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JUNGHWAN HYUN
RAOUL MINETTI

Credit Reallocation, Deleveraging, and Financial Crises

This paper studies how the process of reallocation of credit across firms behaves before and after financial crises. Applying the methodology typically used for measuring job reallocation, we track credit reallocation across Korean firms for over three decades (1980–2012). The credit boom preceding the 1997 crisis featured a slowdown of credit reallocation. After the crisis and the associated reforms, the creditless recovery (deleveraging) masked a dramatic intensification and increased procyclicality of credit reallocation. The findings suggest that the intensification of reallocation was efficiency-enhancing.

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THE GREAT RECESSION HAS REIGNITED the debate over the dynamics of the credit market before and after financial crises. Several scholars put emphasis on the credit booms that often precede the crises and the sluggish credit growth (deleveraging) that follows them (IMF 2004, Reinhart and Rogoff 2009, Gourinchas and Obstfeld 2012, Dell'Ariccia et al. 2016). A popular argument is that periods of credit bonanza can fuel excessive investment, culminating in financial crashes. In turn, financial crashes can trigger a drastic change in lending practices, resulting into slow credit growth during the recoveries (Mendoza and Terrones 2012, The Economist 2012). The policies enacted in response to financial crashes to prevent new credit booms and busts may exacerbate the "creditless" nature of the recoveries.

In contrast with the extensive knowledge on the behavior of aggregate credit growth, we know little about the process of reallocation of credit before and after

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JUNGHWAN HYUN *is an Assistant Professor, Division of International Trade, Kwangwoon University* (*E-mail*: jhhyun@kw.ac.kr). RAOUL MINETTI *is a Professor, Department of Economics, Michigan State University* (*E-mail*: minetti@msu.edu).

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financial crises. Yet, at every stage of the business cycle, many firms reduce their debt exposure, while others expand it. Thus, credit growth masks a continuous reallocation of credit across firms. A growing strand of theoretical studies demonstrates that credit frictions can hinder this process, influencing the allocation of liquidity, firm entry and exit, firms' incentives to start projects, and ultimately aggregate economic activity (see analyses with allocative, e.g., search, frictions, as in den Haan, Ramey, and Watson 2003, Wasmer and Weil 2004, Chamley and Rochon 2011, Becsi, Li, and Wang 2013, Petrosky-Nadeau and Wasmer 2015). And there is established evidence that, due to pronounced firm heterogeneity, the allocation of liquidity among firms plays a key role in aggregate economic activity (Beck, Levine, and Loayza 2000, Caballero and Hammour 2005, Eisfeldt and Rampini 2006, Galindo, Schiantarelli, and Weiss 2007, Caballero, Hoshi, and Kashyap 2008).

These observations elicit fundamental questions: do the credit booms that precede financial crises feature an intense reallocation of credit across firms or mostly a rollover of credit to firms already served by the credit market? Do crises and the subsequent reforms enhance the ability of the credit market to reallocate liquidity? Or does the deleveraging that often follows the crises stifle this allocative function? Answering these questions can yield new insights into the role of the credit market in the aggregate economy, helping discipline macroeconomic models of the credit market and disentangle the possible role of different types of credit frictions. It can also help frame policy responses to credit booms and busts.

This paper takes a step toward addressing these questions. Employing the methodology proposed by Davis and Haltiwanger (1992) for the measurement of job reallocation and used by Herrera, Kolar, and Minetti (2011) for the measurement of credit reallocation across U.S. firms, we study credit reallocation across South Korean nonfinancial businesses over more than three decades (1980–2012) and investigate whether the reallocation process changed after the 1997 Korean financial crisis and the subsequent reforms. In real terms, the growth of credit to South Korean nonfinancial businesses averaged a startling 9.6% per year in the precrisis (1981–96) period. After the crisis, during the deleveraging phase (1999–2004), credit shrank at an annual rate of 2.8%, and overall, between 1999 and 2012, it expanded at an annual rate of 3.3%. By comparison, Herrera, Kolar, and Minetti document that in the United States, the growth of credit to nonfinancial Compustat firms averaged 3.15% in 1980–2007 and 3.17% in 1990–99. According to BIS data, in Japan and Australia, two advanced economies of the Asia-Pacific region, the growth of credit to nonfinancial firms averaged 1.55% and 5.45%, respectively, in 1981–2012.

The Korean economy and our unique firm-level database constitute an ideal testing ground for our purposes. Credit is a key source of finance for Korean firms (about 82% of their external funding in 2000). Our data set comprises unusually rich microeconomic data on more than 30,000 nonfinancial firms, representing about 50% of employment of Korea in 2000.[1] Moreover, it covers more than 30 years, with a

1. The data source is KISLINE, the business information source provided by the leading Korean credit rating agency, Korea Investors Service (KIS), which is affiliated with Moody's.

major financial crisis around the midpoint at the end of 1997. This allows to separate cyclical changes in credit reallocation, as induced by the crisis, from structural long-lasting changes. Finally, the data enable us to disentangle the interfirm reallocation of loans from that of bond borrowing. This is important, as the reforms implemented in response to the crisis to enhance accounting transparency and management standards especially targeted banks and other loan-granting institutions.

The road map of the paper is as follows. After reviewing prior literature (Section 1), we describe the corporate and financial reforms that we expect to have affected the reallocation process (Section 2) and detail the data (Section 3.1) and the empirical methodology (Section 3.2). In Section 4, we first assess the intensity and persistence of credit reallocation (Sections 4.1–4.2). We find that after the crisis and the reforms, the drop in credit growth was associated with a significant increase in interfirm credit reallocation. Indeed, Korea has transited from a credit growth higher, and a reallocation lower, than the United States before the crisis to intensities of credit growth and reallocation similar to those of the United States after the crisis. Next, to better disentangle the possible role of allocative (e.g., search) frictions from that of other credit imperfections, we study whether changes in reallocation during and after the crisis reflected reshufflings of credit across relatively homogenous groups of firms (e.g., "flights to quality" from small to large firms) or changes in reallocation within such groups (Section 4.3). While the evidence points to the existence of flights to quality during the crisis, the increase in reallocation after the crisis primarily reflects a structural intensification of reallocation even within roughly homogeneous groups of firms. In Section 5, we document that after the crisis and the reforms, credit reallocation has exhibited a higher volatility and procyclicality, while the link between credit growth and the GDP has weakened. Finally, in Section 6, we explore whether the changes in reallocation were efficiency-enhancing.

