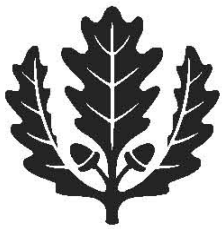

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Abstract

While the existing literature acknowledges the effect of banking structure on industrial growth as well as the effect of financial development on industrial growth and its volatility, we examine whether banking structure, given bank (financial) development, exerts any nontrivial effect on industrial growth volatility. We show that bank concentration magnifies industrial growth volatility, but reduces the volatility in sectors with higher external liquidity needs. The reduction in industrial growth volatility mostly reflects the smoothing in the variance of real value added per firm growth. Finally a variety of sensitivity checks show that our findings remain for different model specifications, banking market structure measures, liquidity needs indicators, and omitted variables.

Keywords: Bank Concentration, External Liquidity, Bank Development, Industrial Growth Volatility.

JEL Classification: G2, O16, E32

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1. Introduction

In the past two decades, theoretical and empirical work rationalizes and supports the view that financial development exerts a significantly positive effect on economic growth (Levine 1997, 2005). Rajan and Zingales (1998, RZ) propose a novel specification that they apply to a large panel of cross-country, cross-industry data and find strong evidence that industries more dependent on external financing grow faster in countries with better developed financial systems. The growth of new establishments represents he key factor through which financial development enhances industrial growth. Also, an increasing number of studies explore whether financial development plays a role in the determination of growth volatility. While the existing literature acknowledges the positive effect of financial development on growth, the effect of financial development on growth volatility remains ambiguous.[1] In this respect, Raddatz (2006) applies the RZ specification and finds that financial development reduces growth volatility of sectors that need larger amounts of external liquidity. The reduction in the volatility mainly comes from stabilizating the output of existing firms.

Researchers typically measure financial development by the ratio of claims on the private sector by deposit money banks (and other financial institutions) to GDP (e.g., Levine, Loayza, and Beck, 2000 and Aghion, Howitt, and Mayor-Foulkes, 2005). Given a measure of bank (financial) development, Cetorelli and Gambera (2001) investigate whether the market structure of the banking system exerts any influence on economic

1 Denizer, Iyigun, and Owen (2002) find that countries with better developed financial systems experience smoother fluctuations in per capita output growth. Acemoglu, Johnson, Robinson, and Thaicharoen (2003) contend that financial development exerts no significant effect on growth volatility, once they control for institutions. Beck, Lundberg, and Majnoni (2006) also show that no robust linkage exists between financial development and aggregate economic volatility. Harvey and Lundblad (2006) find that financial liberalization leads to smaller (consumption) growth volatility. Levchenko, Ranciere, and Thoenig (2009), however, find evidence that financial liberalization increases output volatility. .

growth. Specifically, the authors test whether, for a given bank (financial) development, the amount of credit provided by more competitive or concentrated banking industry matters.

Theoretically, the effect of bank concentration on industrial growth is ambiguous. On the one hand, Pagano (1993) argue that any deviation from perfect competition in the banking market leads to inefficiencies that harm firms' access to credit, thus, hindering economic growth. On the other hand, Mayer (1988, 1990) and Petersen and Rajan (1995) show that more concentrated banks experience a larger incentive to establish lending relationships with their client firms, thus facilitating their access to credit lines and, thus, enhancing their growth. Utilizing the RZ framework, Cetorelli and Gambera (2001) provide cross-country, cross-industry results showing that bank concentration exerts a negative effect on industrial growth as a whole but industries that depend more on external finance grow faster in a more concentrated banking system.[2]

As an extension following Cetorelli and Gambera (2001), we anticipate that banking market structure influences not only growth but also its volatility. In this paper, we examine how growth volatility compares between a country with an unconcentrated, thus, more competitive banking sector or with a relatively concentrated, thus, more powerful banking system.

Policy makers identify output growth stability as one of several macroeconomic policy objectives (Yellen and Akerlof, 2006; Mishkin, 2009). Many adverse effects occur because of higher output growth volatility such as lower economic growth

2 Deidda and Fattouh (2005) and Claessens and Laeven (2005) also show that, for a given level of financial development, the market structure of the banking system plays an important role in determining economic growth. Other studies, such as Cetorelli (2004), Bonaccorsi di Patti and Dell'Ariccia (2004), and Cetorelli and Strahan (2006), offer additional evidence that bank competition affects the formation of nonfinancial industries, the creation of firms in the nonfinancial sectors, and the market structure of nonfinancial industries.

(Ramey and Ramey, 1995; Aghion, Angeletos, Banerjee and Manova, 2010), worsened income distribution (Breen and Garcia-Peñalosa 2005), and higher output and employment costs (Benigno and Ricci, 2011). A successful macroeconomic policy to stabilize or reduce growth volatility depends on knowing the sources of that volatility.

