the branch network of each bank does affect the demand faced by the bank, and thus own and rival banks branch densities are considered in our model. The branch density is commonly used in the empirical literature on local banking competition (see, for instance, Degryse and Ongena, 2005). We consider that rivalry between banks is relevant on the choice of interest rates. Finally, economy-wide variables should influence demand and must be included as demand-side controls.

Since our unit of observation is the bank, we consider the total market demand function L_{it} directed at each bank (i), during a quarter (t), as a function of both economy-wide variables (V_t) and bank-level determinants (S_{it})⁷:

$$L_{it} = V_t S_{it}$$

As mentioned above, loan demand, L_{it} , is measured by loan flows, rather than outstanding loans, thus capturing loan demand in each quarter. The set of variables V_t includes the aggregate average interest rate on new loans granted in the country in quarter t , r_t , and Z_t which refers to other relevant economy-wide variables. The vector V_t is given by:

$$V_t = A_{0v} r_t^{\alpha_1} Z_t^{\alpha_2}$$

where A_{0v} is a constant, and α_1 and α_2 are parameters to be estimated.

The bank specific variables, S_{it} , include the number of branches of a bank and of its rivals, B_{it} and $B_{-it} = (B_t - B_{it})$, respectively.

The overall demand directed at bank i is also determined by the level of competition the bank faces in the local markets in which it is active, as well as by the relative size of such markets. In fact, for a given number of branches, different locations can imply significant differences in demand generated. Therefore, we include a set of local market competition variables X_{it} .

⁷See Kim and Vale (2001) for further details.

The vector of bank-level determinants is given by:

$$S_{it} = A_{0s} B_{it}^{\phi_1} B_{-it}^{\phi_2} r_{it}^{\phi_3} X_{it}^{\phi_4}$$

where A_{0s} is a constant and ϕ_1, ϕ_2, ϕ_3 and ϕ_4 , are parameters to be estimated. It is important to note that in each period, the decision variable r_{it} is the average interest rate that bank i charges on new loans granted during quarter t , not the average interest rate on existing loans.

Pooling all variables together, the demand equation we estimate is:

$$\ln L_{it} = \alpha_0 + \alpha_i + \alpha_1 \ln r_t + \alpha_2 \ln Z_t + \phi_1 \ln B_{it} + \phi_2 \ln B_{-it} + \phi_3 \ln r_{it} + \phi_4 \ln X_{it} + \varepsilon_{it} \quad (1)$$

where α_0 is a constant and α_i are bank fixed effects.

In expression (1), L_{it} stands for the total volume of (new) loans granted by bank i during a particular quarter t . We have district data and therefore $L_{it} = \sum_{k=1\dots K} L_{ikt}$, where k stands for the district identification⁸.

In equation (1), the vector of local market characteristics X_{it} consists of:

$$POP_{it} = \sum_{k=1\dots K} POP_{ikt} \frac{B_{ikt}}{B_{it}}$$

$$LC_{it} = \sum_{k=1\dots K} \left(\frac{B_{kt} - B_{ikt}}{B_{kt}} \frac{B_{ikt}}{B_{it}} \right)^2$$

where the sum is performed for all the districts in the country. The variable LC_{it} is the sum of the squares of the district local market competition values.

The variables capturing local market characteristics deserve some further justification. The first one, POP_{it} , is a measure of the importance of each market to bank i in period t : the proportion of branches each bank has in market k is weighted by the population in that market. Thus, banks which have a higher proportion of branches in more heavily populated areas will have, *ceteris paribus*, a higher demand for their loans.

The second measure, LC_{it} , attempts to capture not a rough indicator of the level of

⁸There are 18 districts in Portugal.

potential demand in each market, but the intensity of competition. The basic element is the share of (branch) competition faced by bank i in market k . This is given by the share of rival banks in the total number of branches in market k , weighted by the importance of market k , branch-wise, to bank i . This index can accommodate the differences involved in having branches in markets where other banks have no branches relative to crowded markets.⁹

2.2 The Bank's Problem

After setting the demand function faced by each bank, we turn now to the supply side of the market. The profit function of a bank relevant for our analysis, which focuses on the loans market, can be simply stated as interest rate income less marginal costs multiplied by total (new) loan demand in each period. Marginal costs include the opportunity cost of financial funds.

The relevant (short-run) decision variable of bank i is its interest rate. To account for possible strategic interactions among banks belonging to different economic groups, we take a simple approach, assuming that they take into consideration the impact they have on the profits of other banks. Under perfect collusion (or joint management) banks would maximize joint profits, while under perfectly independent behavior each would maximize own profits. Thus, this approach accommodates intermediate situations by the introduction of a single parameter, which measures to what extent a bank considers the impact of its decisions on the profits of other banks¹⁰.

The bank's problem is to maximize profits using the interest rate as the control variable:

$$\max_{r_{it}} \Pi_{it} = L_{it}(r_{it} - c_{it}) + \sum_{j \neq i} \lambda_{ij} L_{jt} (r_{jt} - c_{jt})$$

where j represents all remaining banks and c_{it} are marginal costs. Parameters λ_{ij} are the competition factor that accounts for the effect of bank j on bank i 's objective function. The number of parameters implied by λ_{ij} is potentially quite large, and restrictions on possible

⁹A similar index can be found in Barros (1999).

¹⁰For further details, see Barros (1999).

values will be imposed during estimation.

Using the demand equation defined in the previous section, it becomes straightforward to characterize the optimal interest rate choice taken by bank i . The first order condition is:

$$0 = \frac{\partial \Pi_{it}}{\partial r_{it}} = L_{it} + \frac{\partial L_{it}}{\partial r_{it}}(r_{it} - c_{it}) + \sum_{j \neq i} \lambda_{ij} \frac{\partial L_{jt}}{\partial r_{it}}(r_{jt} - c_{jt})$$

and from specification (1), we have:

$$\begin{aligned} \frac{\partial L_{it}}{\partial r_{it}} &= \frac{\phi_3}{r_{it}} L_{it} \\ \frac{\partial L_{jt}}{\partial r_{it}} &= \left[\frac{\partial L_{jt}}{\partial r_t} \right] \left[\frac{\partial r_t}{\partial r_{it}} \right] = \left[\alpha_1 \frac{1}{r_t} L_{jt} \right] \left[\frac{1}{n_t} \frac{1}{r_{it}} r_t \right] = \alpha_1 \frac{1}{n_t} \frac{1}{r_{it}} L_{jt} \end{aligned}$$

where we have used the fact that $(1 + r_t) = [\prod_{i=1}^n (1 + r_{it})]^{1/n_t}$ and n_t is the total number of banks in quarter t .

Simplification allows us to write the first-order-condition as:

$$0 = L_{it} + \phi_3 L_{it} \frac{r_{it} - c_{it}}{r_{it}} + \sum_{j \neq i} \lambda_{ij} \alpha_1 \frac{1}{n_t} L_{jt} \frac{r_{jt} - c_{jt}}{r_{it}}$$

For estimation purposes, it becomes useful to solve the equation with respect to the interest rate r_{it} and estimate the following equation:

$$r_{it} = \frac{\phi_3}{1 + \phi_3} c_{it} + \sum_{j \neq i} \lambda_{ij} \frac{\alpha_1}{-\phi_3 - 1} \frac{1}{n_t} \frac{L_{jt}}{L_{it}} (r_{jt} - c_{jt}) + \beta_i + v_{it} \quad (2)$$

where β_i are bank fixed effects and v_{it} are estimation errors.

Together, the system of equations (1) and (2) characterize the equilibrium in the credit market. The strategic effects between bank i and its j rivals are captured by the group of parameters λ_{ij} . If $\lambda_{ij} = 1$, there is collusion, whereas if $\lambda_{ij} = 0$ banks maximize profits independently. The impact of the branch network is obtained from the coefficients ϕ_1 , ϕ_2 . The parameter ϕ_4 evaluates the extent of the impact of the local market characteristics on granting new credit.

3 The Data

The dataset is the result of merging three different sources of data. The first dataset includes information on the branches' location. The second dataset includes unique interest rate and credit data, which allows to distinguish between the household and the corporate sectors. The third database gathers the regional characterization. The dataset consists of quarterly data from the first quarter of 1995 to the third quarter of 2002 and each observation corresponds to a bank at each quarter.

Regarding branch location, the data are collected by the Banking Supervision Department at Banco de Portugal. Whenever a bank establishes a branch, it is required to report this event to the supervisor within a period of three months. The same time period is set for a branch change of address, closing or other major change.