Throughout Sections 4–6 (see, e.g., Sections 4.4 and 5.3), we interpret our findings through the lenses of the theoretical literature on credit markets and the macroeconomy. The results point to the usefulness of models with credit market allocative frictions (e.g., Wasmer and Weil 2004, den Haan, Ramey, and Watson 2003). Precisely, they suggest that recent approaches that integrate credit search frictions with frictions within credit relationships as in the "financial accelerator" tradition (e.g., Bernanke, Gertler, and Gilchrist 1999) are well positioned to explain the behavior of credit reallocation (see, e.g., Becsi, Li, and Wang 2013, Brand, Isore, and Tripier 2017, Florian-Hoyle and Francis 2017). Some models in this strand increasingly investigate the effect of crises and reforms on interfirm credit reallocation. For example, Chamley and Rochon (2011) predict that in an economy with both credit search frictions and monitoring costs within credit relationships, a reduction in loan monitoring costs and increase in monitoring incentives (due, e.g., to policy reforms) push the credit market from a regime with high credit growth and rollover and low reallocation to a less frictional regime with lower rollover and more flexible reallocation. This strand of models also predicts that, under some conditions, the intensification in reallocation can be associated with increased volatility and procyclicality of reallocation (Chamley and Rochon 2011, Becsi, Li, and Wang 2013,

Florian-Hoyle and Francis 2017). We will return to these points below. Section 7 of the paper concludes. Additional results are relegated to the Supporting Information.

1. PRIOR LITERATURE

Throughout the paper, we will refer to theories of the credit market and its interaction with the macroeconomy for interpreting our findings.[2] On the empirical side, the paper especially relates to two strands of literature. The first investigates the interaction between the credit market and the business cycle. Claessens, Kose, and Terrones (2012) examine the interplay between business cycles and financial cycles using aggregate data for advanced and emerging countries. Mendoza and Terrones (2012) study credit booms and busts in a large set of emerging countries. By means of historical narrative and econometric techniques, Bordo and Haubrich (2010) analyze the comovement of credit, output, and money in the Unites States over more than a century. Jermann and Quadrini (2012) document the behavior of debt repurchases of U.S. firms. Abiad, Dell'Ariccia, and Li (2011) study creditless recoveries and their relation with output performance in a broad set of countries. In this literature, a number of studies focus on the "flights to quality" in the credit market during recessions. Lang and Nakamura (1995) and Oliner and Rudebusch (1995) uncover a reshuffling of bank credit from small to large firms after monetary contractions. Kashyap, Stein, and Wilcox (1993) document an increase in commercial paper relative to bank loans during downturns.[3] Only recently few studies have started to analyze the continuous process of interfirm credit reallocation. Herrera, Kolar, and Minetti (2011) document stylized facts of credit reallocation across U.S. Compustat firms. They do not study the role of financial crises in credit reallocation and how credit reallocation relates to credit booms and to deleveraging processes.

The second related strand of empirical literature investigates the allocative function of financial markets. Eisfeldt and Rampini (2006) and Chen and Song (2013) examine the influence of contractual and financial frictions on the allocation of physical capital across businesses. Galindo, Schiantarelli, and Weiss (2007) study the impact of structural financial shocks, such as financial liberalizations, on the interfirm allocation of physical investment. Our analysis can help understand how the reallocation of credit can generate the observed distribution of capital and total factor productivity (TFP). In this literature, some microeconometric studies examine how financial institutions allocate loans after crises. Borensztein and Lee (2002, 2005) find that in Korea, credit was not directed to profitable sectors in the 1970–96 period, whereas profitability was important for maintaining access to credit during the 1997 crisis. Blalock, Gertler, and

2. For theoretical advances on credit crunches and business cycles, see, for example, Iacoviello (2015) and Quadrini (2011).

3. Some studies examine banks' propensity to specialize in C&I, real estate, and consumer loans and to adjust these loan categories differently during and after downturns. This may also influence banks' response to regional shocks, as the relative importance of these loan categories may differ across regions. See, for example, den Haan, Sumner, and Yamashiro (2007) and Hyun (2016).

Levine (2008) show that in Indonesia, foreign-owned firms (less vulnerable to credit constraints) performed better than domestically owned firms during the East Asian crisis. Unlike these studies, we take a macroeconomic perspective: we construct an indicator of interfirm credit reallocation that, together with credit growth, can be used by macroeconomists for capturing the dynamics of the credit market. We use this indicator to study how the credit market performs its allocative function before and after financial crises and the implications for allocative efficiency.

Finally, the paper is also related to the empirical literature on firm dynamics. We will discuss this link when studying the volatility of credit reallocation.

2. CRISIS, REFORMS, AND THE CREDIT MARKET

The real GDP of South Korea grew at an average annual rate of 6.6% over the 1981–2012 period. At the end of 1997 and beginning of 1998, a major financial crisis hit the economy (the GDP dropped by 5.7% in 1998). In response to the crisis, in 1998 and 1999, the government engaged in radical financial and corporate reforms. The economy started to recover from the crisis in the second half of 1998 and GDP growth rebounded to 10.7% in 1999 and 8.8% in 2000.

Prior to the crisis, firms expanded by relying heavily on bank loans and bonds. The government encouraged preferential credit to large firms, especially business group (*chaebol*) affiliates, in the belief that they would be better global competitors (Jwa 2002, Park and Lee 2003). Banks enjoyed little independence in monitoring firms, and also due to lack of accounting and management transparency, often engaged in a mere rollover of loans (Haggard, Lim, and Kim 2010). In 1997, the median debt–equity ratio of *chaebol* affiliates was almost 400% (Lee and Rhee 2007).

