Shocks at large banks and banking sector distress: the Banking Granular Residual

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Discussion Paper
Series 2: Banking and Financial Studies
No 04/2009

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ISBN 978-3–86558–495–3 (Printversion)
ISBN 978-3–86558–496–0 (Internetversion)

Abstract

Size matters in banking. In this paper, we explore whether shocks originating at large banks affect the probability of distress of smaller banks and thus the stability of the banking system. Our analysis proceeds in two steps. In a first step, we follow Gabaix (2008a) and construct a measure of idiosyncratic shocks at large banks, the so-called Banking Granular Residual. This measure documents the importance of size effects for the German banking system. In a second step, we incorporate this measure of idiosyncratic shocks at large banks into an integrated stress-testing model for the German banking system following De Graeve et al. (2007). We find that positive shocks at large banks reduce the probability of distress of small banks.

Keywords: banking sector distress, size effects, shock propagation, Granular Residual

JEL-classification: E44, E52, E32, G21

Non-technical summary

Size effects matter in banking. Typically, banking systems are dominated by a small number of large players who are also active in a large range of countries and market segments. At the same time, there exist small and often regionally-focused financial institutions. This holds also for the German banking system, which is characterized by a lower degree of concentration than banking systems in other industrialized countries.

In this paper, we explore whether and how the size distribution of banks affects the stability of the German banking system. We are particularly interested in the question whether idiosyncratic shocks originating at large banks affect the distress probabilities of small und mid-sized banks. Our empirical analysis of the link between shocks at large banks and banking distress proceeds in two steps.

In a first step, we apply an idea of Gabaix (2008a) and construct a so-called Granular Residual for the banking industry. Gabaix (2008a) shows that firm sizes follow a power law distribution, i.e. a few large firms coexist with many small firms. If all firms were of the same size, idiosyncratic shocks affecting a few firms would cancel out in the aggregate and would have no systemic implications. Yet, one implication of the power law distribution is that idiosyncratic shocks hitting large firms do not average out. Instead, these shocks can have implications for aggregate outcomes. Our data show that this dichotomous size distribution also characterizes the German banking system. We thus take shocks at large banks as proxies for large events affecting the banking industry. In contrast to Gabaix, our focus is not on the implications of shocks at large banks – the

"Banking Granular Residual" – for aggregate outcomes but for the stability of smaller banks.

In a second step, we introduce the Banking Granular Residual into a micro-macro stress-testing framework for the German banking system that has recently been proposed by De Graeve et al. (2007). The micro-level explains the distress probabilities of banks. The macro-level is described by a vector autoregressive (VAR) model. We explicitly introduce an analysis of large banks into the model. In the period under study, these banks are not affected by distress events but idiosyncratic shocks hitting these banks can have implications for the default probabilities of smaller banks. In other words, we explicitly introduce a micro-micro link between small and large banks, and we analyze how this link affects the feedback from the micro- to the macro-level.

Overall, we find evidence for size effects in the German banking system. Shocks at large banks affect the probability of distress of small and mid-sized banks in Germany. Positive shocks at large banks reduce the smaller banks' probability of distress, while negative shocks increase this probability. This result is robust against various modifications of our empirical model concerning the measurement of the Banking Granular Residual and the estimation method. Hence, we highlight one channel through which concentration in the banking sector and systemic stability could be linked. A broad assessment of the concentration-stability-nexus would, of course, have to take alternative mechanisms into account. Interestingly, we find an impact of large on small banks even for a country like Germany, which is characterized by a relatively low degree of concentration in its banking system. It would be interesting to study the importance of the Banking Granular Residual for other countries with a higher degree of concentration in the banking sector.

Nicht-technische Zusammenfassung

Größeneffekte spielen im Bankensystem eine wichtige Rolle. Typischerweise gibt es einige wenige Institute, die in zahlreichen Marktsegmenten im In- und Ausland tätig sind, neben kleineren und mittelgroßen Banken, die sich auf bestimmte Märkte konzentrieren. Auch wenn das deutsche Bankensystem tendenziell einen geringeren Konzentrationsgrad aufweist als Bankensysteme in anderen Industrieländern, so ist auch hier eine ähnlich dichotome Struktur des Bankensektors zu beobachten.

In diesem Papier gehen wir der Frage nach, inwiefern die Größenverteilung von Banken die Stabilität des Bankensystems beeinflussen könnte. Wir untersuchen, ob idiosynkratische Schocks, die große Banken treffen, sich auf die Wahrscheinlichkeit einer ‚Schieflage' (*probability of distress*) kleinerer Banken auswirken. Wir gehen dabei in zwei Schritten vor.

In einem ersten Schritt übertragen wir eine Idee von Gabaix (2008a) auf das Bankensystem. Gabaix konstruiert ein so genanntes *Granular Residual* als ein Maß für Schocks, die große Unternehmen treffen. Hätten alle Banken bzw. Unternehmen die gleiche oder zumindest eine ähnliche Größe, so sollten Schocks, die nur einzelne Unternehmen treffen, im Aggregat keine große Rolle spielen. Größeneffekte würden somit keine Auswirkungen auf aggregierte Entwicklungen haben. Folgt die Größe von Unternehmen aber nicht einer Normalverteilung, sondern bestehen vielmehr einige wenige große neben zahlreichen kleinen Unternehmen, so mitteln sich Schocks nicht über alle Unternehmen. Wir zeigen, dass eine solche ungleiche Größenverteilung auch für das deutsche Bankensystem gegeben ist. In einem solchen Fall können Schocks, die große Unternehmen oder Banken treffen, Implikationen für gesamtwirtschaftliche Entwicklungen haben und als Maß für diese interpretiert werden. Im Gegensatz zu Gabaix ziehen wir das *Granular Residual* für das deutsche Bankensystem aber nicht heran, um aggregierte Entwicklungen zu erklären. Vielmehr untersuchen wir, wie sich große Schocks innerhalb des Bankensystems auf kleine und mittelgroße Banken auswirken.

In einem zweiten Schritt fügen wir dieses *Granular Residual* für das Bankensystem in ein Mikro-Makro-Stress-Testing Modell ein, das von De Graeve et al. (2007) entwickelt wurde. Auf der Mikroebene erklären wir die Wahrscheinlichkeit einer Schieflage von Banken; auf der Makroebene modellieren wir ein Vektorautoregressives Modell. Wir erweitern das Grundmodell, indem wir explizit eine Verbindung zwischen verschiedenen Akteuren auf der Mikroebene – kleinen und großen Banken – einfügen. Dies erlaubt es uns, Auswirkungen von Schocks bei großen Banken, die ansonsten in der Analyse nicht berücksichtigt würden, zu untersuchen. Wir untersuchen somit eine Verknüpfung zwischen Banken auf der Mikroebene, die auch Auswirkungen auf die Verbindung zwischen der Mikro- und der Makroebene hat.

Unsere Ergebnisse zeigen, dass Größeneffekte im deutschen Bankensystem relevant sind. Schocks, die große Banken treffen, beeinflussen die Wahrscheinlichkeit einer Schieflage kleinerer und mittelgroßer Banken. Positive Schocks reduzieren die Wahrscheinlichkeit einer Schieflage, während negative Schocks diese erhöhen. Diese Ergebnisse sind recht stabil bezüglich verschiedener Spezifikationen des empirischen Modells und der Modellierung von Schocks. Inwiefern unsere Ergebnisse Implikationen für die

Verbindung zwischen dem Konzentrationsgrad und der Stabilität eines Finanzsystems haben, lässt sich naturgemäß nicht abschließend beurteilen, da wir nur einen möglichen Transmissionsmechanismus untersuchen. Interessant sind unsere Ergebnisse aber insbesondere deswegen, weil Deutschland als ein Land mit einem relativ geringen Konzentrationsgrad im Bankensektor gilt und Größeneffekte daher a priori weniger bedeutsam sein sollten als in anderen Ländern. Daher wäre es interessant, unsere Ergebnisse auf andere Länder zu übertragen, die einen höheren Konzentrationsgrad ihres Bankensystems aufweisen.

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1 Motivation

Size effects matter in banking. Typically, banking systems are dominated by a small number of large players who are also active in a large range of countries and market segments. At the same time, there exist small and often regionally-focused financial institutions. This dichotomous banking system structure is particularly prevalent in Germany with its numerous savings and cooperative banks and only a few large and internationally active banks.

In this paper, we explore whether and how the size distribution of banks affects the stability of the German banking system. We are particularly interested in the question

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Sven Blank gratefully acknowledges financial support from the *Stiftung Geld und Währung* under the project "Makroökonomische Stresstests zur Analyse und Prävention systemischer Risiken". Katja Neugebauer gratefully acknowledges financial support from the German Research Foundation under the project "The Consequences of Regulatory Differences in the European Banking Market for Market Integration and Systemic Stability" (DFG project number BU1256/7-1). The authors would like to thank the banking supervision department of the *Deutsche Bundesbank* for its hospitality and for access to its bank-level data. We would also like to thank Ferre De Graeve, Michael Koetter, Thomas Kick, Werner Neus, and Kasper Roszbach as well as participants of conferences and seminars at the University of Groningen, the University of Tübingen, Deutsche Bundesbank, and the Institute for Applied Economic Research (Tübingen) for most helpful discussions of an earlier version. Cathérine Tahmee Koch and Ann-Katrin Zink have provided efficient research assistance. All errors and inaccuracies are solely in our own responsibility.

whether idiosyncratic shocks originating at large banks affect the distress probabilities of small und mid-sized banks.

Our empirical analysis of the link between shocks at large banks and banking sector stability proceeds in two steps.