The data on credit and interest rate is collected from the Monetary and Financial Statistics (MFS) of Banco de Portugal. The MFS are a monthly mandatory survey sent to all financial institutions operating in the country and includes information on end-of-period stocks and flows of credit granted to households and to non-financial corporations. Data on interest rates are based on the flows of new credit granted. There was a major revision in interest rate statistics at the end of 2002, with the purpose of harmonizing methodologies within the Eurosystem, which prevents the use of more recent data. In fact, from 2003 onwards, interest rate statistics began to be estimated using a sample of representative banks, instead of using the whole universe of banking institutions, as before. Hence, there are several banks (including small banks belonging to the seven largest banking groups) for which there is no interest rate data after end-2002. Nevertheless, a longer estimation period would probably not be adequate, given that the effects of mergers should be more strongly and clearly captured in the years immediately after these mergers¹¹. Moreover, it would be a very strong assumption to require that the pre-merger equilibrium holds for many years after the merger wave, as changes in economic and financial variables should also shape this equilibrium.

¹¹For instance, Berger et al (1998) consider that the dynamic effects of bank mergers should be analyzed in the three years following the merger.

Finally, we further collected data on the demographic characteristics of the districts from Statistics Portugal, including total population by municipality.

3.1 Description of the 2000 Merger Wave

During the 1995 to 2002 sample period, the Portuguese financial system experienced several restructuring processes. Among the main corporate changes, we highlight the five most significant ones: (i) in January 1996, *Banco Português de Investimento* (BPI) buys *Banco Borges & Irmão* (BBI) and *Banco Fonecas e Burnay* (BFB); (ii) in December 1997, *Banco Comercial de Macau* (BCM) changes to *Expresso Atlantico*; (iii) in September 1998, there was a merger between BBI, *Banco Fomento e Exterior* (BFE) and BFB and the new institution is named as BBPI; (iv) in March 2000, the group *Banco Pinto e Sotto Mayor* (BPSM), which included the banks BPSM, *Banco Totta e Sotto Mayor Inv* (BTSM Inv), *Banco Totta e Açores* (BTA) and *Credito Predial Português* (CPP) is extinguished. The bank BPSM is bought by *Banco Comercial Português* (BCP). At the same time, BTSM Inv is acquired by *Caixa Geral de Depósitos* (CGD); BTA is created and CPP is acquired by BTA and finally (v) in September 2000, Santander buys BTA.

Among the main events, the ones occurred in 2000 are by far the most important, as they involved major banks as well as major financial groups. Among the seven major financial groups, four were directly involved either by selling a financial institution or by acquiring one, thus generating profound changes in the structure of the Portuguese banking market. Due to the significant changes occurring in 2000, we may distinguish between specific characteristics of the pre-2000 period, which we designate as the pre-merger period, comprehending the 1995-1999 period, and specific characteristics of an after-2000 period, which we denominate the post-merger period (including the 2000-2002 period).

To better understand the changes occurring in the credit market during 2000 we analyze the evolution of the stock of credit and total number of branches in the country during the 1995-2002 period. The pattern is presented in Figure 1. The figure reveals that credit flows seem to peak at mid-1999, while the total number of branches increased more significantly

between 1995 and 1998. Figure 1 also reveals a decelerating trend in the number of branches following the important consolidation move in 2000.

An inspection of the aggregate numbers in Figure 1 suggests that the merger and acquisition activity in 2000 did not significantly affect the total credit figures but that is not necessarily so for the within group composition. In Figure 2 we present a closer look at the corporate changes and compute the market shares of the total stock of credit for the main financial groups during the 1995-2002 period. We observe that the 2000 merger wave significantly changed the market share of some groups. Moreover, as illustrated in Figure 3, the banking groups involved in the 2000 merger wave experienced a larger gain in market shares than the remaining banks.

We also observe that after the merger wave there was some increase in the dispersion of interest rates of the larger banking groups (Figure 4). This heightened dispersion was mostly due to a relative increase in interest rates offered by the groups directly involved in the 2000 merger wave (Figure 5).

All this evidence suggests that the significant changes occurring in 2000 may have had important consequences in the credit market, namely on credit granted, interest rates charged and on the strategic effects among the financial players. This paper analyzes those changes.

3.2 Summary Statistics

Overall, there are 71 banks in the dataset that are in operation for at least one quarter during the sample period. Banks are grouped in 8 major financial groups: we consider the seven most important financial groups that include 26 banks and one additional group including the remaining banks in the sample¹². Four of these banking groups were directly involved in the 2000 merger wave.

Table 1 presents the summary statistics of our sample for the stock of credit, flows and other variables for three different groups of banks: i) the four large banking groups involved

¹²As shown by Park and Pennacchi (2009), bank mergers affect differently large and small banks, hence justifying analysing them separately.

in the merger wave, ii) the three large banking groups not involved in the mergers, and iii) the remaining banks which were not involved in the merger wave. The average credit market share of a bank belonging to the group of banks engaged in mergers is 3.4 percent, while the large banks that do not belong to this group have on average 6.7 percent of the total stock of credit. In turn, the smaller banks not involved in mergers have only, on average, 0.6 percent of the credit market. This last evidence highlights the importance of treating these banks separately and, hence, they will be excluded from regression analysis.

The average interest rate on the total credit flow charged by the banks involved in mergers is 11.1 percent (9.2 percent for the other large banks and 8.5 for the smaller banks). The household market experiences higher interest rates (13.2, 10.4 and 10.2 percent for the groups of banks under analysis) than the corporate sector (9.9, 9.3 and 7.9 percent, respectively)¹³.

These statistics refer to the entire sample period. We will analyze how the merger wave affected credit flows and interest rates, both for households and for firms.

4 Analysis of Equilibrium in the Credit Market

The system of equations that characterizes the equilibrium in the credit market consists of equations (1) and (2). As we have previously discussed, (2) includes the interaction of bank i with each rival bank j . In order to simplify the empirical estimation, we have reduced the number of strategic effects and considered the interaction of bank i with its main rival, which is defined to be the financial institution with the lowest interest rate during the quarter, $R \min_{it}$.¹⁴ As a consequence, the system to estimate is given by:

¹³Most of the banks in the sample operate in both the household and the corporate credit markets, even though some small banks display null credit flows in one of these segments in some quarters. All banks considered grant credit to households and only two small banks never grant credit to firms during the entire sample period.

¹⁴We have tried different strategic effects and the results do not change significantly. For instance, we have considered (i) defining the main rival as the bank that has granted more credit during the quarter ($X \max_{it}$), (ii) the bank with the closest loan flow in each quarter, (iii) the interaction of the five main rivals, (iv) the average of the interaction of the five main rivals $X \max_{it} = 1/5 \sum_{j=1, \dots, 5} X \max_{jt}$ or (v) the interactions given by: $X \max_{it} = (\frac{1}{n_i}) \sum_{i=1, \dots, 5} \frac{L \max_i}{Lit} (r \max_i - c_{jt})$.

$$\left\{ \begin{array}{l} \ln L_{it} = \alpha_0 + \alpha_i + \alpha_1 \ln r_t + \alpha_2 \ln Z_t + \phi_1 \ln B_{it} + \phi_2 \ln B_{-it} + \phi_3 \ln r_{it} + \\ \quad + \phi_{41} POP_{it} + \phi_{42} LC_{it} + \varepsilon_{it} \\ r_{it} = \beta_0 + \beta_1 c_{it} + \beta_2 R \min_{it} + \beta_i + v_{it} \\ \beta_1 = \frac{\phi_3}{1+\phi_3} \\ R \min_{it} = Min_{r_{jt}} \left[\frac{1}{n_t} \frac{L_{jt}}{L_{it}} (r_{jt} - c_{jt}) \right] \end{array} \right. \quad (3)$$

The system (3) also highlights the nonlinear constraint involving the parameters β_1 and ϕ_3 , representing a link between equations (1) and (2).

The results are presented in Table 2. The model is estimated for quarterly data and covers the 1995-2002 period. Estimating the model for the full period allows for a characterization of market structure in this period, which can be useful as a benchmark to assess the impact of mergers. Columns (1) to (4) characterize the equilibrium for the total credit granted, aggregating household and corporate credit, and columns (5) to (8) and (9) to (12) correspond to the estimations for the household and corporate sectors. It should be noticed that, in this setting, we are able to differentiate banking output into household and firm loans without making any assumptions regarding their complementarity or substitutability, given that these are two different and independent markets. This implies null cross-elasticities of demand between these markets, given that, by definition, customers cannot switch between these two markets. Thus, specifying linear demand functions should not inflict problems which would exist in markets where these cross-elasticities vary in response to different strategies¹⁵.