After the onset of the crisis, the government requested *chaebol* affiliates to lower their debt–equity ratio below 200% and abolished their debt guarantees (Chang 2009). It also enacted two sets of reforms. A set of reforms introduced international disclosure principles to improve firms' and banks' transparency, such as quarterly reporting, mark-to-market asset evaluation, and strict classification standards for nonperforming loans (Jwa 2002). The second set of reforms strengthened banks' incentives to monitor firms. In particular, the government amended the "General Banking Act" to enhance the supervision of bank managers. The reforms allegedly altered lending practices. Financial institutions increasingly subjected firms to loan appraisals and gained ability to cut credit to poorly performing firms in a more timely way, rather than rolling over loans inertially (Borensztein and Lee 2005).

It is commonly agreed that the reforms exacerbated the deleveraging of the business sector initiated by the crisis by prompting firms to reduce their debt and forcing financial institutions to apply less inertial lending standards (Bank of Korea 2003). Figure 1 plots the real debt growth rate and equity issuances of nonfinancial firms in 1981–2012 (Panel A) as well as the aggregate debt to GDP ratio of the business

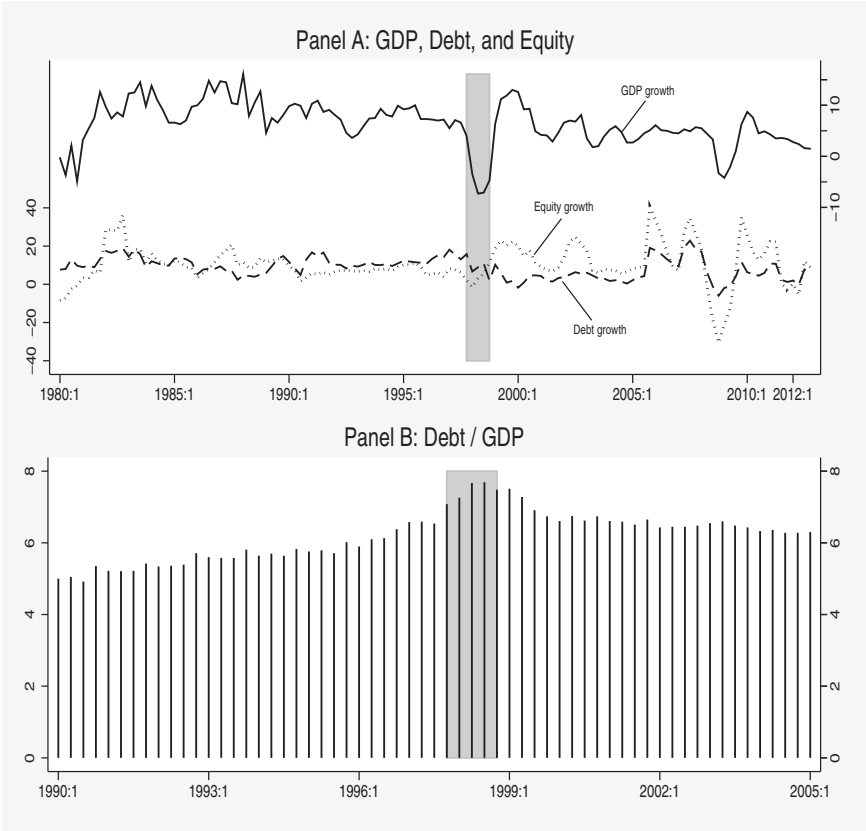

FIG. 1. GDP and Business Sector Debt and Equity.

NOTES: Panel A shows the real GDP growth rate of South Korea and the real growth rate of the total debt and equity of Korean firms. The solid line is the year-on-year quarterly growth rate of the real GDP (scale on the right *Y*-axis). The dashed line and the dotted line represent the year-on-year quarterly real growth rate of the total outstanding debt and total outstanding equity of Korean firms, respectively (scale on the left *Y*-axis). Debt consists of total loans from financial institutions and bonds issued. Debt and equity data are from the Flow of Funds Accounts compiled by the Bank of Korea. Panel B shows the aggregate leverage ratio (total debt/nominal GDP, solid spike) of Korean firms for the period 1990:1–2005:1. The shaded areas in Panels A and B correspond to the financial crisis.

sector (Panel B). The figure illustrates the rapid credit growth before the crisis and the credit contraction after it. In 2001, credit started to increase again, but at a very slow pace. It was only in 2006 that credit growth accelerated.

3. DATA AND METHODOLOGY

In this section, we describe the data and the measurement of credit reallocation.

3.1 The Data Set

Our main data source is KISLINE, the business information source of the leading Korean credit rating agency, KIS, which is affiliated with Moody's. KISLINE provides information on financial statements, governance, and other characteristics of Korean businesses. Our data set covers all the publicly traded firms as well as all the privately held firms subject to annual external auditing. The Corporate External Audit Law requires all privately held firms with assets above a given level and all publicly traded firms to report their annual external audit (including financial statements) to financial authorities. Between 1980 and 2012, to reflect inflation, the asset threshold for privately held firms subject to auditing was raised four times. Our data cover all the years in which a firm existed during the 1980–2012 period, even if the firm was subject to auditing only in 1 year.

The data set spans 33 years, from 1980 to 2012, and includes 33,479 nonfinancial firms (2,245 publicly traded firms, 31,234 privately held ones) and 354,548 firm-year observations. The firms account for a very large fraction of economic activity in Korea: 49.2% and 56.6% of the employment of the nonfinancial sector and of the manufacturing sector in 2000; 81.61% of the bank loans to nonfinancial businesses in 2008. By comparison, the Compustat firms used by Herrera, Kolar, and Minetti (2011) to document credit reallocation in the United States account for one-third of the employment of nonfinancial U.S. businesses. The average sales of the privately held firms and publicly traded firms are 297 million won and 4.6 billion won, respectively.

3.2 Measurement

Following Herrera, Kolar, and Minetti (2011), we define total debt as all forms of financial debt except accounts payable to suppliers. We exclude trade credit because it has properties very different from other kinds of debt. It is for transactional rather than for financial purposes; moreover, it is based on relationships with suppliers rather than with financial institutions. Finally, it is very expensive and firms resort to it only when they lack access to other forms of finance. These features imply that trade credit has low substitutability with other forms of debt (Rajan and Zingales 1995, Nilsen 2002).[4] In addition to total credit, we consider loans and bonds. Loans and bonds can have different dynamics. For example, the reforms enacted in response to the Korean crisis mostly targeted loan-granting institutions, such as banks.[5]

A first methodological issue in the measurement of credit reallocation regards firm entry and exit. KISLINE provides information on all the years in which a firm existed during the sample period and identifies precisely entering and exiting firms. Following Herrera, Kolar, and Minetti (2011), and in line with Ramey and Shapiro (1998), we treat firms that exit due to bankruptcy, liquidation, or merger and acquisition, as

4. See, for example, Garcia-Appendini and Montoriol-Garriga (2013) and Hyun (2017) for analyses of trade credit during crises.