In a first step, we apply an idea of Gabaix (2008a) to the banking industry, and we construct a so-called Banking Granular Residual. Gabaix's original idea has been applied to non-banks. He shows that the idiosyncratic volatility in the sales of the largest non-financial firms in the US can explain a significant fraction of the volatility of US output growth. We take shocks at large banks as proxies for large events affecting the banking industry. In contrast to Gabaix, our focus is not on the implications of shocks at large banks for aggregate outcomes but on the implications of these shocks for the stability of smaller banks.

The Granular Residual hypothesis rests on the assumption that firm size is power law distributed. Power law distributions are fat-tailed, i.e. a few large firms coexist with a very large number of smaller firms. Under a power law distribution, idiosyncratic shocks that hit large firms do not average out in the aggregate as the number of firms increases. Instead, the effects of firm-level shocks on aggregate developments depend on the degree of concentration in an industry. We thus compute the Granular Residual for the German banking system by constructing a measure of shocks to growth in the banks' cost-to-income ratio for the ten largest banks. Size is measured in terms of total operating income. Our results are not sensitive to the use of a specific shock or size measure though. They show the importance of size effects for the banking sector.[1]

In a second step, we introduce the "Banking Granular Residual" into a stress-testing model for the German banking system that has recently been proposed by De Graeve et al. (2007). Building on earlier work by Jacobson et al. (2005), these authors provide an integrated micro-macro stress-testing framework. The micro-level explains the distress probabilities of banks. The macro-level is a vector autoregressive (VAR) model. In the time period under study (1994-2004), distress events for German banks are observed only for smaller and mid-sized banks. Hence, the original model ignores the effects of events – bank failures as well as large shocks – at large banks. On the micro-side, we thus complement the approach by De Graeve et al. by including the Banking Granular Residual for large banks as an additional explanatory variable for the probability of distress of banks. On the macro-side, we estimate the VAR including and excluding the Banking Granular Residual, and we compare the impulse responses qualitatively. Our main interest is in the impact of events at large banks on the probability of distress at smaller banks, but we also test how this affects the feedback between the micro- and the macro-economy.

Overall, we find that shocks at large banks affect the probability of distress of small and mid-sized banks in Germany. Positive shocks at large banks reduce smaller banks' probability of distress, while negative shocks increase this probability. This result is

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[1] We use annual data and focus on the long-run stability of banks rather than short-run liquidity shortages. In principle though, our empirical methodology would be applicable to the study of shorter-run propagation mechanisms as well.

robust against various modifications of our empirical model concerning the measurement of the Banking Granular Residual and the estimation method. We also find that taking the Banking Granular Residual into account has implications for the macroeconomic feedback mechanisms between banking sector distress and monetary policy shocks.

We do not aim at identifying a particular channel of interaction between shocks hitting large banks and the probability of distress of smaller banks. In this sense, our results are consistent with two main explanations of contagion between banks, namely contagion being caused by fundamentals or being caused by investor behavior (Dornbusch et al., 2000; Santor, 2003).[2]

As regards fundamental causes of contagion, our approach is particularly related to linkages between banks through the interbank market.[3] The theoretical model by Allen and Gale (2000) provides an intuition of how liquidity shocks at large banks can be transmitted to smaller banks via interbank linkages. In their model, banks in four regions are linked through bilateral interbank assets and liabilities. 'Normal' liquidity shocks can be diversified across banks and do not become contagious. In this sense, the interbank market serves as a buffer against shocks. However, if one bank in the system is hit by an excess liquidity shock, systemic liquidity crises may occur. This risk is particularly

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2 Empirical studies on contagion in the banking sector include Elsinger et al. (2006) who study correlations across Austrian banks' asset portfolios, Van Lelyveld and Liedorp (2006) who study the impact of failures of large banks, Degryse and Nguyen (2007) who find that time-varying contagion risk across Belgian banks, and Bühler and Prokopczuk (2007) who find that the German banking sector exhibits lower systemic risk than the U.S. banking sector. Upper and Worms (2004) stress the importance of interbank loans in Germany.

3 An alternative fundamental cause of contagion effects could be common shocks such as changes in asset prices or exchange rates (Claessens and Forbes, 2004; Calvo and Reinhart, 1996). Such common shocks can give rise to systemic risks, which we explicitly rule out by focusing on idiosyncratic shocks hitting large banks.

prevalent if banking sector linkages are incomplete and if the liquidity shock is large relative to the liquidity buffers of banks. Hence, the model shows the importance of shocks originating in large banks (or regions) for the probability of default of other banks in the system. We account for this transmission channel by studying the exposure of banks to the Banking Granular Residual as a function of banks' exposure to the interbank market. We find that, in the years under study (1994-2004), the interbank market has played a role as a buffer against shocks.

While our results are consistent with fundamental-based linkages between banks, investor-based contagion due to information asymmetries could be another reason for the feedback mechanisms between shocks at large banks and the probability of distress at smaller banks that we find (Calvo and Mendoza, 1998; Pritsker, 1999). If, for instance, one large bank goes bankrupt, deposits might be withdrawn from other banks in order to obtain liquidity and to avoid further losses. If depositors of small banks observe a shock at a large bank, they might fear that the small bank might be affected as well. If bail outs of smaller banks are deemed unlikely, depositors might withdraw their money although the shock at the large bank might be purely idiosyncratic. While we cannot test the importance of this channel of contagion directly, our findings would not be inconsistent with such an information-based linkage between large and small banks.

The structure of this paper is as follows. In the following Part Two, we summarize the argument made by Gabaix (2008a), and we document size effects in the German banking system. In Part Three, we provide estimates of the impact of the Banking Granular Residual at the micro- and the macro-level. Part Four concludes.

2 Size Effects and the Banking Granular Residual

Large firm effects in the form of a Granular Residual have so far been explored for non-financial firms. Here, we outline the rational of these approaches, and we discuss how the concept can be applied to the banking industry.

2.1 The Granular Residual: The Original Idea

The original concept of the Granular Residual has been developed to analyze the impact of idiosyncratic shocks at large, non-financial firms on the macro-economy. Following Gabaix (2008a) and denoting each firm's sales by $S_{i,t}$, the growth rate of firm's sales can be written as:

$$g_{i,t+1} = \frac{\Delta S_{i,t+1}}{S_{i,t}} = \frac{S_{i,t+1} - S_{i,t}}{S_{i,t}} = \sigma_i \varepsilon_{i,t+1}, \qquad (1)$$

where σ_i is the volatility of firm *i*'s sales, and $\varepsilon_{i,t+1}$ is an independent random shock variable with zero mean and variance one. Total GDP is the sum of output across firms: $Y_t = \sum_{i=1}^{N} S_{i,t}$. Under the assumption that shocks are uncorrelated, the volatility of aggregate GDP is given by the standard deviation of growth rates. Moreover, if all firms have the same volatility, aggregate volatility is equal to firm-level volatility, multiplied by the economy's Herfindahl index:[4]

[4] Note that this argument assumes that volatility is identical across firms, which might be an unrealistic assumption. However, since the focus of this paper is not on aggregation issues, this aspect is not important for the following analysis.

$$\sigma_{GDP} = \sigma \sqrt{\sum_{i=1}^{N} \left(\frac{S_{it}}{Y_t} \right)^2} = \sigma h \,. \qquad (2)$$

The impact of shocks to individual firms on aggregate outcomes depends on the size distribution of firms (Gabaix 2008a).

Suppose all firms *N* in an economy were of equal size. Each firm's effect on the volatility of GDP would thus be given by $\sigma_{GDP} = \frac{\sigma}{\sqrt{N}}$. With large values for *N*, the law of large numbers would apply, and the idiosyncratic impact of a firm's shock on the volatility of GDP would become negligible.

Now suppose that firms are not equally distributed, but that firm size follows a power law distribution. The power law distribution is given by the following cumulative distribution function: $P(X > x) = ax^{-\varsigma}$ for $x > a^{1/\varsigma}$ (Gabaix 2008a). If ς is equal to one, the distribution is called a Zipf distribution. One special feature of this distribution is that, if firm sizes are indeed fat-tailed ($\varsigma < 2$), idiosyncratic shock decay much more slowly than $1/\sqrt{N}$.

Hence, if firm sizes follow a power law distribution, idiosyncratic shocks at the firm-level do not average out but can have an impact on aggregate outcomes. To show this empirically, Gabaix (2008a) constructs the so-called Granular Residual, i.e. a measure of idiosyncratic shock*s:*

$$GR_t = \left(\sum_{i=1}^{K} S_{i,t-1} \right)^{-1} \left(\sum_{i=1}^{K} S_{i,t-1} \left(g_{it} - \overline{g}_t \right) \right) = \left(\sum_{i=1}^{K} S_{i,t-1} \right)^{-1} \left(\sum_{i=1}^{K} S_{i,t-1} \varepsilon_{it} \right), \qquad (3)$$

where $\overline{g_t} = \frac{1}{K}\sum_{i=1}^{K} g_{it}$. Hence, the Granular Residual is the ratio between the size-weighted shocks and total sales of the largest K firms in an economy. As can be seen from (3), the Granular Residual is constructed using data from the 100 largest firms in the sample. For the US, Gabaix (2008a) finds that the Granular Residual explains a large fraction of GDP growth (about 40%) in a time series regression.

2.2 *The Granular Residual: Application to Banking*

Since earlier work has documented the presence of size effects in banking (Pushkin and Aref, 2004), applying the above idea to the banking industry seems a natural next step. Our application differs from the one by Gabaix (2008a) for three reasons. First, whereas he shows how shocks at large firms can affect aggregated outcomes such as the volatility of GDP growth, we want to show how shocks at large banks affect the probability of distress of smaller banks. Second, our focus is not on the implications of shocks at large banks for aggregate outcomes, but for the stability of smaller banks. We take these shocks at large banks as proxies for large events affecting the banking industry. Third, our focus is on cross-sectional transmission channels between large and small firms rather than time series effects. We want to show how shocks at large banks affect a large cross-section of smaller banks, not how shocks at large banks affect the volatility of the aggregate banking sector over time.