In Table 2, columns (1)-(2), (5)-(6) and (9)-(10) are the results when we estimate equations (1) and (2) independently, while the remaining columns consider the constraint presented in the system described by (3). The system of equations is estimated using a seemingly unrelated (SUR) model, which allows for cross-equations correlation of the residuals. All regressions are executed using banks' fixed effects and robust standard errors.

Looking at the results for the aggregated credit flows, in columns (1) to (4), we observe

¹⁵Berg and Kim (1998) empirically document such separability in the Norwegian market and present a discussion on cross-market interactions when banks produce multiple outputs.

that the total number of branches is positively and significantly related to the logarithm of total credit granted, indicating that local branching arrangements are an important factor in liquidity provision¹⁶. In the SUR estimation, we obtain an estimate for ϕ_1 equal to 1.25, with a t -statistic of 3.98.

In addition, the interest rate charged by the bank is negatively related to the total credit granted¹⁷. As expected, the interest rate charged by the bank i , r_{it} , is strongly and positively related to banks' funding costs¹⁸, c_{it} . The estimate for the coefficient β_1 is, in the SUR model, 1.20, with a t -statistic of 27.05.

Although columns (1) to (4) reveal consistent estimates of the determinants of the credit and interest rates charged by the bank, the analysis for the aggregate credit flows smooths important idiosyncratic characteristics of the determinants of the household and corporate sectors credit markets. Columns (5) to (8) present the results for equations (1) and (2) and system (3) for the household sector and columns (9) to (12) present a similar analysis for the corporate sector. The distinction across these institutional sectors highlights important differences in these markets, thus justifying a disaggregate specification rather than treating the credit market as a homogeneous market¹⁹.

We observe that the banks' own number of branches positively influences credit granted, both to households and to firms (the estimated coefficients are 0.88 and 1.66, respectively). In turn, the number of branches of the remaining banks is not significantly correlated with credit granted to households, as illustrated in columns (5) and (7), while it has a negative and significant impact on credit supplied to the corporate sector.

¹⁶In a recent paper, Corvoisier and Gropp (2009) argue that the widespread use of web-based banking platforms should have decreased sunk costs and increased contestability in retail banking, as establishing branches became less important. Nevertheless, the authors find that even though this hypothesis may be true for time and saving deposits, it does not hold for small business loans, where establishing a branching network with local connections is still important.

¹⁷In the table, we omit the t -stats for this coefficient in columns (3), (7) and (11), as this coefficient is determined by the constraint in (3).

¹⁸ c_{it} is a measure of weighted funding costs, taking into account deposit and interbank funding.

¹⁹The lower number of observations in the regressions for households and firms is due to the fact that some small banks show null credit flows in one of these market segments in some quarters, as discussed in Section 3.2. Moreover, two small banks never grant credit to firms during the entire sample period.

Looking at the macro determinants, Table 2 reveals that the impact of the GDP level on credit granted is positive for both credit markets. Given that GDP reflects changes in global macroeconomic conditions and also changing industry risk, this result confirms the usually observed pro-cyclicality of liquidity provision²⁰. However, this impact is statistically significant only for credit to households. Moreover, local branch competition has a positive impact on the credit flow. This impact is fourfold larger in the corporate than in the household sector²¹.

The evidence on strategic behavior, measured by the coordination parameter λ , suggests that there is no collusion between banks, as λ is always less than one. The statistical tests on these parameters show that we can reject the hypothesis of perfect collusion ($\lambda = 1$) in the corporate credit market, thus suggesting that banks behave competitively in this market. However, for households we cannot rule out either the hypothesis of perfect collusion ($\lambda = 1$) or perfect competition ($\lambda = 0$). These results are consistent with previous evidence obtained by Berg and Kim (1998), who argue that the mobility of customers in the corporate market is stronger than in other markets, thus generating more competitive behaviors by banks. More recently, Degryse et al (2009) show that firms may benefit from switching banks after mergers occur, what can be related to banks' competitive strategies.

Having analyzed the determinants of credit flow and interest rates for the household and corporate markets, we can now determine how these parameters change following bank mergers.

5 The Impact of the Merger Wave

This section analyzes the impact of the 2000 merger wave on the determinants of credit flows and interest rates. On the one hand, we are interested in the impact of the merger wave on the

²⁰Controlling for GDP should capture the most relevant time fixed effects. To mitigate concerns about potential cointegration issues, we also considered the GDP growth rate, having obtained broadly similar results.

²¹The estimated coefficient ϕ_{42} is 5.36 for households (with a t -statistic of 1.94) and 20.13 for firms (with a t -statistic of 6.23).

credit flow and interest rates charged and, on the other hand, we aim at determining how has the merger affected local branch competition and coordination moves in the banking industry.

In order to pursue this objective we consider two scenarios. The first scenario determines the differential impact of the merger. That is, we evaluate how has the impact of critical variables such as local branch competition and coordination moves among financial institutions changed from the pre- to the post-merger period. In the second scenario, we explicitly consider that the merger wave might have generated a new setup in credit markets in the post-merger period. The magnitude of the merger wave has most likely induced changes in the interaction between banks and possibly also in consumer preferences. Given these changes, the differential analysis, usually conducted in the literature, may lead to biased and incorrect estimates of the merger impact. Hence, we propose a new methodology for the comparison between the pre- and post-merger periods, through the estimation of a *counterfactual*. In this estimation we combine the pre-merger equilibrium setup with the post-merger observed environment to answer the "*what if*" question.

5.1 The Differential Impact of the Merger Wave

We first compute the differential impact of the merger on the equilibrium in the credit market. In particular, we are interested in determining how variables such as the strategic behavior and local competition change after the merger. In order to pursue this objective, we consider a dummy variable *AFTER* that has value one if the quarter is in year 2000 or after, and zero otherwise, and run a modified empirical model of (3)²²:

²²The choice of the year 2000 is motivated by the large number of mergers observed, some of which involving some of the largest banks. As illustrated in section 3.1, these mergers had a substantial impact on market structure.

$$\left\{ \begin{array}{l} \ln L_{it} = \alpha_0 + \alpha_i + \alpha_{01}AFTER + \alpha_1 \ln r_t + \alpha_2 \ln Z_t + \phi_1 \ln B_{it} + \phi_2 \ln B_{-it} + \phi_3 \ln r_{it} + \\ + \phi_{41}POP_{it} + \phi_{42}LC_{it} + \phi_{43}LC_{it} * AFTER + \varepsilon_{it} \\ r_{it} = \beta_0 + \beta_1 c_{it} + \beta_2 R \min_{it} + \beta_3 R \min_{it} * AFTER + \beta_i + v_{it} \\ \beta_1 = \frac{\phi_3}{1+\phi_3} \\ R \min_{it} = Min_{r_{jt}} \left[\frac{1}{n_t} \frac{L_{jt}}{L_{it}} (r_{jt} - c_{jt}) \right] \end{array} \right. \quad (4)$$

In this model, the coefficient α_{01} captures eventual changes in the level of credit flow after the merger wave and ϕ_{43} considers the difference in the impact of the local branch competition on the quarterly credit flow following the 2000 merger with respect to the impact during the pre-merger period. Using the coefficient β_3 and equation (2) we can compute a similar differential effect for the strategic interaction, λ , which we name λ_{after} .

The results for the differential impact are presented in Table 3. Columns (1) to (4) present the analysis for the total credit flow (household plus corporate credit) and columns (5) to (8) and (9) to (12) present the results for the household and corporate sectors, respectively. As before, columns (1)-(2), (5)-(6) and (9)-(10) represent the first two equations of the model (4) without considering the non-linear constraint.