We assess whether banking market structure affects growth volatility. To this end, we rely on Raddatz's (2006) specification, augmented with alternative measures of banking market structure (bank concentration or bank competition), to test whether bank concentration leads to an increase or decrease in the volatility of industries with higher liquidity needs, after controlling for the size of the banking sector (bank development) in a country. As such, this study provides a synthesis of (and/or a complement to) both Cetorelli and Gambera (2001) and Raddatz (2006).[3]

Using Raddatz's (2006) data on 70 manufacturing industries in 48 countries over the 1981 to 1998 period, we first examine the average effect of bank concentration on industrial growth volatility. That is, we test whether, overall, the growth patterns of industries exhibit more or less volatility if they operate within a more concentrated banking system. Our empirical results show that higher concentration in the banking sector strongly associates with larger industrial growth volatility. Thus, countries with a more concentrated banking market display higher industrial growth volatility. We also confirm that bank development, characterized by a sizable banking sector stabilizes industrial volatility. Therefore, both the market structure and the size of a banking system exert a nontrivial (but opposite) effect on industrial growth volatility. These findings prove similar to that of Cetorelli and Gambera (2001), who detect that a more

[3] Cetorelli and Gambera (2001) consider the effects of bank development and bank concentration on industrial growth whereas Raddatz (2006) examines the effect of bank development on the volatility of industrial growth. We focus on the effect of bank concentration on the volatility, controlling for bank development.

concentrated banking sector associates with lower industrial growth while a larger banking sector associates with higher industrial growth.

Second, the use of industry-specific information allows us to explore more deeply the role played by banking market structure on industrial growth volatility and permits us to determine whether bank concentration exerts a heterogeneous effect across industrial sectors. For this purpose, we estimate alternative regressions of industrial volatility on the interaction between an industry's liquidity needs and a country's bank concentration, controlling for country and industry dummies and other determinants of volatility. The estimated coefficients on the interaction between bank concentration and liquidity indicate a negative and significant relationship at conventional levels. These results suggest that industries more dependent on external liquidity enjoy a beneficial effect (in terms of the reduction in growth volatility) in a country with a more concentrated banking system. Cetorelli and Gambera (2001) argue that concentration of market power in the banking system facilitates the formation of lending relationships, which, in turn, enhances industrial growth. With this channel, we show that bank concentration alleviates industrial growth volatility and the fall in volatility mainly reflects smoothing of the variance of growth in output per firm.

The paper is organized as follows. Section 2 describes the empirical strategy first proposed by Rajan and Zingales (1998), and later used by Cetorelli and Gambera (2001) and Raddatz (2006). Section 3 describes the definitions and sources of data. Section 4 presents our main empirical results. Section 5 performs a variety of robustness checks. Section 6 concludes.

2. Empirical Strategy

2.1 Benchmark Model

Following Cetorelli and Gambera (2001), the first model assesses the overall effect of bank concentration, in addition to bank development, on industrial growth volatility, without considering the role of specific industry characteristics. In this way, we evaluate the separate, economy-wide volatility effect of bank concentration as well as bank development, common to all industrial sectors, after controlling for other country characteristics and industry fixed-effects. We specify the benchmark model as follows:

$$vol_{i,k} = \theta_1 \cdot bdev_k + \theta_2 \cdot bconc_k + \Theta_3 \cdot ccont_k + \Theta_4 \cdot \mathrm{icvar}_{i,k} + \Theta_5 \cdot \mathrm{idum}_i + \varepsilon_{i,k} \quad (1)$$

where *i* denotes the *i*-th industry and *k* denotes the *k*-th country. Uppercase coefficients indicate vectors. We measure the dependent variable *vol* as the standard deviation of the growth of real value added for 70 four-digit industries in 47 countries over 1980 to 1998. We include bank (financial) development (*bdev*) to assess whether the size of the banking sectors exerts a direct effect on industrial volatility. As our concern, we include bank concentration (*bconc*) to isolate the effect of market structure of the banking system on industrial volatility. As mentioned earlier, different theories predict that two opposing effects affect (sectoral) growth and, hence, growth volatility that we associate with bank concentration. Thus, the sign of our focused coefficient (i.e., θ_2) is *a priori* ambiguous.

Additionally, we include other country controls (*ccont*) to reduce the possibility of model specification due to the omission of important explanatory variables. Among those controlling variables, we include (i) the level of per capital real GDP (economic development), which Koren and Tenreyro (2007) find negatively related to volatility, (ii)

a measure of trade openness, which di Giovanni and Levchenko (2009) find positively linked to volatility, (iii) the degree of financial remoteness (integration), which Rose and Spiegel (2009) find positively connected to volatility, and (iv) the extent of democracy, which Rodrik (2000), Almeida and Ferreira (2002), and Mobarak (2005) find negatively associated to volatility. Following Raddatz (2006), we include two initial conditioning variables (*icvar*), the initial share of a sector in a country's manufacturing value added and the (log of the) initial number of firms. Lastly, we include industry dummy variables (*idum*), which control for industry-specific effects that can affect the growth volatility of a particular industry. Since we mainly explore the effects of banking variables on sectoral volatility at the country level, we do not include country dummy variables (*cdum*) to avoid the problem of multicollinearity. We will use such dummy variables later in Model 3.

We can estimate Model (1) by ordinary least squares (OLS), with standard errors corrected for possible heteroskedasticity. The literature notes, however, that the OLS coefficients likely include bias due to the endogeneity of bank development. Thus, we also consider estimates using two-stage least squares (2SLS) with legal origin variables from La Porta, *et al.* (1997, 1998) as instruments. The final outcomes depend on the test results of the Durbin-Wu-Hausman (DWH) statistics, which examine the null hypothesis that the use of instrumental variables (IV) does not change the estimation results. We present IV estimates when we reject the DWH test at the 10-percent level or better, otherwise we report the OLS coefficients.