The key step towards an application of the Granular Residual to banking is to find a sales and a shock measure for banks. There has been an intensive discussion in the banking literature on the appropriate definition of banks' outputs. Banks do not produce physical products, but services. These services are difficult to quantify, and there is no consensus in the literature on how to define output for a multi-service firm. Benston (1965, 1970) and Bell and Murphy (1968) propose the number of deposit accounts and loans produced. Brigham and Pettit (1970), Gramley (1962), and Grebler and Brigham (1963) opt for total assets, whereas Horvitz (1963), and Schweiger and McGee (1961) use total deposits. Further measures that have been proposed in the literature are earning assets, demand deposits, or gross operating income. (For an overview of different measures of bank outputs and inputs, see Benston (1972).) What we need here is a proxy for banks' output (i) which does not suffer from potentially large measurement errors, and (ii) which is available for a large number of banks. In view of the ongoing securitization of the banking industries, bank loans and deposits are increasingly biased measures of banks' activities. Moreover, banks' asset values are book values which might be affected by differences in accounting practices. An appropriate proxy for bank output should thus be taken from the profit and loss account. Using balance sheet items would mean using stock variables which, in our opinion, are a poor proxy for bank output. For instance, taking total loans as an output measure might be misleading since it is the interest income derived from loans that should be regarded as part of a bank's output. In addition, banks also have non-interest income which can be regarded as part of their output. Therefore, we use total operating income (interest income plus non-interest income) as our output proxy. We also check the robustness of our results, using 'classical' measures of bank output, namely loans and deposits.

As a proxy for idiosyncratic shocks, we use the cost-to-income ratio, which measures the overheads (or costs of running a bank) as a percentage of income generated before provisions. This measure can be regarded as a proxy for the efficiency of a bank. It also comes very close to the productivity measure that Gabaix (2008a) uses. To make our results more comparable to Gabaix's (2008a) findings, we use the inverse of the cost-to-income ratio, indicating that a positive deviation from its mean constitutes a positive shock. However, we also check the robustness of our results and present alternative specifications using total assets, equity, and return on average equity.

Furthermore, we have to determine the number of banks used to calculate the shocks. Gabaix (2008a) uses the largest 100 non-financial firms in the economy. Although the German banking sector is large in terms of the number of banks, it is still much smaller than the non-financial sector which Gabaix (2008a) uses. Therefore, we use only the ten largest banks, ranked by total operating income.[5]

We calculate the Banking Granular Residual according to equation (3), where S_{it} is total operating income of bank *i* at time *t*, and g_{it} is the growth rate of the inverse of the cost-to-income ratio for bank *i* at time *t*. Thus, ε_{it} represents a shock, i.e. the deviation of the growth rate of the inverse cost-to-income ratio at time *t* from its mean growth rate. Therefore, the numerator in the above equation gives a measure for the weighted output shocks of the ten largest banks. In accordance with Gabaix (2008a), we use the total operating income of the ten largest banks in the denominator. [6]

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[5] We also ranked banks by total assets, which is a more general proxy for the size of banks. Results were largely unaffected by the different ranking variable.

[6] Alternatively, it would be possible to use all banks to construct the denominator. However, Gabaix (2008a) shows that the resulting Granular Residual is highly correlated with the measure used here.

2.3 Data and Stylized Facts

In this section, we describe the data on distress events that we use, and we present descriptive statistics on the Banking Granular Residual of German banks.

Data on the Banking Granular Residual

To construct our measure for idiosyncratic shocks to large banks, our main data source is *Bankscope*. Since we need data only on the largest banks, limited coverage of smaller and mid-sized banks in *Bankscope* is not an issue. From *Bankscope*, we retrieve data for all German banks from 1991–2005. Some banks present both consolidated and unconsolidated accounts. In order to eliminate double entries, we keep only those banks with the consolidation codes C1 (consolidated and companion is not on the disc), C2 (consolidated and companion is on the disc), U1 (unconsolidated and companion is not on the disc or if the bank does not publish consolidated accounts), and A1 (aggregated statements with no companion). Furthermore, we eliminate all entries with missing operating income, which we use to order the banks by size.[7]

Despite the comparatively low degree of concentration in German banking (see also Casu and Girardone, 2006), idiosyncratic shocks at the largest banks could have an impact on the banking system as a whole. Idiosyncratic shocks would cancel out in the aggregate if all banks were of equal size. However, bank size follows a power law distribution. To see this, Figure 1 gives the size of banks against the frequency of different bank sizes. To see the robustness of the power law for bank sizes, we contrast our measure of bank size

[7] See Table A3 for a list of the largest banks in the sample.

(total operating income) with an alternative measure (total assets). In both cases, the graphs in the left hand panel show the characteristic form of a power law distribution. The right hand panel shows the distribution in logarithmic form. Comparing the graphs with Gabaix (2008b), one can see that the data resemble a power law distribution quite closely.

Next, we plot the Banking Granular Residual using different shock variables (Figure 2a) and for different output measures (Figure 2b). Figure 2a shows somewhat different patterns according to the shock variable used, the main 'regularity' being a negative spike in 2001 or 2002. Furthermore, there are no systematic ups and downs in the Banking Granular Residual, but this measure fluctuates randomly. Since we want to measure idiosyncratic shocks that are not affected by systemic developments, this seems reasonable.

Figure 2b plots the Banking Granular Residual for different output measures. While we proxy for output with total operating income in our baseline specification, we also check the robustness of our results using loans or deposits. Since the time series patterns of the Banking Granular Residual differ somewhat, we will use these different measures to check the robustness of our results.

Data on Banks' Distress

Bankscope data provide us with information on the largest banks and their output. However, it does not contain information about distress events. To obtain information on distress events affecting small and mid-sized banks, we resort to a confidential database provided by the *Deutsche Bundesbank*. These data for the years 1994-2004 are confidential and are available on the premises of the *Deutsche Bundesbank* only.

We order distress events according to the classification proposed by Kick and Koetter (2007) and used by De Gaeve et al. (2007). We distinguish four distress categories with increasing severity and classify each distress event experienced by an individual bank in each year. The weakest type of distress ("Distress Category I") comprises mandatory announcements by individual banks to the supervisory authority like a drop by more than 25% of annual operational profits or liable capital The second category ("Distress Category II") captures official warnings by the German financial supervisory authority (*Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin*). A more severe sign of banking distress ("Distress Category III") are direct interventions into the ongoing business of a bank by the *BaFin*, like restrictions to lending or deposit taking. Finally, the most severe distress category ("Distress Category IV") comprises all closures of banks and restructuring mergers.

Figure 3 shows the evolution of the number of banks that experienced a distress event relative to the total number of banks between 1994 and 2004. If more than one distress event is observed for a given bank, only the most severe event is considered. For the more severe Distress Categories III and IV, there has been no strong time trend. On average, about 1-2% of the banks have been affected in each year. However, events in Category I (Mandatory Announcements) have increased from about 0.1% in the second half of the 1990s to about 1% between 2002 and 2004. Also, events in Category II (Official Warnings) have increased from about 0.1% to 3% between 1994 and 2004.

3 Implications of the Banking Granular Residual for Macroeconomic Stress-Testing

To analyze the impact of the Banking Granular Residual on distress events of smaller banks and on macroeconomic dynamics, we use an integrated stress-testing model for the German banking system developed by De Graeve et al. (2007). This allows modeling, both, the distress risk of banks and the feedback channels between the micro- and the macro-level.

3.1 The Stress-Testing Framework

The micro-level part of the empirical model describes the relationship between individual banks' probabilities of distress, their structural characteristics, and macroeconomic developments. Explanatory variables are bank-specific covariates, which reflect CAMEL characteristics (an acronym for capitalization, asset quality, management, earnings, and liquidity), and macroeconomic variables. As in De Graeve at al. (2007), our bank-specific variables are the equity ratio, total reserves, customer loans, off-balance sheet activities, size, return on equity, and liquidity. The macroeconomic variables provide the link from the macro- to the micro-sphere, and the macroeconomic building block is a standard vector autoregressive model (VAR). (See Section 3.4 below for details on the VAR model.)

The micro- and the macro-part of the model are combined into an integrated micro-macro approach that allows for simultaneous feedback effects from the macro-economy to the financial sector, and *vice versa*. Hence, the macro-VAR is extended by the estimated probabilities of distress as an additional endogenous variable of the system.

3.2 The Granular Residual and Banking Distress

The key regression equation at the micro-level explains the probability that a bank will experience a distress event, using bank-level and macro-level explanatory variables. This equation is estimated using a pooled logit model. To show the impact of idiosyncratic shocks at large banks, we include the Banking Granular Residual (*GR*) to estimate the probability, *PD*, that bank *i* will experience a distress event at time *t*:

$$PD_{it} = \frac{\exp(\boldsymbol{\beta}\mathbf{X}_{it-1} + \boldsymbol{\pi}\mathbf{Z}_{t-1} + \gamma GR_{t-1})}{1+\exp(\boldsymbol{\beta}\mathbf{X}_{it-1} + \boldsymbol{\pi}\mathbf{Z}_{t-1} + \gamma GR_{t-1})}. \tag{4}$$

The vectors $\mathbf{X}_{it-1}$ and $\mathbf{Z}_{t-1}$ comprise information available at time *t-1* on bank-specific covariates and macroeconomic variables, respectively. Idiosyncratic shocks at large banks are captured by GR_{t-1}. We lag the explanatory variables by one period to allow for a delayed impact on the probability of distress. Since the macroeconomic variables do not vary across the different banks, we cannot include time fixed effects. Note that endogeneity is not an issue, since we use only the ten largest banks to construct the Banking Granular Residual, while distress events are observed for small- and medium-scale banks only.