The first row of the estimated coefficients in Table 3 shows the results for the variable *AFTER*. The negative coefficients in columns (5) and (7) reveal that the quarterly credit flow decreased after the mergers for the household sector, despite the decrease in interest rates (columns (6) and (8)). This suggests that there were important changes in market equilibrium after the mergers, given that a pure shift along the demand curve would imply a positive effect on credit due to the decrease in interest rates. For the corporate sector, the sale of credit increased after the merger, as observed in columns (9) and (11), and the interest rate charged decreased, as shown in columns (10) and (12). Post-merger equilibrium loan rates decrease when the merger induces large cost advantages relative to the increase in banks' market power, as shown by Carletti et al (2007). Our results are consistent with Fonseca and

Normann (2008), who argue that even though a merger involving the largest firm in a market creates a more asymmetric market structure, asymmetric markets exhibit lower prices than symmetric markets with the same number of firms.²³

For robustness purposes, we considered the possibility that the effect of bank mergers takes some time to be reflected in credit flows and interest rates. To test this possibility, we estimated the same regressions, but considering that the dummy variable *AFTER* would take the value of unity only from 2001 onwards. The results for households remain broadly unchanged. For firms, we continue to observe the negative impact on interest rates, but the positive impact on credit ceases to be significant. Nevertheless, the impact of the mergers should have been felt almost immediately, as suggested by the rapid change in banks' names and identities. To test the hypothesis that the merger impact could have had immediate impacts, we also estimated these regressions with the dummy variable *AFTER* taking the value of unity from 1999 onwards. We observe that, in this situation, the differential impact of the merger wave on credit flows loses significance, thus confirming 2000 as a sensible break point.

Looking at the effect of local branch competition, we find that the impact was most significant for the corporate sector. In this credit market, we find that the merger leads to a decrease in the impact of local competition on the credit flow. Hence, the positive impact of local bank competition on credit granted to firms becomes slightly smaller (though still positive and large) after the merger wave.

The strategic effect of the main rival following the merger is presented in the last two groups of rows in Table 3. In what concerns the market for households loans, we clearly reject the hypothesis of collusion, though that conclusion does not hold for the post-merger period. In turn, in the corporate loan market we always reject the existence of full coordination moves between banks, even though λ increased somewhat after the merger wave.

²³In order to confirm the validity and strength of these differential impacts, we tested for the existence of a structural break after the merger wave, using a Chow test. In all the tests performed we reject the null hypothesis of structural stability of the parameters.

5.2 Counterfactual Analysis of the Merger Wave

The previous analysis computes a differential effect of specific variables and assumes that all remaining interactions remain constant. However, this analysis does not fully take into account the structural changes which should have occurred in credit markets after the merger wave. Given the magnitude and extension of the mergers, the way banks (and their costumers) interact should have changed substantially after the merger. In this section, we assume that a new scenario is created that influences all variables in the credit market. Under this scenario, the evaluation of the differences in strategic effects requires the comparison between the results for the post-merger period and the ones obtained from the estimation of the pre-merger equilibrium using the post-merger data (counterfactual). The main disadvantage of this empirical estimation is that we need to restrict the analysis to the post-merger sub-sample. The main advantage is that we can analyze the merger impact using the post-merger environment which is obviously a much more realistic assumption.

The way we construct the counterfactual for the empirical estimation is the following. We first estimate the model (3) for the 1995-1999 period and obtain estimations for the pre-merger impact. We then use the pre-merger coefficient estimates of this model for the 2000-2002 data on exogenous variables to obtain the value of the estimated post-merger credit flows and interest rates charged by the bank.²⁴ This means that these two estimated variables are the credit and interest rates practiced in the post-merger period assuming the impact of the market environment, strategic effects and local market competition in the pre-merger period.

We also consider the possibility of ignoring changes in the branch network after the mergers, given that the mergers should have had effects on the structure of the branch network and, most notably, on local bank competition. Hence, we also estimate counterfactual values for credit and interest rates by assuming that the branch network remains unchanged at pre-merger levels.

Table 4 presents the main counterfactual estimations. In the table, we distinguish two

²⁴Given the recursive nature of the model, the estimated interest rates are used to estimate credit flows in the counterfactual.

groups of financial institutions: (i) the ones that are directly involved in the merger wave and (ii) the ones that are not directly involved in the merger wave. By "directly involved" we mean that the financial group acquired or sold a financial institution to a different financial group.²⁵

We begin by directly comparing observed credit flows and interest rates in the pre- and post-merger periods. After the merger wave, loan flows were higher than in the pre-merger period, both for households and firms. It is worth noticing that this trend was stronger for the banks directly involved in the mergers, given that the remaining banks actually recorded some decrease in loan flows, specially in what concerns loans to households. Comparing interest rates in the pre- and post- merger periods, we observe that there was a widespread decrease in interest rates after the mergers occurred, partly reflecting lower banks' funding costs arising from lower money market interest rates during this period, as well as from access to more varied funding sources after the integration in the European Monetary Union. However, the data clearly show that banks directly involved in the mergers decreased interest rates more aggressively than the other banks, narrowing their interest rate margins in order to attract more costumers and, possibly, also reflecting efficiency and informational gains arising from the merger process (see, for example, Sapienza (2002), Hauswald and Marquez (2006) and Panetta et al (2009)).

In columns (3), (7) and (11), we present the counterfactual estimates of loan flows and interest rates. As described above, these estimates result from predicting these two variables for the post-merger period, by taking into account the pre-merger equilibrium and the post-merger environment. Hence, variables such as money market interest rates, GDP or number of branches are considered in the post-merger period to obtain these estimates. In these columns we also present the results of mean comparison tests between the counterfactual estimates and the post-merger observed variables.

By comparing credit flows observed after the merger with the estimated post-merger flows,

²⁵As previously documented, out of the seven major financial groups, four were directly involved in the merger wave and three were not directly involved.

we conclude that loan flows would have increased even more if mergers would not have occurred. When total credit flows are considered, the difference between the counterfactual and the actually observed loan flows is not statistically significant, except for the banks who were not directly involved in the merger wave. In fact, the latter recorded a decrease in credit granted after the merger wave which would not have occurred if the mergers had not taken place, according to the counterfactual estimates. This result demonstrates that mergers induced important market shifts, with merging banks gaining market share.

Our results show that there are important differences between the evolution of loans to households and to firms²⁶. On the one hand, the model predicts that household credit could be larger than what was actually observed (specially for the banks not involved in the merger wave). On the other hand, the model predicts a slowdown in credit granted to firms, in striking contrast with the acceleration actually observed during this period. The difference between estimated and observed corporate loans was larger for the banks directly involved in the merger wave.

The counterfactual estimates also suggest that interest rates would still decrease if no mergers had occurred. However, comparing these estimates to the post-merger observed values, we conclude that the observed decrease in interest rates was, by any means, larger than that predicted by the pre-merger equilibrium, even taking into account the developments in money market interest rates in the post-merger period. The most impressive difference comes from the interest rate on loans to firms applied by the banks involved in the merger wave, what may suggest efficiency and informational gains arising from these mergers.

Finally, in columns (4), (8) and (12) we present the results for the counterfactual estimates when the branch network is assumed to remain unchanged at the pre-merger levels. This may be a strong assumption, given that it is unlikely that the branching structure and the intensity of local bank competition would not change between 1999 and 2002. However, without the mergers this branching network would probably be considerably different from the one actually observed, thus making these results relevant for this counterfactual estimation. In this version

²⁶These differences may have important economic implications, as shown by Beck et al (2009).

of the counterfactual, interest rates would be the same as in the previous counterfactual estimation, given that the model establishes that the number of branches does not directly affect interest rates charged by banks (see equation 4)²⁷. However, in what concerns loan flows, the estimates show that if there were no changes in the branch network, the estimated loan flows would not be as large as predicted by the counterfactual which assumes changes in branches. This result is specially strong for corporate loans.²⁸

Using these estimates, we can decompose the merger impacts into several different components, distinguishing between changes in the exogenous environment and changes in the branch network and market structure. This decomposition is presented in Table 5. In columns (1), (6) and (11) we present the initial estimation error (for all banks, for the banks directly involved in mergers and for the banks not directly involved, respectively), defined as the difference between the predicted values for the pre-merger period and the observed loan flows and interest rates in this period. On average, this estimation error is virtually negligible.

In columns (2), (7) and (12) we present the effect of changes in the exogenous environment on loan flows and interest rates, for the three groups of banks under analysis. This effect is computed as the difference between the counterfactual estimates for the post-merger period when holding the branch network and market structure at pre-merger levels, but taking into account changes in the exogenous environment after the merger wave (columns (4), (8) and (12) in Table 4). In what concerns interest rates, the effect was clearly negative and larger than 2 p.p. Hence, a considerable part of the decrease in interest rates in the post-merger period was due to changes in macroeconomic conditions. Regarding loan flows, changes in banks' operating environment led to an increase in loan flows to households and to a decrease in loan flows to firms. As discussed above, this result means that the counterfactual estimates without changes in branches suggest that loans to households should have been higher if the

²⁷In these columns, the interest rates, loan flows and the strategic interaction variable were computed using the values predicted by the model, instead of using directly the values observed. The results are consistent under both hypothesis.