5. Considering long-term credit led to results very similar to those for total credit.

exiting firms.[6] A second issue is the mismatch between fiscal year and calendar year that occurs in roughly 5% of the firms in the sample. Following the way Compustat addresses this mismatch, if the fiscal year ends after May 31st, the data of the firm are not reallocated as if there was no mismatch; if the fiscal year ends before May 31st, the data are allocated to the previous year. The results are virtually identical if we apportion fiscal year data proportionally to calendar years or if we restrict attention to the 95% of firms for which the mismatch does not occur (see the Supporting Information). Finally, we deflate all the variables using the implicit GDP deflator to study credit reallocation in real terms and relate it with real aggregate variables.

To measure credit reallocation, we replicate the methodology proposed by Davis and Haltiwanger (1992) for measuring job reallocation and employed by Herrera, Kolar, and Minetti (2011) for measuring credit reallocation in the United States. Let c_{ft} denote the average debt of firm f between year $t-1$ and year t and C_{st} denote the average debt of set s of firms between year $t-1$ and year t. The debt growth rate g_{ft} of firm f is obtained by dividing the debt change from year $t-1$ to year t by c_{ft}. This growth rate has the advantages of symmetry and boundedness and takes values in the $[-2, +2]$ interval (for an entering firm, g_{ft} equals $+2$; for an existing firm, g_{ft} equals -2).

Five credit flows are constructed using firms' debt growth rates. Credit creation (POS_{st}) is the sum of the debt growth rates of the firms with growing debt weighted by their debt size (the firm debt average over the subsample's debt average). Credit destruction (NEG_{st}) is the weighted sum of the debt growth rates of the firms with shrinking debt. Gross credit reallocation (SUM_{st}) is the sum of credit creation and credit destruction. Net credit growth (NET_{st}) is constructed as credit creation less credit destruction. Finally, excess credit reallocation (EXC_{st}) measures credit reallocation in excess of the minimum required to accommodate the net credit change.

$$\mathrm{POS}_{st} = \sum_{\substack{f \in s_t \\ g_{ft} > 0}} g_{ft} \left(\frac{c_{ft}}{C_{st}} \right), \tag{1}$$

$$\mathrm{NEG}_{st} = \sum_{\substack{f \in s_t \\ g_{ft} < 0}} |g_{ft}| \left(\frac{c_{ft}}{C_{st}} \right), \tag{2}$$

$$\mathrm{SUM}_{st} = \mathrm{POS}_{st} + \mathrm{NEG}_{st}, \tag{3}$$

6. In the Supporting Information, we detail why mergers are likely to be negligible for credit reallocation in Korea. There is a strong reason to treat the exit of a merged or acquired firm as a credit subtraction. When two firms merge, the management and workforce of either acquire control over the financial resources of the other. For financiers, this is at least partly equivalent to reallocating credit between two firms. Many studies (e.g., Servaes 1991) find that a merger announcement significantly affects the stock market value of target and acquirer, suggesting that mergers have large real effects. Inspection of data on firm bankruptcies for Korea also reveals that, after rising during the crisis, in the postcrisis (1999–2012) subperiod, firm bankruptcies went back to an average annual frequency similar to the precrisis subperiod (1981–96).

$$\mathrm{EXC}_{st} = \mathrm{SUM}_{st} - |\mathrm{NET}_{st}|, \tag{4}$$

$$\mathrm{NET}_{st} = \mathrm{POS}_{st} - \mathrm{NEG}_{st}. \tag{5}$$

4. CREDIT REALLOCATION, CREDIT BOOM, DELEVERAGING

This section studies the magnitude, persistence, and cross-sectional properties of reallocation before and after the crisis. It then takes a first step toward interpreting the behavior of reallocation through extant theories.

4.1 Intensity of Interfirm Credit Reallocation

Figure 2 plots the annual flows of credit, together with the real GDP growth rate, for the period 1981–2012. Table 1, Panel A, shows the average annual flows for the 1981–2012 period, for the precrisis (1981–96) and postcrisis (1999–2012) subperiods, and for two shorter subperiods, the credit boom (1993–96) and the deleveraging phase (1999–2004). The table reveals that in an average year, interfirm credit reallocation well exceeds that needed to accommodate the net credit change: the average gross reallocation (SUM) was 21.4% between 1981 and 2012.

Between 1981 and 1996, credit grew at a mean annual rate of 9.6% (loan growth equaled 8.3%). After the crisis, credit growth dropped dramatically, averaging –2.8% in the 1999–2004 deleveraging phase (loan growth of −5.3%) and 3.3% between 1999 and 2012 (loan growth of 3.4%). A deleveraging can be achieved through a reduction in credit creation, implying lower reallocation, or an increase in credit destruction, entailing higher reallocation. Korea followed the latter path. Gross credit reallocation rose significantly and persistently after the crisis and the associated reforms (from an average of 17.9% in 1981–96 to an average of 24.8% in 1999–2012). This stemmed from a persistent increase in credit destruction, which surged during the crisis and thereafter remained permanently higher than in the precrisis period. Credit creation, instead, dropped during the crisis and then reverted to the precrisis level. Figure 2 makes clear that one should not be misled by the tendency of gross reallocation to increase already in the very last phase of the credit boom (1995–96), which was only due to the acceleration in credit growth. In fact, excess reallocation (which nets out from reallocation the amount needed to accommodate credit growth) was 8.3% in 1981–96, further slowed down to 7% during the credit boom, and rose sharply to 18.8% after the crisis (1999–2012).