2.2 Full Model

The benchmark model provides an average volatility effect of banking concentration. An extended specification utilizing the industry-specific information permits

decomposition of the effect of bank concentration into economy-wide and sector-specific effects to gain a deeper understanding. The specification of Model 2 appears as follows:

$$vol_{i,k} = \lambda_1 \cdot bdev_k + \lambda_2 \cdot (liq_i \times bdev_k) + \lambda_3 \cdot \mathrm{bconc_k} + \lambda_4 \cdot (\mathrm{liq_i} \times \mathrm{bconc_k}) \quad (2)$$
$$+ \Lambda_5 \cdot \mathrm{ccont_k} + \Lambda_6 \cdot \mathrm{icvar_{i,k}} + \Lambda_7 \cdot \mathrm{idum_i} + \varepsilon_{i,k},$$

where *liq* measures the liquidity needs of industry *i*. Raddatz (2006) uses this indicator to test whether bank development exerts a larger causal effect in the reduction of industrial volatility, resulting from the role of the banking system in the provision of external liquidity. Raddatz finds that the estimate for the interaction between bank development and liquidity needs (λ_2), regardless of the set of controls or the estimation technique, proves significantly negative, supporting that financial (bank) development leads to a decrease in the volatility in sectors with higher liquidity needs. In addition to exploring the economy-wide volatility effect of bank concentration (λ_3), we also test whether sectors that need more liquidity exhibit larger or smaller growth volatility when they face higher bank concentration. To accomplish this, we include the interaction between the liquidity needs of industry *i* and bank concentration in country *k*. If bank concentration leads to a larger (smaller) reduction in the volatility of sectors with high liquidity needs, the parameter, λ_4, should be significantly negative (positive).

2.3 Interaction-Only Model

Finally, we explore the volatility effect of banking system concentration across industries, captured by the interaction between a country's level of bank concentration and an industry's measure of liquidity needs. To do this, we replace the country control variables, bank development and bank concentration with the country dummy variables, *cdum*. Thus, the specification includes the interaction terms only with the level variables

for bank development and bank concentration excluded. The resulting model is as follows,

$$vol_{i,k} = \omega_1 \cdot (liq_i \times bdev_k) + \omega_2 \cdot (liq_i \times \mathrm{bconc_k}) + \Omega_3 \cdot \mathrm{icvar_{i,k}} \quad (3)$$
$$+\Omega_4 \cdot \mathrm{cdum_k} + \Omega_5 \cdot \mathrm{idum_i} + \varepsilon_{\mathrm{i,k}}$$

where the variables are described earlier.

Concentrating on the cross-industry analysis, we test whether concentrated banking sector leads to a larger increase or decrease on the volatility of industries with high liquidity needs, which Model (2) also considers. Cetorelli and Gambera (2001) argue that it is econometrically sensible to drop the vector of country controls and include country dummies (as well as industry dummies) to eliminate potential biases resulting from omitted country-specific covariates. Thus, Model (3) provides a robustness check for the hypotheses tested in Model (2). Additionally, focusing on the interactions only, we can compare our estimate of bank development and liquidity needs directly with that of Raddatz (2006). That is, Model (3) is identical to equation (1) of Raddatz (2006, p. 682) after excluding the interaction term between liquidity needs and bank concentration. This allows us to verify whether Raddatz's (2006) key result continues to hold. A significant negative estimate of ω_1 supports his finding. Our main purpose tests (or confirms) whether banking market structure, independent of the size of the banking market, plays any role in the determination of growth volatility in sectors that rely more heavily on external liquidity. A negative (positive) and significant estimate of ω_2 provides evidence supporting the view that bank concentration causes less (more) volatility in liquidity dependent industries.

3. Data

Raddatz (2006) kindly provided the industry data used in this paper, an unbalanced

panel of 47 countries with data on at least ten of 70 four-digit ISIC industries. Raddatz uses the data to show that financial development exerts a causal effect in reducing industrial growth volatility via the provision of external liquidity.

We measure the key dependent variable, industrial growth volatility, by the standard deviation of the real value added growth over 1981 to 1998 for each 4-digit ISIC industry in each country. The main country-level explanatory variables include (i) bank (financial) development, measured by the ratio of claims on the private sector by deposit money banks and other financial institutions divided by GDP in country *k* over 1980 to 1998, and (ii) bank concentration, calculated as the ratio of the three largest banks' assets to total banking sector assets for 1980 to 1998. The bank concentration data come from Beck, Demirgüc-Kunt, and Levine (2000, 2010). As an alternative measure of the banking market structure, we also consider an indicator of bank competition (*bcomp*), which equals the average H-statistic using Panzar and Rosse's (1987) approach for 1987 to 1996.[4] Table 1 reports the average values of bank concentration and bank competition over the 1980-to-1998 and the 1987-to-1996 samples, respectively.