²⁸For robustness purposes, we conducted several sensitivity tests on the definition of the post-merger period (as done for the analysis of the differential impact of the merger wave). Despite differences in the magnitude of the impacts, qualitatively the results are robust.

mergers had not occurred (the opposite being true concerning loans to firms). The impact of the changes in the operating environment on loan flows was stronger for the banks directly involved in the merger wave.

When changes in the branch network and in local market competition are considered (columns (3), (8) and (13)), we observe a positive impact in loan flows, when compared to the impact of considering only changes in the exogenous environment. These estimates correspond to the difference between columns (3) and (4) in Table 4, i.e., the difference between the counterfactuals with and without changes in branches. Hence, when changes in the branching network observed after the merger wave are considered, we conclude that loan flows should have been even higher if mergers had not occurred. This difference assumes a larger magnitude in loans to firms. As previously discussed, interest rates estimates remain unchanged, given that they are not directly influenced by the number of branches in our structural model.

Finally, we present the estimates for the impact of other structural changes (which includes a prediction error), defined as the difference between interest rates and loan flows observed after the merger wave and the counterfactual estimates (with changes in the branch network), for these variables. In other words, these estimates represent the merger impact which is not accounted for the change in the operating environment neither for the change in market structure. For interest rates, this impact is negative and larger for the banks directly involved in the merger wave, thus showing that banks decreased interest rates more aggressively after the merger than what would have been predicted by the model if mergers had not taken place. In what concerns loan flows to households, we obtain a similar result: these flows were lower after the merger than what is predicted by the counterfactual analysis. In contrast, loan flows to firms were higher than those predicted by the counterfactual estimates, as previously discussed, specially for the banks directly involved in the merger wave.

In sum, we observe that mergers have increased the amount of credit granted to firms and decreased the availability of loans to households. Moreover, the merger wave induced a stronger decrease in interest rates than what could be expected, thus benefiting consumers. By decomposing the merger impact, we conclude that the decrease in interest rates was mainly ex-

plained by changes in banks' operating environment, even though the merger wave contributed to intensify this decrease. The increase in loan flows to households after the merger was mainly explained by changes in the exogenous environment, given that structural changes generated by the mergers had a negative effect on loan flows to households. Finally, the increase in loan flows to firms in the post-merger period can be mostly explained by structural changes generated by the mergers, as macroeconomic changes would have implied a deceleration in loans to firms during this period.

These results are broadly consistent with those resulting from the differential analysis of the merger wave impacts, even though the counterfactual analysis provides a much more rigorous and detailed framework to disentangle the merger impacts, by relying on a structural model of equilibrium.

6 Concluding remarks

Bank mergers usually have important consequences in terms of bank competition, access to credit or loan pricing. However, the effects of bank mergers on these variables are hard to disentangle from other market and macroeconomic dynamic effects that occur simultaneously, affecting loan demand and supply, as well as its pricing. In this paper, we present a structural analysis of the impact of mergers in the Portuguese banking market. In the late 90s, several large banks were involved in a strong and fast consolidation process, thus providing an empirical setup to assess changes in market structure after the mergers.

Using a structural model, we derive the equilibrium in the pre-merger setting. Combining this estimated equilibrium with the post-merger environment, we are able to construct a counterfactual estimate of loans and interest rates. This allows us to compare the observed loan flows and interest rates with those resulting from the pre-merger equilibrium, thus assessing the impacts of the bank merger wave.

We obtain several interesting results. The interest rates observed after the mergers were lower than those predicted by the model, in the pre-merger equilibrium. This may reflect efficiency and informational gains resulting from the mergers and translated into more com-

petitive pricing. In turn, there are important differences between loans granted to households and to firms: whereas loans granted to households were in fact lower than what would be suggested using the pre-merger equilibrium, loans granted to firms actually recorded a stronger growth than what could have occurred if no mergers had taken place. All in all, households may have faced some constraints in access to credit after the merger, even though loans to households recorded robust growth rates during this period. On the contrary, loans granted to firms seem to have surpassed by a large extent the counterfactual estimates.

The counterfactual estimates also highlight important differences between the banks directly involved in the merger wave and the remaining large banking groups. The banks directly involved in this process decreased their interest rates on corporate loans much more aggressively than other banks. Simultaneously, credit granted to firms by these banks was also much larger than what could have been expected if no mergers had occurred. In turn, the estimated decrease of loans granted to households assumed a larger magnitude for the banks who did not directly participate in the merger wave.

By decomposing the merger impacts through the use of the counterfactual estimates, we conclude that changes in banks' operating environment were the main driving force when explaining the differences in interest rates and loan flows before and after the merger wave. Structural changes generated by the mergers contributed to intensify these changes in interest rates and loans to firms, but had the opposite impact on loans to households.

The structural model used to perform these counterfactual estimates allows to clearly identify the effects of bank mergers on credit and interest rates, isolating changes in the exogenous environment and in market structure. Changes in market equilibrium resulting from the mergers affect significantly banks' decisions, as well as their strategic interactions, thus demonstrating the importance of relying on a structural estimation method. All in all, we observe that potential efficiency and informational gains seem to haven been transmitted to customers through lower lending rates and firms have faced less bank financing constraints than they otherwise would.

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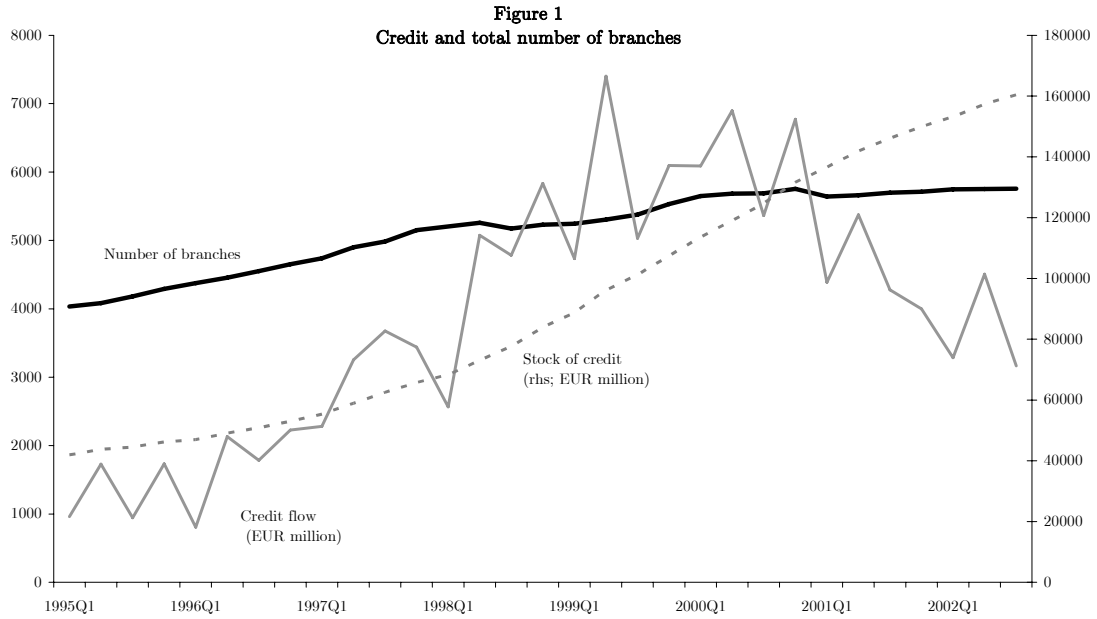
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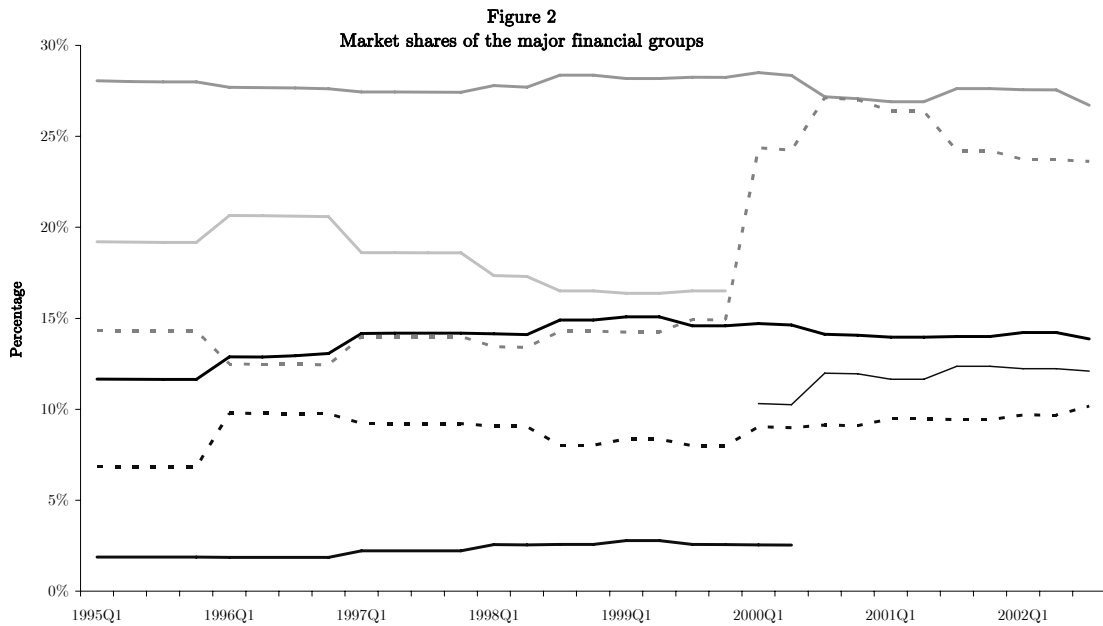
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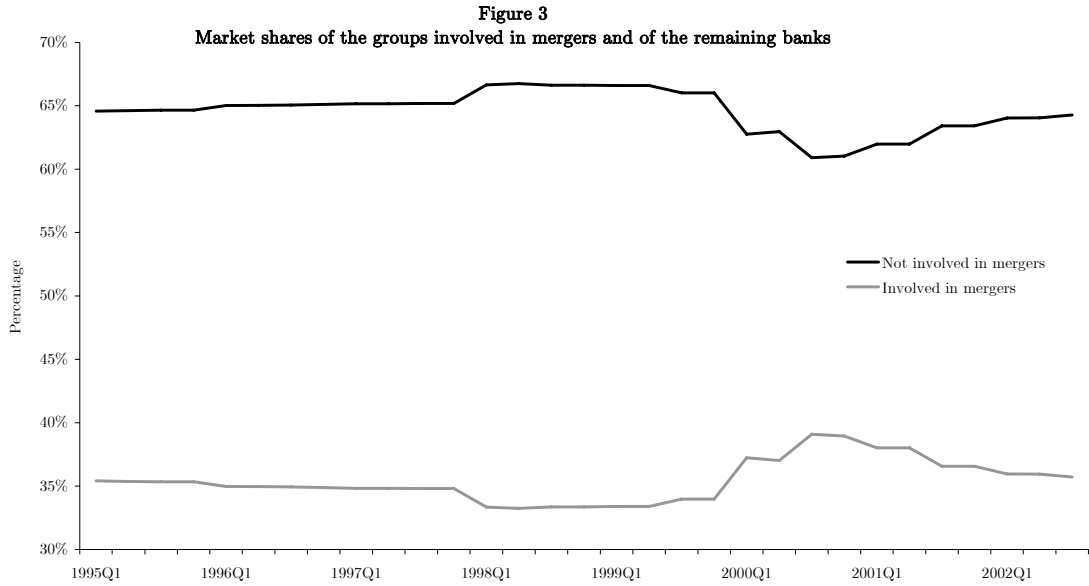
Figures and tables