Herrera, Kolar, and Minetti (2011) find that in the United States, in 1980– 2007, the average gross and excess credit reallocation equaled 21.4% and 16.8%, respectively; the average credit growth was 3.15%. Korea thus transited from a credit growth higher, and a reallocation lower, than the United States before the crisis to intensities of credit growth and reallocation similar to those of the United States after the crisis.

The Chow test results in Table 1, Panel A, suggest that in 1998, there was a structural break in credit destruction, net change, gross, and excess reallocation.

TABLE 1

MAGNITUDE OF GROSS CREDIT FLOWS

Panel A: Credit flows

	Total credit					Loans					Bonds				
Period	POS	NEG	SUM	NET	EXC	POS	NEG	SUM	NET	EXC	POS	NEG	SUM	NET	EXC
1981–2012	14.2	7.2	21.4	6.9	13.2	18.9	12.7	31.6	6.3	22.0	22.1	11.7	33.8	10.3	21.0
1981–96	13.7	4.2	17.9	9.6	8.3	16.5	8.2	24.7	8.3	15.5	25.1	9.5	34.6	15.6	18.9
1993–96	13.8	3.5	17.3	10.3	7.0	17.1	7.3	24.4	9.7	14.7	19.7	5.2	25.0	14.5	10.4
1999–2004	11.2	14.0	25.2	−2.8	22.1	17.2	22.5	39.7	−5.3	32.7	13.4	19.4	32.7	−6.1	26.6
1999–2012	14.0	10.7	24.8	3.3	18.8	21.2	17.8	39.0	3.4	30.3	17.0	14.9	31.9	2.2	24.3
Chow test	0.2	2.3	1.9	2.6	4.0	1.5	3.6	3.9	1.1	8.3	3.2	2.3	0.6	4.0	1.2
Rank sum	0.7	−4.4	−4.1	2.8	−4.4	−2.5	−3.9	−4.7	1.5	−4.3	3.0	−2.7	0.8	3.1	−1.9

Panel B: Credit flows due to large credit changes

	Total credit					Loans					Bonds				
Period	POSbig	NEGbig	SUMbig	NETbig	EXCbig	POSbig	NEGbig	SUMbig	NETbig	EXCbig	POSbig	NEGbig	SUMbig	NETbig	EXCbig
1981–2012	11.5	5.3	16.8	6.3	9.7	17.0	10.8	27.8	6.2	18.5	19.9	10.1	30.0	9.8	17.7
1981–96	10.7	2.3	13.0	8.4	4.6	14.1	6.1	20.2	8.1	11.4	23.1	7.9	30.9	15.2	15.6
1999–2012	11.7	8.5	20.2	3.1	15.2	19.6	16.1	35.7	3.5	27.4	14.7	13.2	28.0	1.5	20.8

NOTES: This table reports the average flows of total credit, loans, and bonds (Panel A) and the average flows of total credit, loans, and bonds due to large credit changes (Panel B). The periods 1981–96 and 1999–2012 reflect the precrisis period and the postcrisis one, respectively.

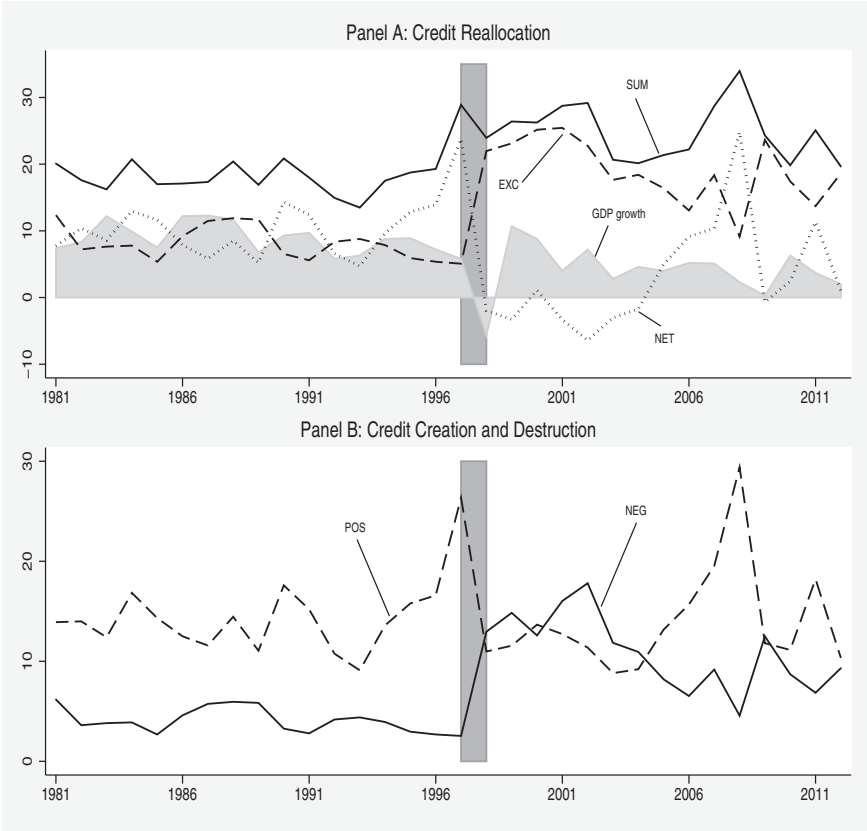

FIG. 2. Credit Change and Credit Reallocation.

NOTES: Panel A shows gross credit reallocation (SUM, solid line), excess credit reallocation (EXC, dashed line), the net credit change (NET, dotted line), and the annual real GDP growth rate (gray area). Panel B shows credit creation (POS, dashed line) and credit destruction (NEG, solid line). The vertical shaded areas in the two panels correspond to the financial crisis.

Following Stock and Watson (2003), we also specified an AR(1) process for the conditional mean of reallocation and used the Quandt likelihood ratio statistic to test whether the conditional mean had a structural break at some unknown date. The results (available from the authors) point to a structural break of excess reallocation in 1999; the 67% confidence interval for the break date is between 1997 and 2001. Further, the rank sum tests in Table 1 suggest that the means of the credit flows differ between the precrisis period and the postcrisis period.