Empirical results for our baseline regressions are reported in Table 1, Column (1). In Column (2), we add the Banking Granular Residual. In Columns (3)-(6), we show results for the different distress categories.

Our baseline regression has a pseudo-R^2 of 0.11, and the results for bank-level and macro-level variables largely confirm De Graeve et al. (2007). Better capitalized banks, i.e. banks with a higher equity ratio and higher reserves, have a lower probability of distress. The coefficients are negative and highly significant. Higher customer loans and higher off-balance sheet activities imply higher risk, and we expect a positive impact on the probability of distress (see also Kick and Koetter 2007). While off-balance sheet activities are insignificant, customer loans have the expected positive sign. Larger and more profitable banks are less likely to be in distress, as expected. The impact of liquidity is not clear a priori. On the one hand, banks with higher liquidity are less likely to experience a distress event. On the other hand, high liquidity could signal a lack of interest-bearing investment possibilities and thus low profitability. We find a positive sign on liquidity, suggesting that the signaling effect dominates.

A stronger macroeconomic environment, as measured by real GDP growth and increasing inflationary pressure, should reduce the probability of distress. We indeed find a significantly negative coefficient for real GDP growth and for inflation. We also expect a positive impact of the interest rate on the probability of distress, since a high interest rate indicates higher costs of refinancing. However, in contrast to DeGraeve et al. (2007), the influence is insignificant.

Positive shocks to large banks should positively affect the financial stance of small and mid-sized banks and thus reduce the probability of distress. Column (2) shows that the Banking Granular Residual is highly significant and negative, as expected. The remaining results are not only qualitatively but also quantitatively similar. When including the Banking Granular Residual, the pseudo-R^2 slightly increases to 0.12. Idiosyncratic shocks to large banks thus have explanatory power for the probability of distress beyond bank-specific characteristics or the macroeconomic environment. This shows that we miss an important additional channel when thinking about financial stability without considering the role of shocks that originate at large banks.

Next, we investigate whether shocks at the macro-level affect different distress categories differently. We particularly expect a relatively larger impact of macroeconomic, aggregate developments on weaker distress events. A relatively modest violation of regulatory norms as a consequence of adverse macroeconomic developments may be compensated by a competent bank management team. Supervisors may realize this and, hence, harsher sanctions are unlikely. Moreover, measures by the financial supervisor are unlikely to be affected by macroeconomic shocks, but are likely to be the result of bank-specific, idiosyncratic factors.

If we restrict our distress measure to those events characterized by mandatory automatic signals by individual banks (Column 3), the Granular Residual and the macroeconomic aggregates are highly significant. In contrast, liquidity is significant only at the 10%-level, and the equity ratio becomes insignificant.[8] Distress events in terms of interventions by the financial supervisor (Distress Category III, Column 5), cannot be explained by macroeconomic developments though. If mergers and acquisitions were solely initiated by the financial supervisor and head institution of the respective banking group, we would expect little explanatory power of macroeconomic variables to hold for Distress Category IV (Column 6). However, real GDP growth and inflation enter significantly, at the 10%-level and 1%-level, respectively. Hence, the *timing* of distress-

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[8] It could be argued that some bank-level variables are endogenous to one of the distress events. For instance, distress events are triggered by equity capital falling below a certain threshold. However, the first distress category also comprises reports by individual banks if there is a significant drop in the bank's equity. This overrules a potential objection of endogeneity.

related mergers and acquisitions depends, to a certain degree, on the macroeconomic environment.

In Table 2, we explore the impact of shocks to large banks for different banking groups. For the commercial banks (Column 3), most of the estimates are insignificant, and the pseudo-R^2 is only 0.04. This reflects the fact that the commercial banks are the smallest banking group in terms of the number of banks while, at the same time, including very heterogeneous banks. Turning to the cooperative banks (Column 4), we find, apart from size, qualitatively the same results compared to the baseline specification with the Banking Granular Residual (Column 2). This banking group with about 20,000 bank-year observations dominates and drives the results for the full sample. Results for the savings banks (Column 5) are very similar to the ones from the cooperative banks.

3.3 Robustness

We check the robustness of our results in different ways. First, we construct the Granular Residual with different shock and output variables. Second, we use different estimation methods. Third, we study whether the banks' exposure to the interbank market matters.

Different Granular Residuals: We replace our Granular Residual from the baseline specification with alternative measures. In Table 3a, the output measure remains unchanged, but we alter the shock variable to total assets, equity, and return on average equity (ROAE). Results for the micro variables are very stable. By and large, this holds true for the macro variables as well. The Granular Residual remains significant and negative for all specifications. In Table 3b, we change our measure of bank output to loans and deposits. We also use different proxies for the idiosyncratic shocks since loans and deposits should not be affected by shocks to the cost-to-income ratio. To make results comparable, we choose shock variables from Table 3a, namely total assets and equity. We find our results to be very robust to changes in the output measure.

Estimation method: In unreported regressions, we re-estimate our model using different panel data models. First, we employ a panel logit with random effects. Our results from the pooled logit remain unchanged. In a next step, we go back to our original estimation method, but we incorporate standard errors that are clustered across banks. Our qualitative results do not change.

Interbank propagation channels: The concept of the Granular Residual is a-theoretical in the sense that the effects of idiosyncratic shocks to large players do not depend on specific assumptions on linkages between banking firms. The obvious linkage mechanism is the interbank market (see, e.g., Allen and Gale 2000). We investigate the importance of this channel using bank-level information on the importance of (aggregate) interbank linkages. Columns (2) to (4) of Table 4 present our estimation results when including information on interbank linkages. Our previous results remain stable (Column 1). Higher interbank assets significantly decrease the individual probability of distress (at the 10%-level), whereas interbank liabilities and the sum of interbank assets and liabilities are insignificant. Hence, in the period under study (1994-2004), the interbank market provided an insurance mechanism to buffer shocks.

3.4 Effects on the Macro-Economy: VAR Estimation

So far, we have shown that idiosyncratic shocks at large banks affect the probability of distress of smaller and mid-sized banks. But how is the link between the micro- and the macro-level affected? We answer this question by investigating the sensitivity of the VAR model to including the Banking Granular Residual at the micro-level.

We follow De Graeve et al. (2007) and proceed in two steps. First, we estimate a VAR to analyze the impact of the banking sector on the macro-economy. The VAR comprises a system of the three macroeconomic variables – GDP growth, inflation, and the interest rate. We also include the aggregate distress frequency as an exogenous variable. This allows assessing the impact of the financial stance on macroeconomic aggregates. Given the short time interval of ten years, for which annual distress data are available, an alternative quarterly indicator is created instead. This indicator relies on subset databases which cover only about 75% of all events. The pure macro VAR is given by:

$$\mathbf{Z}_q = \mathbf{\Pi}^{mm}\mathbf{Z}_{q-1} + \mathbf{\Pi}^{fm} PD_{q-1} + \boldsymbol{\varepsilon}_q\,, \qquad (5)$$

where PD is the aggregate distress frequency and $\mathbf{Z}$ is the vector of macroeconomic variables. The Matrix $\mathbf{\Pi}^{mm}$ captures the impact of the macroeconomic variables on themselves, and the vector $\mathbf{\Pi}^{fm}$ gives the influence of the financial stance on the real side of the economy.

The model described by equation (5) is not suited to address the influence of the macroeconomic variables on financial sector distress. Hence, in a second step, a combined model that links the micro- to the macro-level is estimated. The extended model allows for simultaneous feedback effects from the micro- to the macro-sphere, and vice versa. The VAR is augmented by the estimated probabilities of distress as an additional endogenous variable. Hence, in the combined model, the marginal effects of the macroeconomic variables on the probability of distress obtained from the micro estimation from Section 3.2 are included. Note that the bank-specific covariates as well as the Banking Granular Residual are assumed to be exogenous in the integrated model. While it would, in principle, be possible to endogenize the bank-specific variables, this is impossible for the Banking Granular Residual, since it measures idiosyncratic shocks, which are by definition, exogenous. However, the marginal effects of the macro variables on the probability of distress also depend on the level of all other variables in the micro model.[9] Hence, there is an indirect impact of the Banking Granular Residual on the variables of the combined model. See also DeGraeve et al. (2007) for a discussion. Since the distress events are observed annually and thus at a lower frequency than the macroeconomic variables, the quarterly VAR has to be rewritten in annual form to combine the micro and the macro part into a unifying framework:

$$\begin{pmatrix} \mathbf{Z} \\ PD \end{pmatrix}_a = \begin{pmatrix} \mathbf{\Pi}^{mm} \\ \mathbf{\Pi}^{mf} \end{pmatrix} \mathbf{Z}_{a-1} + \begin{pmatrix} \mathbf{\Pi}^{fm} \\ \mathbf{\Pi}^{ff} \end{pmatrix} PD_{a-1} + \boldsymbol{\varepsilon}_a . \qquad (6)$$

The parameter vector $\mathbf{\Pi}^{mf}$ comprises the marginal effects estimated at the micro-level. The impact of the stance of the financial sector on itself is captured by $\mathbf{\Pi}^{ff}$.

Having established an extended micro-macro system, we analyze how a monetary policy shock affects the system. The identification of this shock is done using sign restrictions as proposed by Uhlig (2005). As in De Graeve et al. (2007), we model a monetary policy shock via a positive interest rate shock, and we restrict GDP growth and inflation to react negatively to a positive interest rate shock during the first year.

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[9] This is just a consequence of the non-linear nature of the micro model.

The top panel (a) of Figure 4 shows the response of the system to a one standard deviation shock to the interest rate without the Banking Granular Residual. As imposed by the restrictions, real GDP growth is negative initially and gradually reverts to its original level. Also, inflation is negative during the first year and slightly positive in subsequent periods before it returns to its original value. The aggregate probability of distress reacts positively to a monetary tightening and gradually reverts to its original level, but its response is insignificant initially.