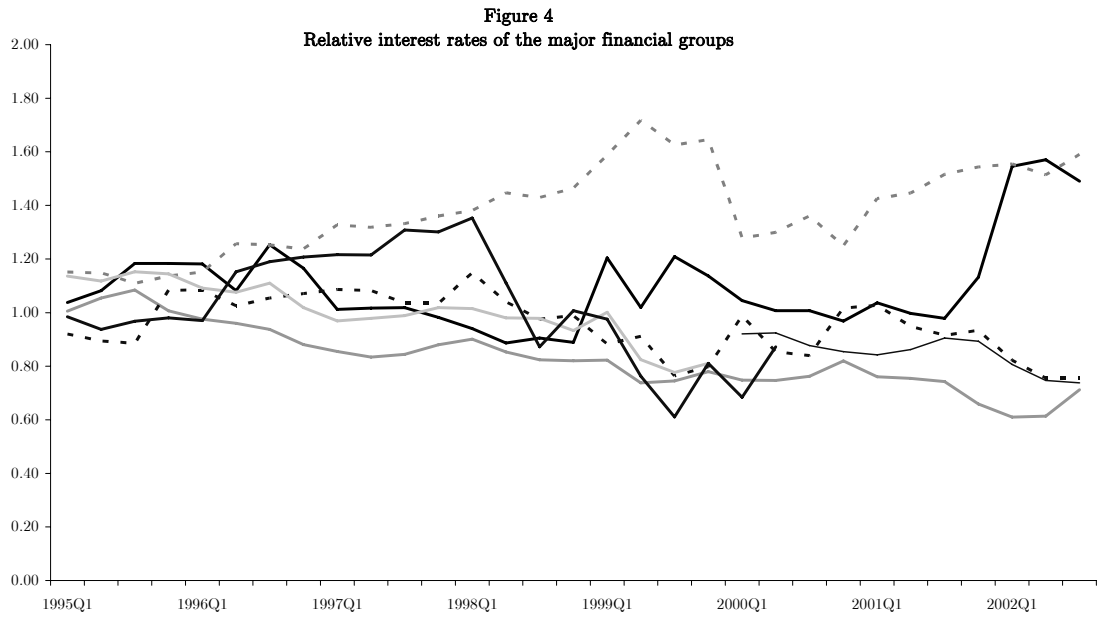
Notes: The stock of credit and the credit flow reported are aggregate values from the Monetary and Financial Statistics, Banco de Portugal.



Notes: Market shares are computed by taking into account the total outstanding amount of credit. Banks were grouped into 8 major groups: the 7 largest banking groups in the banking system, plus one additional group of other group including all other small banks.

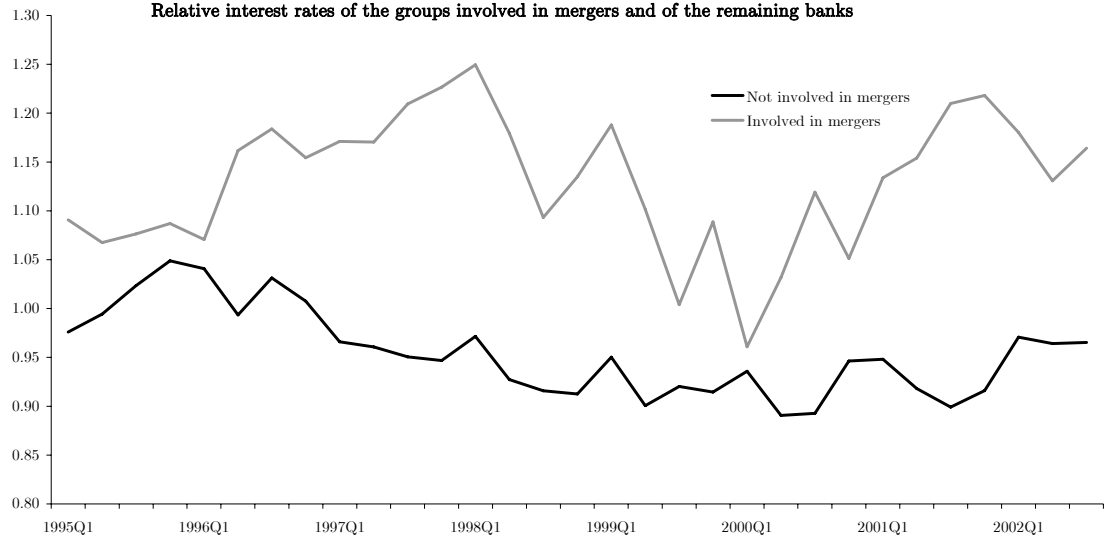


Notes: Market shares are computed by taking into account the total outstanding amount of credit. The group of financial institutions directly involved in the merger includes institutions belonging to financial groups that have acquired or sold a financial institution to a different financial group in 2000. The small banks not belonging to any large banking group are considered in the set of banks not directly involved in the mergers.



Notes: Only the 7 largest banking groups are considered in this figure. The relative interest rates are computed as the average rate on new loans granted by each banking group relative to the average rate on all new loans granted in each quarter.

Figure 5
Relative interest rates of the groups involved in mergers and of the remaining banks



Notes: The relative interest rates are computed as the average rate on new loans granted by each banking group relative to the average rate on all new loans granted in each quarter. The group of financial institutions directly involved in the merger includes institutions belonging to financial groups that have acquired or sold a financial institution to a different financial group in 2000. The small banks not belonging to any large banking group are considered in the set of banks not directly involved in the mergers.