Table 1, Panel A, and Figure 3 reveal that the gross reallocation of loans rose significantly from 24.7% in the precrisis period to 39% in the postcrisis period, while the gross reallocation of bond borrowing remained stable. Moreover, the excess loan reallocation almost doubled, while the excess reallocation of bond borrowing went

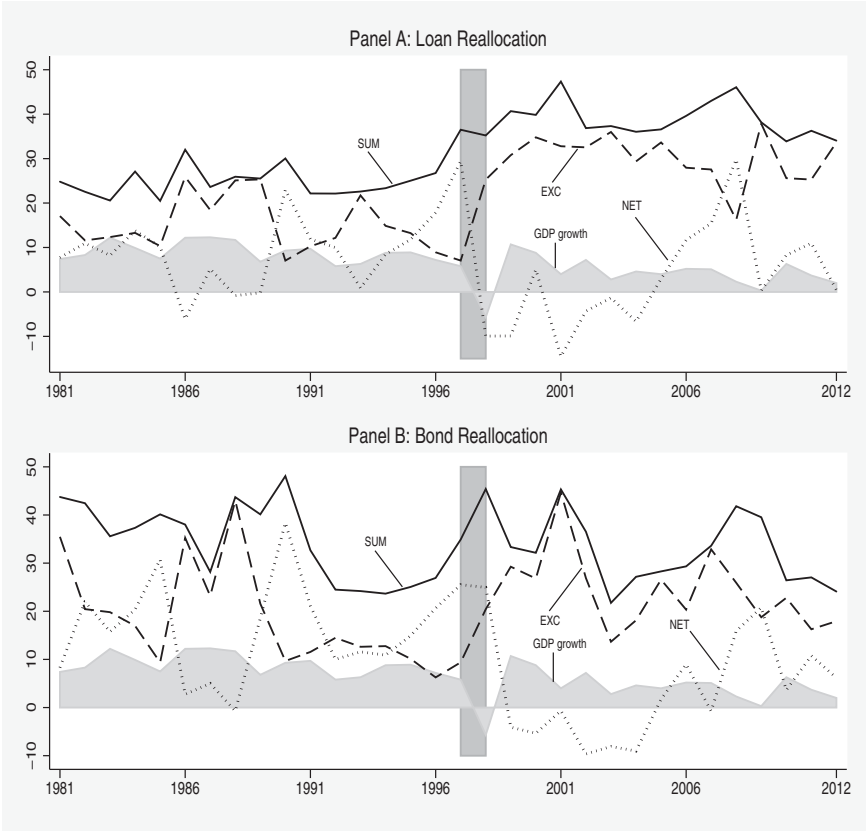

FIG. 3. Loan and Bond Reallocation.

NOTES: Panel A shows loan reallocation (SUM, solid line), excess credit reallocation (EXC, dashed line), the net credit change (NET, dotted line), and the annual real GDP growth rate (gray area). Panel B shows bond reallocation (SUM, solid line), excess credit reallocation (EXC, dashed line), the net credit change (NET, dotted line), and the annual real GDP growth rate (gray area). The vertical shaded areas in the two panels correspond to the financial crisis.

from 19% to 24%. This stems from the fact that both loan creation and destruction rose, while the increase in bond destruction was largely offset by the decrease in creation. To summarize, credit reallocation has significantly intensified after the crisis and this has primarily been due to the intensification in loan reallocation.

4.2 Size and Persistence of Underlying Credit Changes

Nonconvex adjustment costs can induce firms to adjust credit in a lumpy way (Bazdresch 2013, Eisfeldt and Muir 2016). It is then important to understand to what degree the intensification of reallocation after the crisis was driven by large firm-level credit changes. Gourio and Kashyap (2007) define changes of physical capital above

20% as large. Following their approach, and in line also with Herrera, Kolar, and Minetti (2011), we label a firm's debt growth rate g_{ft} above 18% (canonical growth rate of 20%) as a large increase and a debt growth below –18% as a large decrease. Table 1, Panel B, and Supplementary Figure A1 display the credit flows due to large credit changes. The average share of gross reallocation due to large credit changes rose from 72.7% to 81.6% after the crisis. Thus, a sizeable portion of the increase in reallocation was due to large credit adjustments. This is especially true for loans, while we find again little evidence of a change in the reallocation of bond finance.

Credit flows could be large but reflect short-lived liquidity shortfalls. We assess the persistence of firms' debt changes applying the index

$$\mathbf{P}_{ft} = \min\left[1, \max\left(0, \frac{g_{ft,t+2}}{g_{ft,t+1}}\right)\right] \tag{6}$$

in Davis and Haltiwanger (1992), where $g_{ft,t+s}$ is the debt growth rate of a firm f between years t and $t+s$. The index equals 1 when all the debt change from t to $t+1$ lasts until $t+2$ and 0 when the change is purely temporary. Its average value equaled 0.72 before the crisis, 0.70 after it, signaling that the firm-level debt changes were persistent both before and after the crisis. Thus, the intensification of reallocation after the crisis was not driven by temporary liquidity shortfalls.

4.3 The Role of Flights to Quality

The financial accelerator literature has shown that downturns can feature reshufflings of credit (flights to quality) from information opaque small firms to information transparent big firms (Bernanke, Gertler, and Gilchrist 1999, 1996). Similarly, credit can flow from industries suffering from tight credit to industries less exposed to tight credit. The reader may then wonder to what extent the observed intensification of reallocation reflects a persistent flight to quality triggered by the crisis.