The measure of liquidity needs (*liq*) for each industry, the major industry-level explanatory variable, comes from U.S. Compustat data over 1980 to 1989. Specifically, we calculate the proxy for liquidity needs as the ratio of inventories to sales, which denotes the portion of inventory investment that ongoing sales revenue can finance. Thus, a larger value of this ratio represents a higher level of external liquidity needs. For a robustness check, we follow Raddatz (2006) and use three additional proxies for the level of liquidity needs, including (i) the cash conversion cycle (*cccycle*), which equals

4 The measure of bank competition comes from Claessens and Laeven (2005).

the mean age of inventories plus the mean age of accounts receivables minus the mean age of accounts payable, (ii) the ratio of labor cost to sales (*lcost*), which evaluates the ability of a firm to finance its ongoing labor cost from its sales revenue, and (iii) the ratio of short-term debt to sales (*sdebt*), which appraises the real use of external liquidity and the ability of a firm to pay its current liabilities through ongoing sales.

Apart from the country and industry dummies, the other conditioning information contains a variety of country-level variables (*ccont*). We consider (i) the degree of democracy (Rodrik, 2000; Almeida and Ferreira, 2002; and Mobarak, 2005), which is measured by the Polity V indicator, (ii) international financial remoteness (Rose and Spiegel, 2009), which measures the proximity to major international financial centers, (iii) the level of economic development (Koren and Tenreyro, 2007), which is measured by the (logarithm of) real per capita GDP, and (iv) trade openness (di Giovanni and Levchenko, 2009), which is measured as the ratio of import plus export to GDP. We average these macroeconomic variables over 1980 to 1998.

We also include cross-country, cross-industry variables (*icvar*) such as (i) the initial share of a sector in its country's manufacturing value added to determine if a more advanced or mature industry is systematically more stable, and (ii) the (logarithm of the) initial number of firms to capture the (law of large number) notion that a larger number of firms lowers industrial volatility.

Finally, to explore the channels through which industrial growth volatility responds to the interaction between liquidity needs and bank development and bank concentration, we examine the following three potential channels: (i) the variance of the growth of real value added per firm, (ii) the variance of the growth in the number of firms, and (iii) the covariance between the growth of real value added per firm and the growth in the number of firms. See Raddatz (2006) for more detailed description. Table 2 provides the

basic statistics for the selected relevant variables, and Table 3 displays the correlation matrix among major country-level variables.

4. Empirical Findings

4.1 Benchmark Model

Table 4 reports the results of estimating Model (1). Besides the industry dummies (included but not reported), the first column shows that the estimate of bank development (*bdev*) is negative and significant at 1-percent level. Thus, higher banking development reduces (industrial) growth volatility. Our banking market structure variable (bank concentration) exerts a significantly positive effect. This result supports the notion that countries with a more concentrated banking sector more likely experience higher industrial growth volatility. Cetorelli and Gambera (2001) find that bank concentration hinders growth, we show that higher bank concentration enlarges growth volatility.

Columns (2) to (5) of Table 4 include four additional country-level variables separately to determine if the findings remain robust to other country controls. All control variables exhibit the expected signs, conforming to the findings of prior studies. That is, the democracy variable possesses a negative and significant coefficient, confirming that more democratic countries exhibit less growth volatility (Rodrik, 2000; Almeida and Ferreira, 2002; and Mobarak, 2005). The coefficient of the financial remoteness variable is significantly positive, suggesting that countries further from international financial activity experience systematically more volatility (Rose and Spiegel, 2009). A negative and statistically significant coefficient associates with real per capita GDP variable, indicating that poorer countries experience more volatile growth than richer ones (Koren and Tenreyro, 2007). Finally, trade openness correlates

with higher growth volatility, judged by its significant and positive coefficient (di Giovanni and Levchenko, 2009). By adding one variable each time, we verify that better bank development continues to reduce growth volatility, while higher bank concentration continues to increase growth volatility. These results do not change qualitatively when we include these four variables together and contain two additional initial conditioning variables, as shown in columns (6) and (7) of Table 4, respectively. Both the coefficients on the initial share of an industry in a country's manufacturing value added and the (logarithm of the) initial number of firms are negative and significant at the 1-percent level, indicating that more advanced industries and a larger number of firms are systematically more stable. For our purposes, bank concentration, independent of bank development, exerts a positive and significant effect on growth volatility, and that this effect remains robust to the inclusion of a variety of controlling covariates.

4.2 Full Model

Table 5 reports the outcome of estimating Model (2), which adds interactions between liquidity needs, bank development and bank concentration to Model (1). The inclusion of these two interactions allows us to explore the possible differential effects of bank development and bank concentration on sectors with different degrees of liquidity needs. Column (1) considers the simplest case without any other country variables. In contrast to the previous finding in Table 4 that improved bank development reduces volatility, we now detect that bank development by itself exerts no effect on the reduction of growth volatility, judged by the positive and insignificant parameter estimate. The interaction between liquidity needs and bank development, however, exerts a negative and significant effect. This result corresponds to that of Raddatz (2006), who offers

overwhelming evidence that bank development leads to a larger reduction in the growth volatility in industries with higher external liquidity needs.

The estimate of the coefficient on bank concentration remains positive and significant at the 1-percent level after including the interaction of liquidity needs and bank concentration. It, thus, confirms that bank concentration exerts a harmful effect on growth stability that, on average, affects all industries in an indiscriminate way. The interaction term between liquidity needs and bank concentration proves significantly negative at the 1-percent level. That is, higher concentration in the banking system significantly reduces volatility of industries with high liquidity needs.