However, if the Granular Residual is used as an additional explanatory variable to estimate the probability of distress, this pattern changes, as shown in the bottom panel (b) of Figure 4. There are some changes in the reaction of the macroeconomic variables. After the initial negative reaction as imposed by the sign restrictions, real GDP growth is positive but levels off in the second year following the shock. Moreover, inflation turns negative after two years.. The most striking change is the response of the probability of distress which is far from being significant for all periods. One interpretation is that, in panel (a), we measure the unconditional impact of monetary policy on banks' probability of distress. Once we account for the fact that the probability of distress in smaller banks also depends on the Banking Granular Residual, the (conditional) impact of monetary policy becomes insignificant. Note, however, that these results should not be overemphasized since, even in panel (a), the impact of monetary policy on the distress probabilities is not large.

4 Conclusions

Adverse shocks to large financial institutions can have an impact on the soundness of the banking system. These shocks can affect aggregated banking sector outcomes, and they can affect the probability of distress of small and mid-sized banks. In this paper, we have asked whether shocks originating at large banks affect the probability of distress of smaller banks in Germany.

To answer this question, we have analyzed the propagation of shocks between small and large banks both from a micro- and from a macroeconomic perspective. Our data for distress events at German banks come from the distress database provided by the *Deutsche Bundesbank*. Information on large banks, which we use to compute the Banking Granular Residual, comes from *Bankscope*. Following Gabaix (2008a), we have computed a Banking Granular Residual as a proxy for idiosyncratic shocks at large German banks. We have also introduced the Banking Granular Residual into a micro-macro stress-testing framework for the German banking system that has recently been proposed by De Graeve et al. (2007). The micro-level explains the distress probabilities of banks. The macro-level is described by a vector autoregressive (VAR) model.

Our analysis has three main findings. First, the size distribution of German banks is uneven, and the banking market is dominated by a few large players. This holds even though the market share of these large banks in Germany is smaller than those in other industrialized countries.

Second, shocks at large banks affect the probability of distress of small and mid-sized banks in Germany. Positive shocks at large banks reduce the smaller banks' probability of distress, while negative shocks increase this probability. The remaining bank-level and macro-level determinants of banks' probability of distress are unaffected by taking this propagation channel into account. Size and profitability lower the probability of distress while higher exposure to customer loans increases this probability. These results are driven by distress events of cooperative banks, which dominate the sample in terms of absolute numbers and in terms of the number of distress events.

Third, once the Banking Granular Residual is taken into account, the macroeconomic feedback mechanism between banking sector distress and monetary policy shocks changes. Most importantly, the impact of the Granular Residual on the distress frequency becomes insignificant in the macro-model when accounting for the fact that the probability of distress of smaller banks also depends on developments in large banks.

The results of this paper have a number of potentially important policy implications. They suggest, first of all, that links between macroeconomic developments and the probability of distress of individual banks may be driven by idiosyncratic developments at large financial institutions. This micro-micro link could be a useful building block of empirical stress-testing models. Preliminary results also show that the exposure to the Banking Granular Residual is dampened if banks have a large exposure to the interbank market. This result emphasizes the role of the interbank market as a channel for the transmission of shocks across banks.

References

Allen, F., and D. Gale (2000). Financial Contagion. *Journal of Political Economy* 108 (1): 1-33.

Allen, F., and D. Gale (2004). Competition and Financial Stability. *Journal of Money, Credit and Banking* 36(3): 453-480.

Bell, F.W., and N.B. Murphy (1968). Costs in Commercial Banking. A Quantitative Analysis of Bank Behavior and its Relation to Bank Regulation. Research Report No. 41, Federal Reserve Bank of Boston.

Benston, G.J. (1965). Economomies of Scale and Marginal Costs in Banking Operations. *The National Banking Review* 2: 507-549.

Benston, G.J. (1970). Cost of Operations and Economies of Scale in Savings and Loan Associations, in: Study of the Savings and Loan Industry. Federal Home Loan Bank Board. Washington: U.S. Government Printing Office: 677-761.

Benston, G.J. (1972). Economies of Scale of Financial Institutions. *Journal of Money, Credit, and Banking* IV: 312-341.

Bikker, J.A., and K. Haaf (2002). Competition, Concentration and Their Relationship: An Empirical Analysis of the Banking Industry. *Journal of Banking and Finance* 26: 2191-2214.

Black, H.A., and C. Collins (1997). Changes in Market Perception of Riskiness: The Case of Too-Big-to-Fail. *The Journal of Financial Research* XX(3): 389-406.

Boyd, J.H., and De Nicoló, G. (2005). The Theory of Bank Risk Taking and Competition Revisited. *The Journal of Finance* 60 (3): 1329-1343.

Brigham, E.F., and R. Richardson Pettit (1970). Effects of Structure on Performance in the Savings and Loan Industry, in: *Study of the Savings and Loan Industry*.

Federal Home Loan Bank Board. Washington: U.S. Government Printing Office: 971-1209.

Bühler, W., and M. Prokopczuk (2007). Systemic Risk: Is the Banking Sector Special?, mimeo, University of Mannheim.

Calvo, G., and E. Mendoza (1997). Rational Herd Behavior and the Globalization of Securities Market, Federal Reserve Bank of Minneapolis: *Discussion Paper/Institute for Empirical Macroeconomics*, 120.

Calvo, S., and C. Reinhart (1996). Capital Flows to Latin America: Is There Evidence of Contagion Effects?, in: *Private Capital Flows to Emerging Markets after the Mexican Crisis*. (G. A. Calvo, M. Goldstein and E. Hochreiter, eds.), Institute for International Economics, Washington, D.C.

Casu, B., and C. Girardone (2006). Bank Competition, Concentration and Efficiency in the Single European Market. *The Manchester School* 74(4), Special Issue, 441-468.

Cavallo, L., and S.P.S. Rossi (2001). Scale and Scope Economies in the European Banking System. *Journal of Multinational Financial Management* 11, 515-531.

Claessens, S., and K. Forbes (2004). International Financial Contagion: The Theory, Evidence and Policy Implications, Paper presented at World Economic Forum/Reinventing Bretton Woods Committee Conference on"The IMF's Role in Emerging Market Economies" in Amsterdam.

De Graeve, F., T. Kick, and M. Koetter (2008). Monetary Policy and Financial (In)Stability: An Integrated Micro-Macro Approach. *Journal of Financial Stability* 4(3),205-231.

Degryse, H., and G. Nguyen (2007). Interbank Exposures: An Empirical Examination of Contagion Risk in the Belgian Banking System. *International Journal of Central Banking* 3, 123-172.

Dornbusch, R., Y.C. Park, and S. Claessens (2000). Contagion: How It Spreads and How It Can Be Stopped. *The World Bank Research Observer* 15(2): 177-197.

Elsinger, H., A. Lehar, and M. Summer (2006). Risk Assessment for Banking Systems. *Management Science* 52(9), 1301-1314.

Gabaix, X. (2008a). The Granular Origins of Aggregate Fluctuations. Available at SSRN: http://ssrn.com/abstract=1111765.

Gabaix, X. (2008b). Power Laws in Economics and Finance. A survey for the inaugural issue of the *Annual Reviews of Economics*. National Bureau of Economics Research. NBER Working Paper 14299, Cambridge, MA.

Gramley, L.E. (1962). *A Study of Scale Economies in Banking*. Kansas City, Mo.: Federal Reserve Bank of Kansas City.

Grebler, L., and E.F. Brigham (1963). *Savings and Mortgage Markets in California*. Pasadena: California Savings and Loan League.

Horvitz, P.M. (1963). Economies of Scale in Banking, in: *Private Financial Institutions*. Englewood Cliffs, N.J.: Prentice-Hall: 1-54.

Jacobson, T., J. Lindé, and K. Roszbach (2005). Exploring Interactions Between Real Activity and the Financial Stance. *Journal of Financial Stability* 1(3): 308-341.

Kick, T., and M. Koetter (2007). Slippery Slopes of Stress: Ordered Failure Events in German Banking, *Journal of Financial Stability* 3(2): 132-148.

Lelyveld, I., and F. Liedorp (2006). Interbank Contagion in the Dutch Banking Sector: A Sensitivity Analysis, *International Journal of Central Banking* 2(2): 99-133.

Pritsker, M. (2000). The Channels for Financial Contagion, mimeo, Federal Reserve Board, Washington, D.C.

Pushkin, D.O., and H. Aref (2004). Bank Mergers As Scale-Free Coagulation. *Physica* A 336: 571-584.

Schinasi. G.J., and R.T. Smith (2000). Portfolio Diversification, Leverage, and Financial Contagion. *IMF Staff Papers* 47(2): 159-176.

Schweiger, I., and J.S. McGee (1961). Chicago Banking. The Structure and Performance at Banks and Related Financial Institutions in Chicago and Other Areas. *The Journal of Business* XXXIV: 201-366.

Uhlig, H. (2005). What are the Effects of Monetary Policy on Output? Results From an Agnostic Identification Procedure. *Journal of Monetary Economics* 52: 381-419.

Upper, C., and A. Worms (2004). Estimating Bilateral Exposures in the German Interbank Market: Is There a Danger of Contagion? *European Economic Review* 48(4): 827-849.

5 Data Appendix

Data on Banking Distress

To measure the soundness of the German banking sector, we use confidential information from the distress database of the *Deutsche Bundesbank* for individual banks at an annual frequency for the period 1994-2004. These data allow for a distinction between different distress categories that differ in terms of severity of distress observed. Following Kick and Koetter (2007), we distinguish

- Mandatory announcements by individual banks to the supervisory authority (Distress Category I),
- Official warnings by the *Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin)* (Distress Category II),
- Direct interventions into the ongoing business of a bank by the *BaFin* (Distress Category III), and
- All events that reflect the disappearance of a bank from active business operations such as closure of a bank or restructuring mergers (Distress Category IV).