To probe this point, we break down our sample based on a wide array of firm characteristics. Focusing first on firms' demographics, we partition our sample in size (sales) quintiles, two-digit Standard Industrial Classification (SIC) industries, and regions. We next consider firms' governance and break down the sample into *chaebol* affiliates and nonaffiliates and into publicly listed and nonlisted firms. Using measures of profitability and efficiency, we also partition the sample into quintiles by return on assets, return on equity, sales to capital ratio, and profits to capital ratio.[7] For each classification, we measure the relative importance of the reallocation of credit within groups (e.g., size classes or industries) using the "within index" in Davis and Haltiwanger (1992)

$$\mathbf{W}_t = 1 - \frac{\sum \left|\mathrm{NET}_{jt}\right|}{\sum \mathrm{SUM}_{jt}}, \tag{7}$$

7. In untabulated results, we also considered the current asset ratio and working capital ratio.

where *j* denotes a group. $W_t = 1$ if all the reallocation is within groups; $W_t = 0$ if it is all across groups. Table 2, Panel A, displays the credit flows for size classes. Credit reallocation decreases with size. The average W_t for sales quintiles was 0.57 and rose from 0.44 before the crisis to 0.73 after it (Panel B).[8] In unreported tables, we also show that in most two-digit SIC industries, reallocation increased after the crisis. For manufacturing industries, the average W_t rose from 0.43 to 0.63 (Panel B). Next, we partition the firms based on their headquarter location in the 16 Korean administrative districts. The average W_t rose from 0.40 to 0.67 after the crisis. When we classify firms based on whether they are affiliated to a top 30 *chaebol*, we obtain again that the average W_t rose after the crisis. The increasing importance of reallocation within groups of firms after the crisis is confirmed when we partition firms by profitability and efficiency. For quintiles by return on equity, the average W_t rose from 0.49 to 0.64; for quintiles by return on assets, it rose from 0.47 to 0.63.

Altogether, these results suggest that reallocation within roughly homogeneous groups of firms is important and that after the crisis, its importance increased relative to that of reallocation across groups. Does this imply that no flight to quality occurred during the crisis, for example, across size classes? Actually, the increase in the W-index occurred after a drop during the crisis. For instance, the drop of the W-index for sales quintiles in 1997 (Table 2, Panel B) points to a credit reshuffling from small to large firms during the crisis. This would have occurred in the loan market (the W-index for bond borrowing remained unaltered). Nonetheless, the increase of the W-index after the crisis signals that the rise in reallocation after the crisis does not reflect temporary flights to quality but a structural intensification of credit reallocation even within roughly homogeneous groups of firms.

The literature stresses that flights to quality can also manifest themselves as reshufflings across categories of credit and securities (Kashyap, Stein, and Wilcox 1993). We compute a W-index that disentangles the reallocation between loan and bond finance from the reallocation within these two categories of credit. The average W_t rose from 0.58 to 0.78 after the crisis (Table 2, Panel B). This supports the hypothesis that after the crisis, the intensification of reallocation reflected a structurally higher flexibility of financial institutions in reallocating loans rather than flights to quality between loans and bond finance. However, consistent with the view that during crises, flights to quality can also entail reshufflings between loans and bonds, in 1997, this W-index dropped to 0.23 before rising after the crisis.[9]

4.4 Interpreting the Findings through Credit Market Theories

Macroeconomic models with allocative (e.g., search) frictions can help interpret the patterns of reallocation, including its staggering increase after the crisis and

8. In the United States, the mean value of this W_t was 0.64 in 1952-2007 (Herrera, Kolar, and Minetti 2011).

9. Firms may (partially) compensate a change in loans with a change in bond borrowing (see, e.g., Becker and Ivashina 2014). If we focus on firms that do not compensate loan changes with changes in bond borrowing, we obtain a loan reallocation about three-fifths of the total loan reallocation.

TABLE 2

CREDIT REALLOCATION IN SUBGROUPS

Panel A: Credit reallocation in size (sales) quintiles

		Total credit					Loans					Bonds				
	Period	POS	NEG	SUM	NET	EXC	POS	NEG	SUM	NET	EXC	POS	NEG	SUM	NET	EXC
First size quintile	1981–2012	20.0	7.9	27.9	12.1	15.8	23.3	10.8	34.1	12.4	20.4	41.7	29.2	70.9	12.6	40.9
	1981–96	18.5	5.1	23.6	13.3	10.3	21.7	8.8	30.5	12.9	15.0	39.0	17.2	56.2	21.8	30.6
	1999–2012	22.1	11.3	33.4	10.7	22.6	25.5	13.4	38.9	12.1	26.8	47.7	40.1	87.9	7.6	52.4
	Chow test	0.2	7.6	2.0	0.4	7.6	0.3	1.2	0.7	2.2	3.7	0.4	3.5	3.3	0.3	1.7
Second size quintile	1981–2012	17.4	7.5	25.0	9.9	14.8	21.5	11.2	32.7	10.3	20.6	36.1	22.7	58.8	13.4	36.1
	1981–96	16.6	5.0	21.7	11.6	9.9	20.0	9.5	29.5	10.5	16.0	34.1	14.5	48.5	19.6	26.3
	1999–2012	18.4	10.3	28.7	8.1	20.3	23.1	13.3	36.3	9.8	26.0	41.3	30.5	71.8	10.8	48.0
	Chow test	0.8	4.8	2.1	1.8	3.9	0.2	1.6	1.5	0.6	4.3	0.5	2.2	2.9	0.3	5.9
Third size quintile	1981–2012	15.1	7.3	22.4	7.9	13.9	20.9	12.0	33.0	8.9	21.9	24.6	17.3	42.0	7.3	26.2
	1981–96	15.3	4.7	20.0	10.6	9.4	18.8	9.6	28.4	9.2	16.3	30.8	10.8	41.6	19.9	20.8
	1999–2012	14.5	10.1	24.6	4.5	19.1	22.7	14.9	37.5	7.8	28.3	18.9	24.9	43.8	−6.0	33.4
	Chow test	0.4	3.5	1.3	2.3	2.8	0.7	1.3	1.9	0.6	2.3	0.6	5.2	0.6	2.6	3.5
Fourth size quintile	1981–2012	16.4	6.7	23.1	9.7	13.2	20.5	11.1	31.6	9.4	20.9	27.7	16.4	44.1	11.3	27.9
	1981–96	16.8	4.2	21.0	12.5	8.5	19.5	8.6	28.1	11.0	15.2	25.5	9.4	35.0	16.1	18.7
	1999–2012	15.7	9.5	25.2	6.2	18.6	21.5	14.2	35.8	7.3	27.8	30.3	24.3	54.6	6.0	37.5
	Chow test	0.4	4.9	2.3	2.2	5.3	0.3	2.1	3.1	0.3	3.7	0.3	3.5	1.1	1.1	1.7
Fifth size quintile	1981–2012	13.0	6.2	19.2	6.8	10.7	17.8	12.3	30.1	5.5	19.5	21.4	10.7	32.1	10.7	19.2
	1981–96	12.6	3.5	16.1	9.2	6.9	15.4	7.5	22.9	7.9	13.8	24.3	9.1	33.4	15.2	18.2
	1999–2012	12.6	9.2	21.9	3.4	15.0	19.9	17.6	37.5	2.2	26.9	16.2	13.3	29.5	2.9	21.6
	Chow test	0.1	1.7	1.4	2.0	3.3	1.1	3.4	3.8	1.1	10.3	3.6	1.6	1.2	3.9	0.9