The next four columns of Table 5 include four additional country variables, one at a time. Again, all four control variables exhibit the expected signs and all estimates differ from 0 at the 1-percent significance level. Some evidence shows that bank development associates with higher, instead of, lower industrial volatility (found in Table 4). The estimate for the interaction between liquidity needs and bank development proves negative and significant consistently. This finding lends further support to Raddatz's (2006) claim that underdevelopment of the banking sector augments the volatility of industries that naturally require more liquid funds to operate.

Bank concentration still holds a positive and significant coefficient. Higher bank concentration results in larger industrial growth volatility overall. The coefficient on the interaction term between liquidity needs and bank concentration always exerts a negative and significant effect, however. Bank market power, by facilitating the formation of lending relationships, mitigates volatility for those industries that need such connections besides enhancing the growth potential (Cetorelli and Gambera, 2001). Columns (6) and (7) of Table 5 demonstrate that the above findings remain virtually unchanged when we add all four country controls at the same time and include the two

initial conditions of the initial share of an industry in a country's manufacturing value added and the (logarithm of the) initial number of firms.

4.3 Interaction-Only Model

Table 6 reports the estimation results of Model (3), concentrating on the interaction-only specification. Across all regressions, we control for the country-specific and industry-specific effects with dummy variables, but omit the results for brevity. In columns (1) and (2), the coefficients on the interaction between liquidity needs and bank development as well as that between liquidity needs and bank concentration remain negative and significant (at 5-percent level or better). The results, on the one hand, confirm the finding of Raddatz (2006) that bank development mitigates growth volatility through greater provision of external liquidity. On the other hand, they demonstrate that more concentrated banking sectors help to reduce industrial growth volatility in sectors that rely on more external liquidity needs, regardless of whether we include the initial conditioning variables.

In columns (3) to (5), we re-estimate Model (3) with alternative banking market structure measures and initial conditioning variables. We consider (i) the rank of bank concentration, which uses the three largest banks ratio, in column (3); (ii) a dummy of high bank concentration, which equals 1 for countries with bank concentrations larger than the median value of all countries' bank concentration, 0 otherwise, in column (4); and (iii) a measure of competition in the banking system, which comes from Claessens and Laeven (2005), in column (5). The results qualitatively match those reported in columns (1) and (2), with better banking development and more banking system concentration (competition) each exerting a negative (positive) effect on industrial growth volatility in all regression specifications. As such, our key finding of the

volatility-reducing effect of bank concentration remains robust to alternative measures of banking market structure (concentration and/or competition). The result supports the hypothesis that less concentrated (more competitive) banking systems lead to more unstable growth paths in industries with higher liquidity needs.

5. Robustness Checks

5.1 Alternative Liquidity Needs Measures

As more sensitivity checks, we first experiment with distinct measures of industrial needs of external liquidity such as the cash conversion cycle (*cccycle*), the ratio of labor cost to sales (*lcost*), and the portion of short-term debt to sales (*stdebt*). In each case, we interact these industrial liquidity needs indicators with bank development and countries' level of bank concentration and bank competition. We also include the initial conditioning variables along with country and industry dummy variables. Table 7 reports the results. These findings show that sectors more dependent on external liquidity needs enjoy a volatility-reducing effect from a more-developed banking system. We also find a negative and (mostly) significant effect of the interaction between different indicators of liquidity needs and bank concentration on industrial growth volatility in columns (1) to (3) of Table 7. The interaction between various measures of liquidity needs and bank competition exerts a positive and significant effect, except for the proxy short-term debt (as in the bank concentration in column 2). Overall, the evidence supports the view that a more-concentrated (competitive) banking system lessens (raises) growth volatility in value added for liquidity dependent firms (industries).

5.2 Omitted Variables

Now, we investigate whether adding interactions between industrial liquidity needs and macroeconomic determinants of growth volatility eliminates the effect of bank concentration on industrial volatility. In all regressions, we include the initial conditioning variables, the country and industry dummy variables. Table 8 summarizes the results. Column (1) repeats the basic results for liquidity needs interacted with bank development and bank concentration, as reported in column (2) of Table 6. Columns (2) to (5) of Table 8 present estimation results additionally with the level of democracy, financial remoteness, economic development, or trade openness separately. Column (6) provides the estimates with all the four variables included. Only two of these four extra country (interaction) variables achieve statistical significance (financial remoteness and trade openness). The negative and significant coefficients from the first row of Table 8 indicate that bank development keeps playing a causal and important role in the reduction of industrial volatility in sectors with higher needs of external liquidity. In the second row, the estimates on the interactive term between liquidity needs and bank concentration are negative and significant. Accordingly, we find more support that a more-concentrated banking market structure reduces volatility in industries with high liquidity needs. Finally, the analysis provides evidence supporting the outcome that bank development and bank concentration exert independent effects on reducing sectoral growth volatility through the provision of liquidity needs.

5.3 The Channels

Previous subsections find that both banking sector development and concentration smooth industrial growth volatility in those industries with higher external liquidity needs. This subsection examines how this reduction is realized. We focus on three

potential channels through which bank development and bank concentration can moderate the volatility of the growth of real value added: (i) the growth volatility of value added per firm, (ii) the growth volatility in the number of firms, and/or (iii) the covariance between the prior two variables. Table 9 summarizes the empirical results on how the interaction of bank development and bank concentration with liquidity needs influences each of the three components of industrial growth volatility.