Table 1 - Summary statistics

	Banks involved in mergers					Large banks not involved in mergers					Other banks not involved in mergers				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Stock of credit															
Total stock of credit	323	2751	5134	1.5	31866	232	5422	7270	0.04	37014	791	419	580	0.24	3268
Number of branches	323	175	249	1	1312	232	242	229	1	786	791	26	44	1	217
Market share (total credit)	323	3.4	4	0.0	26.1	232	6.7	8	0.0	27.4	791	0.6	1	0.0	3.9
Flow of credit															
Total credit flow	323	2268	6064	0.2	39776	232	1903	2866	0	16420	791	314	555	0	3514
Credit flow (households)	323	318	761	0	5769	232	401	567	0	2750	791	41	78	0	437
Credit flow (corporate sector)	323	1950	5335	0	35655	232	1502	2341	0	13812	791	273	496	0	3116
Interest rates															
Interest rate	323	11.1	5	3.2	25.7	232	9.2	4	3.8	20.0	791	8.5	4	2.6	23.6
Interest rate (household credit)	287	13.2	5	3.2	25.7	213	10.4	4	3.2	20.0	622	10.2	5	1.5	28.0
Interest rate (corporate sector credit)	264	9.9	4	3.1	23.5	226	9.3	4	3.8	18.8	736	7.9	3	2.6	22.3
Interbank market rate	323	5.2	2	2.4	9.1	232	5.0	2	2.4	9.1	791	4.9	2	2.4	9.1
Bank specific and demographic variables															
ROA	323	0.003	0.0	-0.1	0.03	232	0.003	0.0	-0.1	0.02	791	0.001	0.0	-0.3	0.04
LC	323	0.3	0.3	0.1	1.0	232	0.3	0.3	0.1	1.0	791	0.5	0.3	0.1	1.0
POP	323	14.0	3.8	9.4	21.4	232	13.0	3.7	2.4	21.4	791	15.0	5.1	2.5	21.4

Notes: The group of financial institutions directly involved in the merger includes institutions belonging to financial groups that have acquired or sold a financial institution to a different financial group in 2000. All credit values are in Eur million. Market shares are computed by taking into account the total outstanding amount of credit and are displayed as percentages. Interest rates are annualized and refer to new loans granted in each quarter. ROA is the return on assets of each bank, LC is a measure of local competition and POP is a measure of the importance of each market to bank i in period t . LC and POP are defined in Section 2.1.

Table 2 - Characterization of the determinants of credit flows and interest rates

	Total credit flows				Households				Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS ln(Credit)	OLS rit	System of equations ln(Credit)	System of equations rit	OLS ln(Credit)	OLS rit	System of equations ln(Credit)	System of equations rit	OLS ln(Credit)	OLS rit	System of equations ln(Credit)	System of equations rit
ln(number of branches)	1.224 ** (2.08)		1.250 *** (3.98)		0.849 ** (2.48)		0.884 ** (2.48)		1.644 * (1.83)		1.658 *** (3.53)	
ln(number of branches other banks)	-0.897 (-1.13)		-0.863 (-1.23)		0.377 (0.60)		0.475 (0.69)		-3.237 *** (-2.84)		-3.076 *** (-3.21)	
ln(r_t)	-0.063 (-0.17)		-0.417 (-1.41)		-0.224 (-0.55)		-0.119 (-0.30)		-0.416 (-0.61)		-0.265 (-0.54)	
ln(r_{it})	-0.612 *** (-2.80)		-0.194 *** -		-1.078 *** (-4.32)		-1.155 *** -		-1.099 ** (-2.52)		-1.197 *** -	
GDP	0.032 (1.43)		0.031 (1.46)		0.078 *** (3.26)		0.075 *** (3.08)		0.013 (0.39)		0.008 (0.23)	
POP	0.085 (0.50)		0.069 (0.88)		0.012 (0.12)		0.013 (0.12)		-0.207 (-0.70)		-0.199 * (-1.70)	
LC	8.119 * (1.66)		8.277 *** (3.62)		5.276 * (1.76)		5.356 * (1.94)		20.389 *** (2.88)		20.126 *** (6.23)	
c_t		1.206 *** (16.28)		1.198 *** (27.05)		1.209 *** (14.73)		1.210 *** (23.11)		1.214 *** (15.77)		1.213 *** (23.46)
Rmin		3.876 (0.48)		-1.683 (-0.15)		0.072 (0.07)		-0.110 (-0.09)		0.134 *** (3.06)		0.132 *** (3.51)
constant	5.597 (0.75)	5.234 ** (7.64)	5.247 (0.81)	5.279 *** (7.57)	-2.423 (-0.40)	6.304 ** (9.54)	-3.412 (-0.52)	6.304 *** (7.89)	26.635 ** (2.51)	5.412 ** (7.39)	25.161 ** (2.73)	5.419 *** (7.04)
Lambda (λ)				-3.3				0.1				-0.1
$H_0 = \lambda = 0$ [Prob > χ^2]				0.88				0.93				0.59
$H_0 = \lambda = 1$ [Prob > χ^2]				0.85				0.60				0.00
Observations	562	562	562	562	507	507	507	507	496	496	496	496
R-squared	0.90	0.79			0.92	0.75			0.85	0.68		

Notes: All regressions include banks' fixed effects and robust standard errors. Robust t statistics are presented in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. The estimations are performed for quarterly data during the 1995-2002 period. Columns (1)-(2), (5)-(6) and (9)-(10) refer to the independent OLS estimation of the two equations in the model, while the remaining columns consider the constraint included in the system, estimated using a seemingly unrelated (SUR) model. The interest rates refer to the new loans granted in each quarter. LC is a measure of local competition and POP is a measure of the importance of each market to bank i in period t . LC and POP are defined in Section 2.1. C_t is a measure of weighted funding costs, taking into account deposits and interbank funding. Rmin is a variable that measures the strategic interaction between banks, being defined as $Rmin = (1/nbanks) * L_{jt} / L_{it} * (r_{jt} - c_t)$, where L_{jt} and r_{jt} are, respectively, the loan flow and the interest rates of each banks' rival, defined as that with the lowest interest rate in that quarter, in each market segment.

The t statistics for the coefficient associated with $\ln(rit)$ in columns (3), (7) and (11) are omitted, as this coefficient is determined by a constraint in the model. The lower number of observations in the regressions for households and firms is due to the fact that some small banks show null credit flows in one of these market segments in some quarters (two small banks never grant credit to firms during the entire sample period). Lambda reflects the effect of the rival banks on the profit maximization function of each bank and is derived from a combination of the estimated coefficients, resulting from the model.