Data on Bank-Level Covariates

Information on individual bank balance sheets comes from data collected by the *Deutsche Bundesbank*. These bank-level data are constructed as in De Graeve et al. (2007). We use core capital to risk-weighted assets (equity ratio), total reserves to total assets, customer loans to total assets, off-balance sheet activities to total assets, log of total assets (size), return on equity, and finally, cash and short-term net interbank assets to total assets (liquidity), total interbank assets and liabilities to total assets. All variables, except for size, are given in percent.

To compute the basic version of the Banking Granular Residual, we use data taken from the *Bankscope* database as provided by Bureau van Dijk. We use total assets, equity, total operating income, total loans, total deposits, and return on average equity. All variables (except for return on average equity) are on a yearly basis and in million (see Table A1).

Bankscope Data

Banking groups: Bankscope offers two different ways of doing splitting the data into different banking groups, using a general specialization or a country-specific specialization. For our purpose, the country-specific specialization proves to be more accurate. We create the following groups of banks: 1. all banks (2,656), 2. all banks excluding central banks (2,631), 3. commercial banks (274), 4. local cooperatives (1,487), and 5. local savings banks (627).

We use the second sample for the calculation of the Banking Granular Residual, thus excluding all banks that are coded as being central banks.

Macroeconomic Data

All macroeconomic data are at a quarterly frequency as provided by the *Kiel Institute for the World Economy* and published by the *Statistisches Bundesamt* (Fachserie 18: Volkswirtschaftliche Gesamtrechnung, Reihe 1.2) and the *Deutsche Bundesbank*:

- Growth in real Gross Domestic Product (GDP): constructed as percentage change using seasonally adjusted data on GDP (in billion Euros) in chained constant prices (with base year 2000),
- Inflation: calculated as the percentage change in the price index represented by the GDP deflator,
- Short-term interest rate: average money market rate given by FIBOR (prior to 1999) and EURIBOR (after 1999) on three-months funds.

Table A1: Data Used to Compute the Banking Granular Residual

	Observations	Mean	Standard deviation	Minimum	Maximum
Equity (million €)	110	8.24	9.61	0.46	58.40
Return on average equity (%)	110	5	12	–64	50
Total assets (million €)	110	251	256	7.09	1,020
Total deposits (million €)	110	138	137	6.10	522
Total loans (million €)	110	115	114	1.83	453
Total operating income (million €)	110	5.41	6.41	0.33	33.60

Table A2: Explanatory Variables of Micro-Level Estimation

Bankspecific and macroeconomic covariates used to estimate banks' probability of distress. Total reserves, customer loans, off-balance sheet activities, liquidity, and interbank assets and liabilities are given relative to total assets. All variables are in percent, except size which is given in logs.

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Customer loans	27,699	11.40	9.52	0.00	100
Equity ratio	27,699	8.46	3.85	4.48	53.57
GDP growth	27,699	1.54	1.13	–0.80	3.50
Inflation	27,699	1.09	1.07	–0.70	3.70
Interbank assets	27,699	12.99	9.93	0.00	95.89
Interbank liabilities	27,699	15.50	11.24	0.00	95.22
Interest rate	27,699	4.01	1.18	2.30	7.30
Liquidity	27,699	6.74	5.10	0.00	96.64
Off-Balance sheet activities	27,699	3.18	2.96	0.01	33.21
Return on equity	27,699	15.31	12.53	–65.64	61.96
Size	27,699	19.21	1.48	15.39	27.33
Total reserves	27,699	0.91	0.81	0.00	13.63

Table A3: List of the Largest Banks

This Table shows the banks that are used to construct the Banking Granular Residual. Since the ranking of banks has changed over the estimation period, there are more than ten banks on the list. Banks belonging to the same group do not appear simultaneously among the ten largest ones in one year. Including the KfW Group does not change the main qualitative results. Central banks including head organizations of the savings and cooperative banks are explicitly excluded from our sample.

BHW Bausparkasse AG
Bausparkasse Schwäbisch Hall AG, Bausparkasse
Bayerische Hypo- und Vereinsbank AG
Bayerische Landesbausparkasse LBS
Citibank Privatkunden AG & Co KGaA
Citicorp Deutschland
Commerzbank AG
Deutsche Bank AG
Deutsche Postbank AG
Dresdner Bank AG
Frankfurter Sparkasse
HASPA Finanzholding
HSBC Trinkaus & Burkhardt AG
KfW Group-KfW Bankengruppe
Kreissparkasse Köln
LBB Holding AG-Landesbank Berlin Holding
LBS Landesbausparkasse Rheinland-Pfalz
LBS Westdeutsche Landesbausparkasse
Landesbausparkasse Saarbrücken
Sparkassen-Finanzgruppe Hessen-Thüringen
Stadtsparkasse München
Volkswagen Financial Services AG
Wüstenrot & Württembergische
Wüstenrot Bausparkasse AG

Figure 1: Size Distribution of Banks

This Figure displays the distribution of bank size, measured by total operating income and total assets, respectively over the whole estimation period (1994-2004). Results are very similar when plotting the graphs for single years. The graphs on the left hand side plot the frequency vs. bank size. The graphs on the right hand side plot the log frequency of bank size vs. the log of bank size.

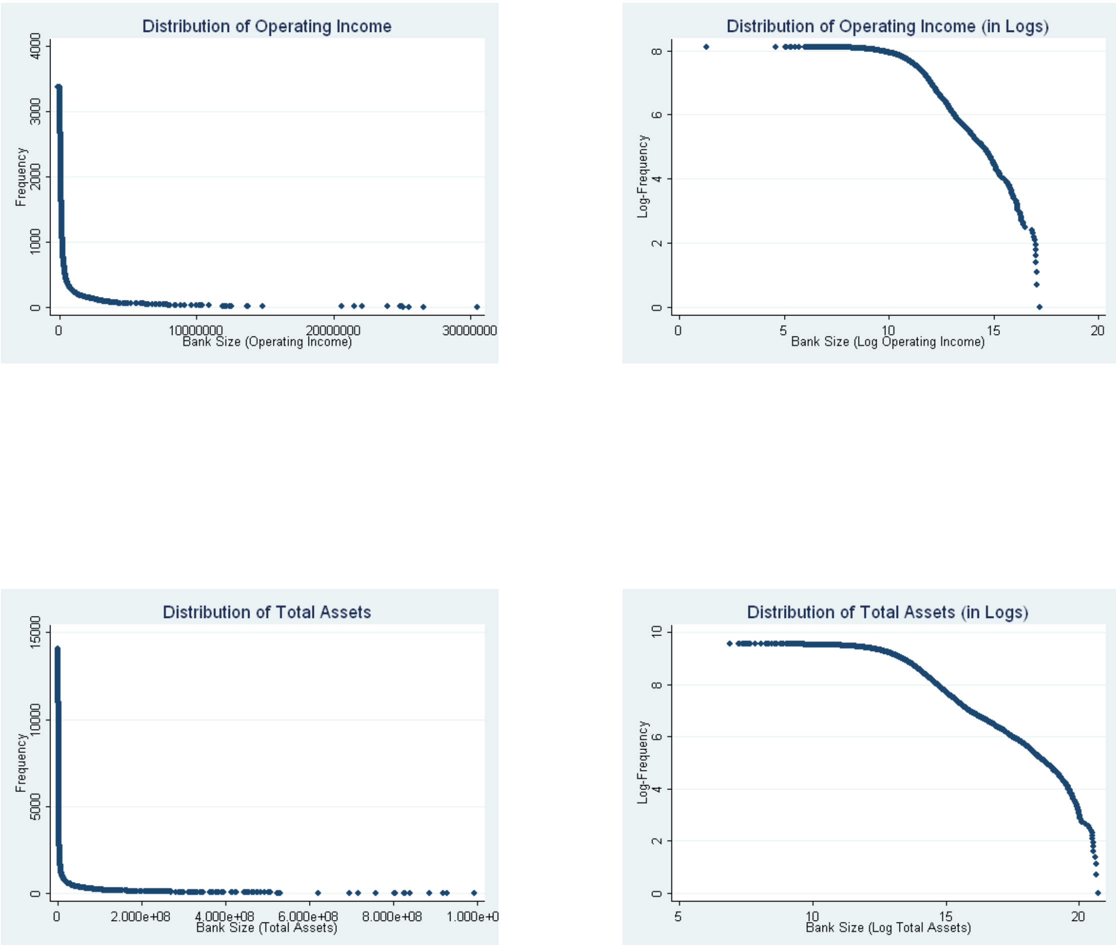
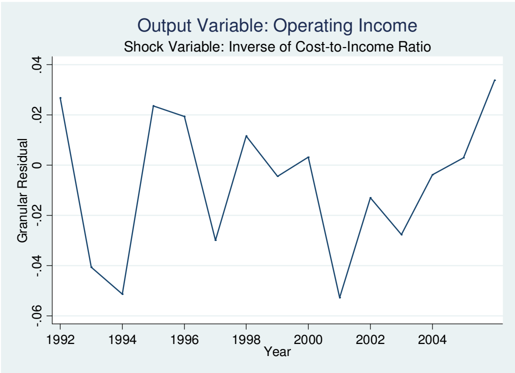


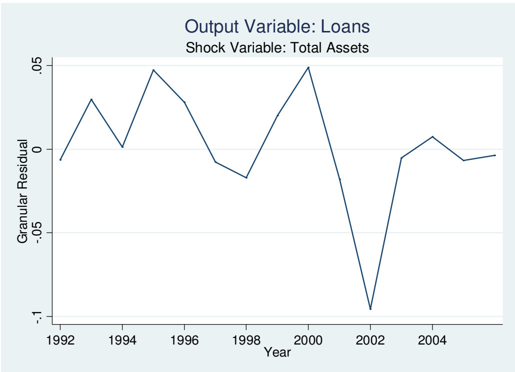
Figure 2: The Banking Granular Residual

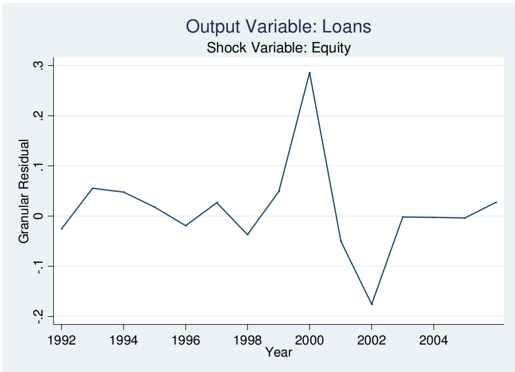
This Figure plots the Banking Granular Residual for different shock variable and output measures. Panel 2a: In the baseline specification (upper left hand graph) the inverse of the cost-to-income ratio is used to construct idiosyncratic shocks. The original shock variable is then substituted by total assets equity, and return on average equity, respectively to examine if different shocks result in different Banking Granular Residuals. Panel 2b: In the baseline specification (upper left hand graph), operating income is used as the output variable. The original output variable is then substituted by loans and deposits, respectively. The shock variable is also changed for the last two specifications to fit the different output measures.