Following Raddatz (2006), now we use variances rather than standard deviations of the real value added growth as the dependent variables. The first row of Table 9 illustrates the differential effects of interaction between bank development and liquidity needs on sectoral volatility. The outcome reveals that a better-developed banking system smoothes the volatility of the real value added growth (column 1) via the reduction of the volatility of the growth of value added per firm (column 2) and the volatility of the growth in number of firms (column 3). The covariance between these two terms, however, becomes larger (column 4). According to the estimated coefficients, the volatility reduction effect of value added per firm is substantially larger than the effect in the number of firms and/or the covariance term. Consistent with Raddatz (2006), the result supports the view that well-functioning banking sectors reduce the sectoral volatility by providing liquidity to smooth fluctuations in real value added per firm growth and the number of firms growth, but the volatility-mitigating effect of the first term dominates.

The second row of Table 9 exhibits the effects of the interaction of bank concentration and liquidity needs on sectoral volatilities. First, from column (1), the negative and significant coefficient on the interaction term indicates that industries with higher liquidity needs exhibit less fluctuation (in term of variance of the real value added growth) in countries with more concentrated banking system. The reduction of

the sectoral volatility mostly occurs through diminishing the growth volatility of the real value added per firm, judged by the significantly negative coefficient reported in column (2). At the same time, no decisive effect exists on either the volatility of the number of firms growth (column 3) or the covariance term (column 4). The two coefficients on the interaction terms are not significant at conventional levels.

6. Conclusion

Completing the analysis of Cetorelli and Gambera (2001) and Raddatz (2006), this study explores whether banking market structure, given the development of a country's banking sector, plays a role in determining industrial growth volatility. By applying the Rajan and Zingales (1998) specification to a large panel data of 47 countries, 70 four-digit ISIC industries, some interesting findings emerge.

First, significant evidence indicates that bank concentration exerts a common inflating effect on industrial growth volatility, which is consistent with the view that a concentrated banking system imposes a deadweight loss in the credit market, in particular, and on the economy, in general. Second, further examination suggests that bank concentration exerts heterogeneous effects across sectors. A more concentrated banking industry reduces the growth volatility in sectors that depend more on external liquidity needs. This result favors the theoretical prediction that concentration in the banking system facilitates relationship lending and, as a consequence, smoothes the volatility of industrial growth. Third, considering the channels through which bank concentration affects sectoral volatility, the evidence shows that bank concentration stabilizes industrial volatility mainly by smoothing the variance of real value-added per firm growth. Finally, the above findings remain robust to alternative model specifications, banking market structure measures, liquidity needs indicators, and

additional country control variables.

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Table 1: Indicators of Banking Market Structure

Country	Bank Concentration	Bank Competition	Country	Bank Concentration	Bank Competition
Australia	0.575	0.800	**Korea**	0.321	–
Austria	0.781	0.660	**Kuwait**	0.681	–
Bangladesh	0.653	0.690	**Malaysia**	0.517	0.680
Côte d'Ivoire	0.920	–	**Malta**	0.916	–
Cameroon	0.934	–	**Mauritius**	0.943	–
Canada	0.569	0.670	**Mexico**	0.663	0.780
Chile	0.562	0.660	**Netherlands**	0.741	0.860
Colombia	0.539	0.660	**Norway**	0.854	0.570
Costa Rica	0.817	0.920	**Panama**	0.475	0.740
Cyprus	0.943	–	**Peru**	0.676	0.720
Ecuador	0.944	0.680	**Philippines**	0.776	0.660
Egypt	0.698	–	**Portugal**	0.632	0.670
Fiji	–	–	**Singapore**	0.748	–
Finland	0.915	–	**Spain**	0.708	0.530
France	0.602	0.690	**Sri Lanka**	0.787	–
Germany	0.619	0.580	**Sweden**	0.912	–
Ghana	0.921	–	**Trinidad and Tobago**	0.699	–
Greece	0.827	0.760	**Tunisia**	0.542	–
Honduras	0.541	0.810	**Turkey**	0.725	0.460
Hong Kong	0.561	0.700	**United Kingdom**	0.755	0.740
Iceland	1.000	–	**Uruguay**	0.850	–
India	0.387	0.530	**Venezuela**	0.640	0.740
Indonesia	0.534	0.620	**Zimbabwe**	0.610	–
Jordan	0.887	–			

Note: The concentration of commercial banks is measured as the ratio of the three largest banks' assets to total banking sector assets over 1980 to 1998, obtained from Beck, Demirguc-Kunt, and Levine (2000, 2010). The measure of bank competition comes from Claessens and Laeven (2005) and calculates the average H-statistic, using Panzar and Rosse's (1987) approach over 1987 to 1996.