Table 3 - Analysis of the differential impact of the merger wave

	Total credit flows				Households				Firms			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS ln(Credit)	OLS rit	System of equations ln(Credit)	System of equations rit	OLS ln(Credit)	OLS rit	System of equations ln(Credit)	System of equations rit	OLS ln(Credit)	OLS rit	System of equations ln(Credit)	System of equations rit
AFTER	0.350 ** (2.25)	-1.604 *** (-8.07)	0.343 ** (2.09)	-1.628 *** (-8.07)	-0.473 *** (-3.12)	-2.001 *** (-8.60)	-0.471 *** (-3.01)	-2.003 *** (-8.22)	0.957 *** (4.38)	-1.938 *** (-8.62)	0.971 *** (4.48)	-1.939 *** (-8.40)
ln(number of branches)	0.948 (1.60)		0.974 *** (3.07)		0.987 *** (3.01)		1.052 *** (2.89)		1.166 (1.31)		1.168 ** (2.50)	
ln(number of branches other banks)	-0.925 (-1.13)		-0.745 (-1.05)		0.525 (0.82)		0.774 (1.13)		-3.421 *** (-3.03)		-3.337 *** (-3.56)	
ln(r_t)	-0.036 (-0.10)		-0.133 (-0.38)		0.137 (0.33)		0.343 (0.81)		-0.716 (-1.10)		-0.545 (-1.04)	
ln(r_{it})	-0.658 *** (-3.03)		-0.310 *** (-)		-1.032 *** (-4.13)		-1.064 *** (-)		-1.135 *** (-2.67)		-1.268 *** (-)	
GDP	0.030 (0.95)		0.041 (1.37)		0.130 *** (3.77)		0.130 *** (4.01)		-0.043 (-0.94)		-0.045 (-0.91)	
POP	0.133 (0.81)		0.130 * (1.65)		-0.022 (-0.20)		-0.023 (-0.21)		-0.220 (-0.79)		-0.213 * (-1.87)	
LC	6.131 (1.27)		6.066 *** (2.63)		6.442 ** (2.19)		6.559 ** (2.31)		17.591 ** (2.54)		17.389 *** (5.46)	
LC*AFTER	-0.990 *** (-3.10)		-1.021 *** (-4.02)		0.474 (0.99)		0.462 (1.47)		-2.295 *** (-5.04)		-2.289 *** (-5.21)	
c_t		1.056 *** (13.93)		1.046 *** (22.71)		1.033 *** (12.51)		1.036 *** (19.30)		1.069 *** (13.55)		1.068 *** (20.68)
Rmin		-9.797 (-1.26)		-15.475 (-1.34)		-0.442 (-0.39)		-1.147 (-1.01)		0.625 ** (2.06)		0.622 *** (4.47)
Rmin*AFTER		12.528 (1.13)		4.953 (0.12)		-3.663 (-0.36)		-6.171 (-0.42)		-0.493 * (-1.66)		-0.491 *** (-3.49)
constant	7.019 (0.89)	6.049 *** (9.18)	4.598 (0.68)	6.102 *** (9.12)	-6.336 (-0.98)	7.263 *** (11.25)	-9.142 (-1.36)	7.247 *** (9.55)	33.217 *** (2.96)	6.198 *** (8.74)	32.409 *** (3.53)	6.202 *** (8.64)
Lambda (λ)				-80.6				-0.2				-0.3
$H_0 = \lambda = 0$ [Prob> χ^2]				0.71				0.53				0.31
$H_0 = \lambda = 1$ [Prob> χ^2]				0.71				0.00				0.00
Lambda*AFTER (λ_{after})				25.8				-1.2				0.2
$H_0 = \lambda = 0$ [Prob> χ^2]				0.91				0.71				0.32
$H_0 = \lambda = 1$ [Prob> χ^2]				0.91				0.49				0.00
Observations	562	562	562	562	507	507	507	507	496	496	496	496
R-squared	0.90	0.81			0.92	0.78			0.86	0.73		

Notes: All regressions include banks' fixed effects and robust standard errors. Robust t statistics are presented in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. The estimations are performed for quarterly data during the 1995-2002 period. Columns (1)-(2), (5)-(6) and (9)-(10) refer to the independent OLS estimation of the two equations in the model, while the remaining columns consider the constraint included in the system, estimated using a seemingly unrelated (SUR) model. AFTER is a binary variable which takes the value one if the observation is on or after 2000. The interest rates refer to the new loans granted in each quarter. LC is a measure of local competition and POP is a measure of the importance of each market to bank i in period t . LC and POP are defined in Section 2.1. C_t is a measure of weighted funding costs, taking into account deposits and interbank funding. Rmin is a variable that measures the strategic interaction between banks, being defined as $Rmin = (1/nbanks) * Ljt / Lit * (rjt - ct)$, where Ljt and rjt are, respectively, the loan flow and the interest rates of each banks' rival, defined as that with the lowest interest rate in that quarter, in each market segment.

The t statistics for the coefficient associated with $ln(rit)$ in columns (3), (7) and (11) are omitted, as this coefficient is determined by a constraint in the model. The lower number of observations in the regressions for households and firms is due to the fact that some small banks show null credit flows in one of these market segments in some quarters (two small banks never grant credit to firms during the entire sample period). Lambda reflects the effect of the rival banks on the profit maximization function of each bank and is derived from a combination of the estimated coefficients, resulting from the model.

Table 4 - Analysis credit flows and interest rate levels in different scenarios - counterfactual

	All banks				Banks directly involved in mergers				Banks not directly involved in mergers			
	Observed in the pre-merger period (1)	Observed in the post-merger period (2)	Estimated for the after-merger period (without merger effect) (3)	Estimated for the post-merger period (keeping branch network at pre-merger levels) (4)	Observed in the pre-merger period (5)	Observed in the post-merger period (6)	Estimated for the after-merger period (without merger effect) (7)	Estimated for the post-merger period (keeping branch network at pre-merger levels) (8)	Observed in the pre-merger period (9)	Observed in the post-merger period (10)	Estimated for the after-merger period (without merger effect) (11)	Estimated for the post-merger period (keeping branch network at pre-merger levels) (12)
Credit flows (ln)												
Total	5.76	5.81	5.93	4.72 ***	5.50	5.76	5.33 *	3.98 ***	6.16	5.88	6.68 ***	5.65
Households	4.10	4.77	5.26 ***	4.97 *	3.74	5.07	5.13	4.93	4.60	4.37	5.44 ***	5.02 ***
Firms	5.59	6.01	4.36 ***	3.86 ***	5.39	6.14	3.92 ***	3.26 ***	5.84	5.89	4.79 ***	4.43 ***
Interest rates												
Total	11.46	8.20	9.53 ***	9.53 ***	12.18	8.92	10.71 ***	10.71 ***	10.39	7.30	8.06 ***	8.06 ***
Households	13.31	9.37	11.08 ***	11.08 ***	14.49	10.46	12.34 ***	12.34 ***	11.68	7.96	9.46 ***	9.46 ***
Firms	11.03	6.83	8.92 ***	8.92 ***	11.30	6.58	9.74 ***	9.74 ***	10.68	7.07	8.14 ***	8.14 ***

Notes: The estimations are performed for quarterly data during the 1995-2002 period. The pre-merger period comprehends the 1995-1999 period, whereas the post-merger period goes from 2000 to 2002. The group of financial institutions directly involved in the merger includes institutions belonging to financial groups that have acquired or sold a financial institution to a different financial group in 2000. The interest rates refer to the new loans granted in each quarter. Columns (3), (7) and (11) present the counterfactual estimates for the post-merger period, by taking into account the pre-merger equilibrium and the post-merger environment. Columns (4), (8) and (12) present similar counterfactual estimates for the post-merger period, with the difference that the branch network is assumed to remain unchanged at pre-merger levels. Asterisks refer to mean comparison tests between the counterfactual and the observed post-merger variables. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5 - Decomposition of merger impacts using counterfactual analysis

	All banks					Banks directly involved in mergers					Banks not directly involved in mergers				
	Mean of initial estimation error	Changes in exogenous environment	Changes in branch network and market structure	Other structural changes and prediction error	Total effect	Mean of initial estimation error	Changes in exogenous environment	Changes in branch network and market structure	Other structural changes and prediction error	Total effect	Mean of initial estimation error	Changes in exogenous environment	Changes in branch network and market structure	Other structural changes and prediction error	Total effect
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Credit flows (ln)															
Total	0.00	-0.80	1.05	-0.20	0.05	0.00	-1.22	1.14	0.34	0.26	0.00	-0.35	0.93	-0.86	-0.28
Households	0.00	0.97	0.23	-0.53	0.67	0.00	1.32	0.11	-0.10	1.33	0.00	0.48	0.37	-1.08	-0.23
Firms	0.00	-1.73	0.64	1.52	0.42	0.00	-2.19	0.90	2.03	0.74	0.00	-1.37	0.38	1.03	0.05
Interest rates															
Total	0.00	-2.25	0.00	-1.01	-3.26	0.00	-1.85	0.00	-1.41	-3.26	0.00	-2.58	0.00	-0.51	-3.09
Households	0.00	-2.48	0.00	-1.47	-3.95	0.00	-2.45	0.00	-1.57	-4.03	0.00	-2.39	0.00	-1.33	-3.72
Firms	0.00	-2.45	0.00	-1.76	-4.20	0.00	-2.14	0.00	-2.59	-4.72	0.00	-2.65	0.00	-0.97	-3.62

Notes: The estimations are performed for quarterly data during the 1995-2002 period. The pre-merger period comprehends the 1995-1999 period, whereas the post-merger period goes from 2000 to 2002. The group of financial institutions directly involved in the merger includes institutions belonging to financial groups that have acquired or sold a financial institution to a different financial group in 2000. The interest rates refer to the new loans granted in each quarter. The mean of the initial estimation error (1) is the difference between the variable mean in the pre-merger period and the value predicted by the model for that period. The change in exogenous environment (2) is the difference between the estimated value for the after merger period keeping the branching network at pre-merger levels and the value predicted for the pre-merger period. The change in the branch network (3) is the difference between the values estimated for the post-merger period with and without changes in branches. Other structural changes (4) are the difference between the values estimated and observed for the after merger period. The total effect (5) is the sum of all the previous effects, being the difference between the values observed after and before the merger wave.

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