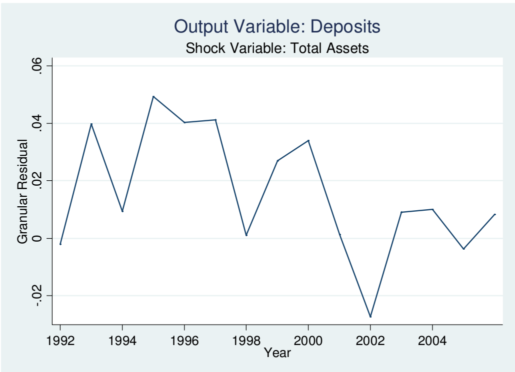
(a) Using Alternative Shock Variables

(b) Using Alternative Output Measures









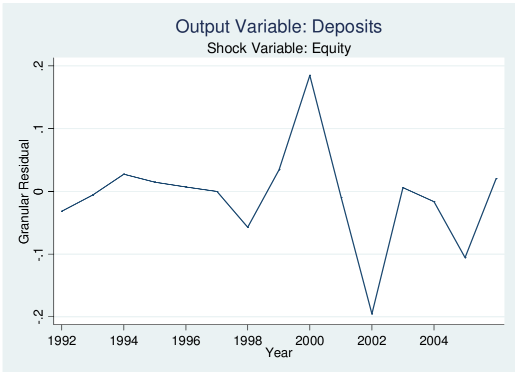


Figure 3: Fraction of Distressed Banks

This figure shows the fraction of distressed banks relative to all banks for the different distress categories for the years 1994 to 2004. If more than one distress event is observed for a bank, only the most severe event is reported.

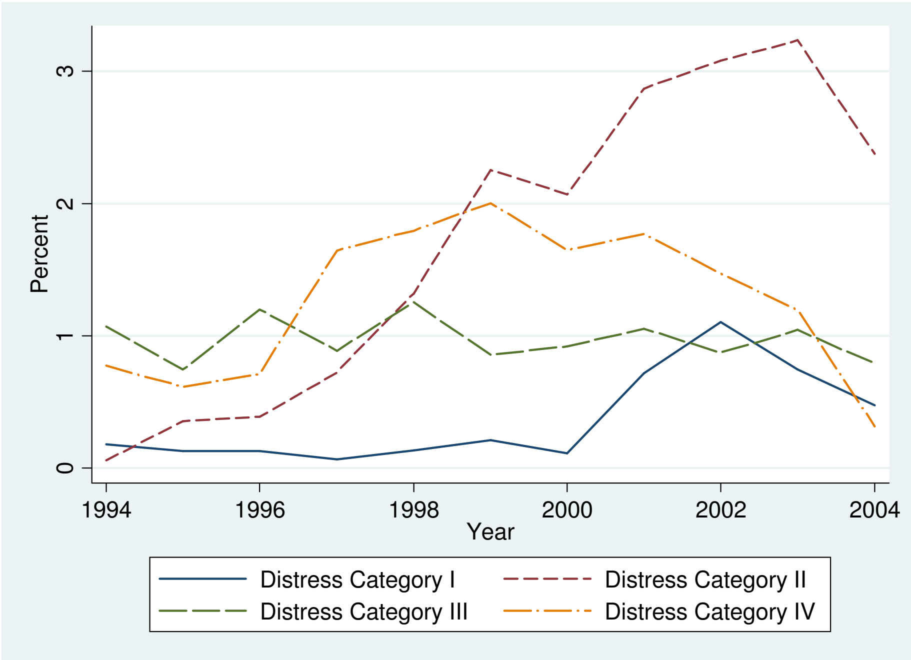
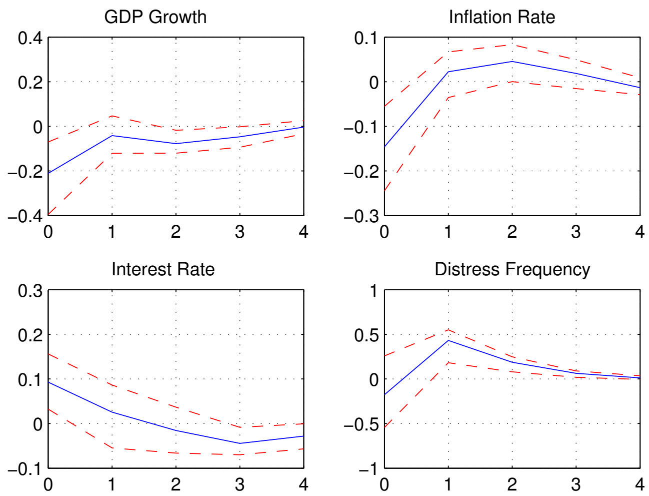


Figure 4: Impulse Responses to a Monetary Policy Shock

This Figure shows median impulse responses of real GDP growth, inflation, the interest rate and the aggregate probability of distress to a one unit standard deviation shock to the interest rate. Impulse responses are plotted for four years after the occurrence of the shock.

(a) VAR without the Banking Granular Residual



(b) VAR including the Banking Granular Residual

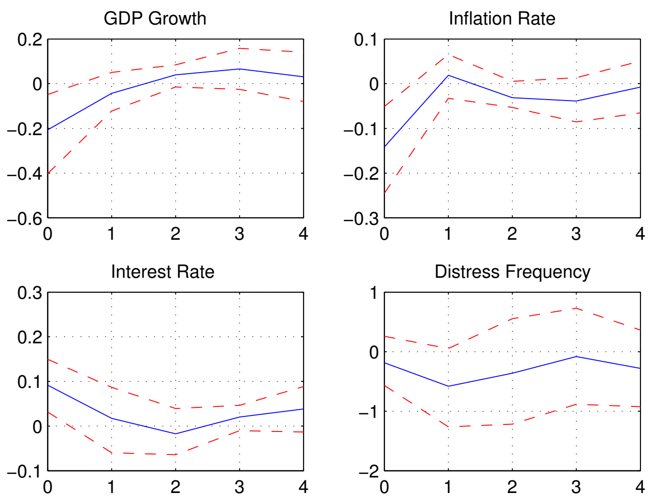


Table 1: Determinants of Banks' Probability of Distress by Distress Category

This Table reports the regression results for the pooled logit estimation without the Granular Residual (Column (1)), with the Granular Residual (Column 2), and for four different distress categories defined in the main text (Columns 3 to 4). All variables are in percent except size (which is given in logs). GR = Granular Residual, ***, **, and * denote significance at a 1%-, 5%-, and 1%-level, respectively.

	(1) Baseline	(2) Baseline with GR	(3) Distress Category I	(4) Distress Category II	(5) Distress Category III	(6) Distress Category IV
Equity ratio	–0.075***	–0.075***	0.009	–0.139***	–0.142***	–0.054**
	(–4.55)	(–4.56)	(0.40)	(–5.00)	(–4.39)	(–2.18)
Total reserves	–0.748***	–0.762***	–0.914***	–0.305***	–1.481***	–1.238***
	(–8.84)	(–8.94)	(–3.43)	(–3.99)	(–3.51)	(–8.08)
Customer loans	0.022***	0.022***	0.016**	0.021***	0.030***	0.018***
	(8.21)	(8.28)	(1.98)	(4.67)	(6.19)	(3.92)
Off–balance sheet	–0.002	–0.001	–0.04	–0.031*	0.021	0.008
Activities	(–0.23)	(–0.06)	(–1.09)	(–1.74)	(1.38)	(0.59)
Size	–0.046**	–0.051**	0.154**	–0.061*	–0.058	–0.136***
	(–2.21)	(2.45)	(2.50)	(1.86)	(–1.59)	(–3.51)
Return on equity	–0.042***	–0.041***	–0.037***	–0.033***	–0.039***	–0.037***
	(–19.27)	(–18.74)	(–8.17)	(–12.28)	(–10.76)	(12.65)
Liquidity	0.030***	0.029***	0.019*	0.037***	0.033***	0.015*
	(5.91)	(5.82)	(1.71)	(5.23)	(3.80)	(1.65)
Real GDP growth	–0.175***	–0.179***	–0.415***	–0.247***	–0.059	–0.134*
	(–4.08)	(–4.12)	(–2.76)	(–3.41)	(–0.79)	(–1.73)
Inflation	–0.440***	–0.474***	–0.899***	–0.697***	–0.127	–0.506***
	(–7.55)	(–7.68)	(3.45)	(–6.44)	(–1.07)	(–5.18)
Interest rate	0.048	0.04	0.369**	–0.081	–0.002	0.093
	(0.96)	(0.80)	(2.46)	(–1.05)	(–0.02)	(1.05)
Granular Residual		–3.329**	–18.348***	–9.431***	2.144	1.17
		(–2.41)	(–3.13)	(–4.23)	(0.80)	(0.50)
Observations	27,699	27,699	26,622	26,978	26,801	26,891
Pseudo R^2	0.11	0.12	0.11	0.08	0.15	0.12

Table 2: Determinants of Banks' Probability of Distress by Banking Group

Notes: See Table 1. This Table reports estimated coefficients if the sample is split into commercial (Column 2), cooperative (Column 3), and savings banks (Column 5).