Table 2: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Standard deviation of the growth of real value added (VA)	2463	0.271	0.183	0.029	1.004
Industry's initial share of total manufacturing VA	2463	0.016	0.028	0.000	0.408
Industry's initial number of firms (log)	2381	3.846	1.856	0.000	10.008
Variance of the growth of real VA	2412	0.106	0.138	0.001	1.008
Variance of real VA per firm growth	2410	0.107	0.156	0.000	1.454
variance of number of firms growth	2410	0.040	0.070	0.000	0.685
Covariance of real VA per firm and number of firms growth	2333	−0.023	0.051	−0.525	0.098
Inventories over sales (liquidity needs)	2390	0.162	0.053	0.053	0.303
Cash conversion cycle	2390	1.018	0.374	0.190	1.980
Short-term debt over sales	2390	0.012	0.014	0.000	0.070
Labor costs over sales	2361	0.182	0.075	0.020	0.350
Bank development	2427	0.515	0.319	0.032	1.358
Bank concentration	2438	0.701	0.162	0.321	1.000
Bank competition	1596	0.677	0.099	0.460	0.920
Democracy	2407	0.755	0.273	0.089	1.000
Financial remoteness	2463	7.535	0.633	5.536	8.695
GDP per capita (log)	2463	8.327	1.394	5.355	10.337
Trade openness (log)	2408	4.065	0.521	2.835	5.459

Note: See Table 1. Bank development is the ratio of private domestic credit to GDP.

Table 3: Correlation Matrix

Variable	Bank Development	Bank Concentration	Bank Competition	Democracy	Financial Remoteness	GDP Per-Capita	Trade Openness
Bank development	1.000						
Bank concentration	−0.075***	1.000					
Bank competition	−0.034	0.107***	1.000				
Democracy	0.343***	0.165***	0.041	1.000			
Financial remoteness	−0.381***	−0.044	0.275***	−0.268***	1.000		
GDP per capita (log)	0.777***	0.211***	0.100***	0.428***	−0.311***	1.000	
Trade openness (log)	0.474***	0.195***	0.288***	−0.082***	−0.001	0.363***	1.000

Note: See Table 1.

Table 4: Average Effects of Bank Concentration on Industrial Volatility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank development	−0.301***	−0.248***	−0.236***	−0.154***	−0.350***	−0.100***	−0.081***
	(0.015)	(0.010)	(0.012)	(0.030)	(0.011)	(0.020)	(0.019)
Bank concentration	0.103***	0.202***	0.121***	0.206***	0.038**	0.257***	0.209***
	(0.018)	(0.017)	(0.018)	(0.023)	(0.018)	(0.020)	(0.021)
Democracy		−0.234***				−0.191***	−0.180***
		(0.013)				(0.017)	(0.016)
Financial remoteness			0.045***			0.020***	0.011**
			(0.005)			(0.005)	(0.005)
GDP per capita (log)				−0.044***		−0.039***	−0.038***
				(0.006)		(0.004)	(0.004)
Trade openness (log)					0.093***	0.031***	0.017***
					(0.007)	(0.007)	(0.008)
Initial share of total manufacturing VA							−0.895***
							(0.159)
Initial number of firms (log)							−0.014***
							(0.002)
Country dummies	No	No	No	No	No	No	No
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.323	0.467	0.346	0.393	0.372	0.501	0.531
Observations	2402	2346	2402	2402	2347	2291	2209
Durbin-Wu-Hausman statistic	10.450***	0.750	0.615	17.310***	0.031	0.000	0.827

Note: The dependent variable is the standard deviation of real value added growth over 1981 to 1998 for each 4-digit ISIC industry in each country. The heteroskedasticity-robust standard errors are reported in parentheses. The Durbin-Wu-Hausman statistics test the null hypothesis that the use of instrumental variables (legal origins) does not change the estimation results. We report IV estimates when the test is rejected at the 10-percent level or better. ***, ** and * indicate significant at 1-, 5-, and 10-percent levels, respectively.

Table 5: Economy-wide and Sector-Specific Effects of Bank Concentration on Industrial Volatility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bank development	0.097	0.195*	0.155	0.240*	0.097	0.293**	0.036
	(0.130)	(0.117)	(0.128)	(0.128)	(0.124)	(0.115)	(0.032)
Liquidity needs × Bank development	−2.408***	−2.592***	−2.392***	−2.444***	−2.569***	−2.516***	−0.713***
	(0.776)	(0.690)	(0.761)	(0.743)	(0.735)	(0.658)	(0.160)
Bank concentration	0.265***	0.318***	0.281***	0.359***	0.228***	0.367***	0.323***
	(0.065)	(0.060)	(0.065)	(0.065)	(0.069)	(0.061)	(0.053)
Liquidity needs × Bank concentration	−0.988***	−0.698**	−0.982***	−0.967***	−1.118***	−0.734**	−0.698**
	(0.378)	(0.345)	(0.373)	(0.362)	(0.395)	(0.337)	(0.301)
Democracy		−0.238***				−0.185***	−0.179***
		(0.014)				(0.017)	(0.016)
Financial remoteness			0.043***			0.015***	0.010**
			(0.006)			(0.006)	(0.005)
GDP per capita (log)				−0.042***		−0.037***	−0.039***
				(0.007)		(0.006)	(0.004)
Trade openness (log)					0.086***	0.033***	0.019**
					(0.009)	(0.008)	(0.007)
Initial share of total manufacturing VA							−0.869***
							(0.158)
Initial number of firms (log)							−0.014***
							(0.002)
Country dummies	No	No	No	No	No	No	No
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.304	0.444	0.326	0.371	0.350	0.482	0.536
Observations	2214	2162	2214	2214	2162	2110	2143
Durbin-Wu-Hausman statistic	16.895***	7.441**	7.457**	27.806***	6.478**	7.554**	3.533

Note: See Table 4.

Table 6: Focusing on the Interactive Terms and Alternative Banking Market Structure Indicators

	(1)	(2)	(3)	(4)	(5)
Liquidity needs × Bank development	−2.560***	−0.508***	−0.512***	−0.479***	−0.596***
	(0.558)	(0.142)	(0.141)	(0.143)	(0.176)
Liquidity needs × Bank concentration	−0.744**	−0.548**			
	(0.334)	(0.279)			
Liquidity needs × Rank of bank concentration			−0.008**		
			(0.004)		
Liquidity needs × Dummy of high bank concentration				−0.202**	
				(0.087)	
Liquidity needs × Bank competition					0.888**
					(0.431)
Initial share of total manufacturing VA		−0.620***	−0.619***	−0.552***	−0.443***
		(0.133)	(0.133)	(0.132)	(0.123)
Initial number of firms (log)		−0.026***	−0.026***	−0.027***	−0.024***
		(0.003)	(0.003)	(0.003)	(0.004)
Country dummies	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes
R^2	0.593	0.662	0.665	0.661	0.638
Observations	2214	2251	2251	2276	1529
Durbin-Wu-Hausman statistic	10.293***	2.449	2.231	2.185	2.199

Note: See Table 4.

Table 7: Alternative Liquidity Needs Measures

	Bank market structure measured as					
	Bank concentration			Bank competition		
	(1)	(2)	(3)	(4)	(5)	(6)
Cash conversion cycle × Bank development	−0.148***			−0.079***		
	(0.033)			(0.026)		
Short-term debt × Bank development		−9.268***			−7.582***	
		(2.458)			(2.464)	
Labor cost × Bank development			−1.690***			−1.318***
			(0.387)			(0.412)
Cash conversion cycle × Bank market structure	−0.088**			0.135**		
	(0.042)			(0.064)		
Short-term debt × Bank market structure		−1.867			−1.431	
		(1.317)			(2.402)	
Labor cost × Bank market structure			−0.410*			0.558*
			(0.225)			(0.329)
Initial share of total manufacturing VA	−0.573***	−0.641***	−0.426***	−0.434***	−0.481***	−0.253*
	(0.129)	(0.135)	(0.133)	(0.123)	(0.125)	(0.137)
Initial number of firms (log)	−0.027***	−0.028***	−0.020***	−0.024***	−0.024***	−0.019***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.662	0.623	0.661	0.638	0.593	0.619
Observations	2237	2237	2208	1529	1529	1507
Durbin-Wu-Hausman statistic	8.396***	14.077***	19.001***	2.534	11.600***	10.311***

Note: See Table 4.

Table 8: Omitted Variables

	(1)	(2)	(3)	(4)	(5)	(6)
Liquidity needs × Bank development	−0.508***	−0.520***	−0.398**	−0.477*	−0.766***	−0.630**
	(0.142)	(0.155)	(0.158)	(0.247)	(0.145)	(0.283)
Liquidity needs × Bank concentration	−0.548**	−0.440*	−0.469*	−0.527*	−0.780***	−0.728**
	(0.279)	(0.290)	(0.281)	(0.299)	(0.284)	(0.324)
Liquidity needs × Democracy		−0.195				0.001
		(0.196)				(0.257)
Liquidity needs × Financial remoteness			0.167**			0.154**
			(0.074)			(0.074)
Liquidity needs × GDP per capita (log)				−0.009		0.007
				(0.060)		(0.069)
Liquidity needs × Trade openness (log)					0.284***	0.274**
					(0.105)	(0.115)
Initial share of total manufacturing VA	−0.620***	−0.641***	−0.618***	−0.621***	−0.645***	−0.660***
	(0.133)	(0.138)	(0.132)	(0.133)	(0.137)	(0.142)
Initial number of firms (log)	−0.026***	−0.026***	−0.027***	−0.027***	−0.027***	−0.026***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.662	0.671	0.663	0.668	0.665	0.674
Observations	2251	2197	2251	2251	2197	2143
Durbin-Wu-Hausman statistic	2.449	1.937	2.083	2.317	1.414	1.162

Note: See Table 4..

Table 9: Channels – Decomposition of the Change in Volatility

	Variance of Real VA added Growth (1)	Variance of Real VA per Firm Growth (2)	Variance of Number of Firms Growth (3)	Covariance of Real VA per Firm and Number of Firms Growth (4)
Liquidity needs × Bank development	−1.302***	−1.231***	−0.517***	0.109*
	(0.234)	(0.281)	(0.115)	(0.064)
Liquidity needs × Bank concentration	−0.564**	−0.597**	−0.180	−0.010
	(0.233)	(0.282)	(0.118)	(0.090)
Country dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
R^2	0.532	0.469	0.477	0.262
Observations	2286	2284	2284	2203
Durbin-Wu-Hausman statistic	9.469***	21.620***	41.605**	1.176

Note: The dependent variables are (1) the variance of real value added growth over 1981 to 1998 (Column 1), the variance of the growth of real value added per firm over 1981 to 1998 (Column 2), the variance of the growth in the number of firms over 1981 to 1998 (Column 3), and the covariance between the growth of real value added per firm and the growth in the number of firms over 1981 to 1998 (Column 4) for each 4-digit ISIC industry in each country.