	(1) Baseline	(2) Baseline with GR	(3) Commercial banks	(4) Cooperative banks	(5) Savings banks
Equity ratio	–0.075***	–0.075***	0.012	–0.128***	–0.123
	(–4.55)	(–4.56)	(1.07)	(–5.30)	(–1.13)
Total reserves	–0.748***	–0.762***	–0.686*	–0.682***	–0.866***
	(–8.84)	(–8.94)	(–1.77)	(–6.37)	(–4.51)
Customer loans	0.022***	0.022***	0.008	0.021***	0.045***
	(8.21)	(8.28)	(1.18)	(6.03)	(3.56)
Off–balance sheet	–0.002	–0.001	–0.022	0.001	0.033
Activities	(–0.23)	(–0.06)	(–1.16)	(0.06)	(0.46)
Size	–0.046**	–0.051**	0.034	0.159***	–0.195
	(–2.21)	(–2.45)	(0.40)	(4.71)	(–1.44)
Return on equity	–0.042***	–0.041***	–0.013***	–0.044***	–0.055***
	(–19.27)	(–18.74)	(–2.61)	(–15.30)	(–5.97)
Liquidity	0.030***	0.029***	0.001	0.040***	0.113***
	(5.91)	(5.82)	(0.11)	(5.19)	(2.96)
Real GDP growth	–0.175***	–0.179***	–0.182	–0.132***	–0.301*
	(–4.08)	(–4.12)	(–1.34)	(–2.66)	(–1.71)
Inflation	–0.440***	–0.474***	–0.506**	–0.384***	–0.847***
	(–7.55)	(–7.68)	(–2.46)	(–5.58)	(–3.29)
Interest rate	0.048	0.04	0.463***	–0.031	0.165
	(0.96)	(0.80)	(3.33)	(–0.54)	(0.84)
Granular Residual		–3.329**	7.048	–3.213**	–12.149*
		(–2.41)	(1.33)	(–2.17)	(–1.90)
Observations	27,699	27,699	1,662	19,894	5,927
Pseudo R^2	0.11	0.12	0.04	0.12	0.19

Table 3a: Robustness Tests – Different Proxies for Shocks at Large Banks

Notes: See Table 1. This Table reports estimated coefficients if the Granular Residual is constructed using the inverse of the cost-to-income ratio (Column (2), total assets (Column(3), equity (Column (4)), and return of average equity (Column (5)) as measures for idiosyncratic shocks as described in section 2.3.

	(1) Baseline	(2) Baseline with GR	(3) GR with total assets	(4) GR with equity	(5) GR with ROAE
Equity ratio	–0.075***	–0.075***	–0.075***	–0.073***	–0.074***
	(–4.55)	(–4.56)	(–4.52)	(–4.46)	(–4.54)
Total reserves	–0.748***	–0.762***	–0.797***	–0.766***	–0.752***
	(–8.84)	(–8.94)	(–9.24)	(–8.97)	(–8.85)
Customer loans	0.022***	0.022***	0.023***	0.022***	0.022***
	(8.21)	(8.28)	(8.47)	(8.31)	(8.25)
Off–balance sheet	–0.002	–0.001	0.003	0.000	–0.001
Activities	(–0.23)	(–0.06)	(0.33)	(0.05)	(0.16)
Size	–0.046**	–0.051**	–0.063***	–0.051**	–0.047**
	(–2.21)	(–2.45)	(–3.00)	(–2.49)	(–2.29)
Return on equity	–0.042***	–0.041***	–0.040***	–0.041***	–0.041***
	(–19.27)	(–18.74)	(17.93)	(–18.76)	(–19.16)
Liquidity	0.030***	0.029***	0.027***	0.028***	0.029***
	(5.91)	(5.82)	(5.29)	(5.52)	(5.82)
Real GDP growth	–0.175***	–0.179***	–0.116**	–0.102**	–0.175***
	(–4.08)	(–4.12)	(–2.44)	(–2.01)	(–4.00)
Inflation	–0.440***	–0.474***	–0.461***	–0.582***	–0.426***
	(–7.55)	(–7.68)	(–7.91)	(–8.05)	(7.08)
Interest rate	0.048	0.04	0.051	0.150**	0.027
	(0.96)	(0.80)	(0.95)	(2.42)	(0.52)
Granular Residual		–3.329**			
		(–2.41)			
Granular Residual			–3.750***		
			(–5.06)		
Granular Residual				–2.121***	
				(–3.54)	
Granular Residual					–0.129*
					(–1.74)
Observations	27,699	27,699	27,699	27,699	27,699
Pseudo R^2	0.11	0.12	0.12	0.12	0.11

Table 3b: Robustness Tests – Different Proxies for Bank Output

Notes: See Table 1. This Table reports estimated coefficients if the Granular Residual is constructed using different proxies for bank output and idiosyncratic shocks.

	(1) Baseline with GR (Operating Income)	(2) GR with loans Shock: total assets	(3) GR with deposits Shock: total assets	(4) GR with loans Shock: equity	(5) GR with deposits Shock: equity
Equity ratio	–0.075***	–0.074***	–0.075***	–0.073***	–0.073***
	(–4.56)	(4.49)	(4.56)	(4.46)	(4.46)
Total reserves	–0.762***	–0.784***	–0.807***	–0.748***	–0.754***
	(–8.94)	(9.14)	(9.36)	(8.81)	(8.87)
Customer loans	0.022***	0.023***	0.024***	0.022***	0.022***
	(8.28)	(8.49)	(8.81)	(8.30)	(8.33)
Off–balance sheet	–0.001	0.001	0.004	–0.003	–0.002
Activities	(–0.06)	(0.14)	(0.49)	(0.28)	(0.21)
Size	–0.051**	–0.057***	–0.066***	–0.044**	–0.046**
	(–2.45)	(2.73)	(3.14)	(2.15)	(2.24)
Return on equity	–0.041***	–0.040***	–0.039***	–0.041***	–0.041***
	(–18.74)	(18.18)	(17.56)	(19.19)	(19.02)
Liquidity	0.029***	0.028***	0.027***	0.029***	0.029***
	(5.82)	(5.49)	(5.35)	(5.75)	(5.74)
Real GDP growth	–0.179***	–0.140***	–0.165***	–0.142***	–0.130***
	(–4.12)	(3.07)	(3.61)	(3.01)	(2.79)
Inflation	–0.474***	–0.533***	–0.540***	–0.600***	–0.581***
	(–7.68)	(8.30)	(8.57)	(7.29)	(7.91)
Interest rate	0.04	0.143**	0.120**	0.187**	0.164**
	(0.80)	(2.49)	(2.18)	(2.53)	(2.56)
Granular Residual	–3.329**				
	(–2.41)				
Granular Residual		–5.233***			
		(5.08)			
Granular Residual			–9.962***		
			(6.11)		
Granular Residual				–1.722***	
				(2.83)	
Granular Residual					–2.221***
					(3.46)
Observations	27,699	27,699	27,699	27,699	27,699
Pseudo R^2	0.12	0.12	0.12	0.12	0.12

Table 4: Robustness Tests – Role of the Interbank Market

Notes: See Table 1. This Table reports estimated coefficients if interbank assets (Column (2)), interbank liabilities (Column (3)), and the sum of interbank assets and liabilities (Column (4)), are added.

	(1)	(2)	(3)	(4)
Equity ratio	–0.075***	–0.068***	–0.076***	–0.073***
	(–4.56)	(–4.00)	(–4.56)	(–4.27)
Total reserves	–0.762***	–0.780***	–0.761***	–0.769***
	(–8.94)	(–8.97)	(–8.92)	(–8.91)
Customer loans	0.022***	0.022***	0.022***	0.022***
	(8.28)	(8.02)	(8.29)	(8.19)
Off–balance sheet activities	–0.001	0.001	–0.001	0.001
	(–0.06)	(0.14)	(–0.14)	(0.15)
Size	–0.051**	–0.041*	–0.054**	–0.044*
	(–2.45)	(–1.93)	(–2.28)	(–1.85)
Return on equity	–0.041***	–0.041***	–0.041***	–0.041***
	(–18.74)	(–18.76)	(–18.68)	(–18.72)
Liquidity	0.029***	0.035***	0.029***	0.030***
	(5.82)	(6.26)	(5.58)	(5.74)
Real GDP growth	–0.179***	–0.177***	–0.179***	–0.181***
	(–4.12)	(–4.05)	(–4.12)	(–4.18)
Inflation	–0.474***	–0.469***	–0.473***	–0.477***
	(–7.68)	(–7.60)	(–7.67)	(–7.74)
Interest rate	0.04	0.041	0.039	0.042
	(0.80)	(0.83)	(0.80)	(0.86)
Granular Residual	–3.329***	–3.154***	–3.321***	–7.132***
	(–2.41)	(–2.29)	(–2.41)	(–2.97)
Interbank assets		–0.008*		
		(–1.96)		
Interbank liabilities			0.001	
			(0.38)	
Interbank assets and liabilities				0.000
				(0.15)
Observations	27,699	27,699	27,699	27,699
Pseudo R^2	0.12	0.12	0.12	0.12

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