(*Continued*)

TABLE 2

CONTINUED

Panel B: W indexes based on firm subgroups or credit categories

	Firms' demographics									*Firms' governance*					
	Size			Industry			Region			Chaebol affiliation			Listing		
Period	Total	Loans	Bonds	Total	Loans	Bonds	Total	Loans	Bonds	Total	Loans	Bonds	Total	Loans	Bonds
1981–2012	0.57	0.63	0.61	0.52	0.56	0.44	0.52	0.58	0.44	0.60	0.67	0.61	0.62	0.68	0.66
1981–96	0.44	0.54	0.55	0.43	0.50	0.38	0.40	0.47	0.36	0.47	0.62	0.51	0.50	0.62	0.57
1997	0.23	0.31	0.69	0.26	0.25	0.41	0.24	0.29	0.46	0.17	0.19	0.29	0.23	0.24	0.40
1999–2012	0.73	0.74	0.68	0.63	0.63	0.50	0.67	0.71	0.54	0.75	0.76	0.74	0.75	0.78	0.77

	Firms' profitability and efficiency												
	Return on assets			Return on equity			Profits to capital			Sales to capital			*Credit category*
Period	Total	Loans	Bonds	Total	Loans	Bonds	Total	Loans	Bonds	Total	Loans	Bonds	(Loans, Bonds)
1981–2012	0.54	0.62	0.59	0.55	0.63	0.56	0.56	0.65	0.58	0.59	0.67	0.55	0.65
1981–96	0.47	0.61	0.56	0.49	0.61	0.54	0.45	0.60	0.49	0.41	0.59	0.46	0.58
1997	0.25	0.31	0.39	0.28	0.31	0.48	0.19	0.24	0.36	0.19	0.23	0.36	0.78
1999–2012	0.63	0.65	0.64	0.64	0.69	0.59	0.71	0.75	0.71	0.74	0.75	0.64	0.23

NOTES: Panel A of the table shows the average credit flows in sales quintiles; Panel B shows the W indexes for firm classifications (size, industry, region, chaebol affiliation, listing, return on assets, return on equity, profits to capital ratio, and sales to capital ratio) and for credit category (loans and bonds). In Panel A, the first (fifth) quintile is the quintile with the smallest (largest) firms. The Chow test statistics come from Chow tests for a structural break in 1998.

the reforms. In particular, models that integrate credit search frictions with frictions within credit relationships appear to be well positioned to explain these patterns.

In models with search frictions, reallocation is governed by a credit matching function. In particular, the amount of credit created in period t is $m_t = \mathcal{M}(F_t, L_t)$, where $\mathcal{M}(.)$ denotes the matching function and F_t and L_t are the mass of firms and the mass of lenders searching in the credit market. The amount of credit destruction is driven by endogenous separation decisions of lenders and borrowers (or an exogenous destruction process, in simplified settings). In Wasmer and Weil (2004) and Petrosky-Nadeau and Wasmer (2013, 2015), firms need to borrow for posting job vacancies but are randomly matched with lenders. In den Haan, Ramey, and Watson (2003), firms are randomly matched with project financiers. In these models, consistent with the patterns in our data, the matching process makes credit flow to firms randomly (independently of firms' characteristics), generating large credit flows within (and across) groups of businesses with similar characteristics. The patterns in our data are, however, also consistent with key predictions of models with frictions within credit relationships as in the financial accelerator literature (Bernanke, Gertler, and Gilchrist 1999). Such models predict that recessions trigger large spikes in credit reshuffling across groups of firms (e.g., from small to large firms), a flight to quality that appears to have occurred during the 1997 Korean crisis, as noted. All in all, approaches that integrate search frictions with frictions within credit relationships thus appear to be well positioned to capture salient properties of credit flows. In Becsi, Li, and Wang (2013), entrepreneurs face search frictions and also face rationing within credit relationships because they can abscond funds. Florian-Hoyle and Francis (2017) and Brand, Isore, and Tripier (2017) incorporate search frictions into DSGE models of the financial accelerator.

Models that embed both search frictions and frictions within credit relationships can also help interpret the increase in reallocation after the crisis. Our findings support the view that the reforms not only prompted financial institutions to expand credit less aggressively than before the crisis, triggering firms' deleveraging, but also mitigated the frictions hindering reallocation, inducing lenders to reallocate credit more flexibly rather than inertially rolling over loans (Lim 2010). Indeed, we have also found that the rise in reallocation was especially pronounced for loans, hinting at a change in the flexibility of financial institutions in reallocating loans. Chamley and Rochon (2011) can help formalize this interpretation in an economy with credit search frictions and agency (monitoring) costs within credit relationships. The economy can be in an equilibrium where banks have the incentive to rollover loans and credit reallocation is depressed—a scenario similar to the Korean precrisis period. A policy-driven reduction in loan monitoring costs and increase in monitoring incentives (such as the reforms that enhanced firms' transparency and banks' monitoring incentives) push to an equilibrium with lower rollover and higher loan reallocation. In fact, a drop in monitoring costs increases the payoff of matching with new borrowers relative to that of loan rollover, inducing banks to dissolve credit matches more flexibly. Interestingly, Chamley and Rochon show that the equilibrium switch can also be caused by an endogenous crisis. The high-rollover equilibrium features the

accumulation of underperforming loans until the return from rollover drops below that of reallocation. A crisis then occurs with a spike in loan destruction and the switch to the equilibrium with higher reallocation (see also BIS 2018 for a comprehensive discussion of changes in banks' lending behavior and credit risk analysis after crises).

5. VOLATILITY AND CYCLICAL BEHAVIOR OF REALLOCATION

In this section, we examine whether, besides its intensity, the volatility and cyclical behavior of reallocation also changed after the 1997 financial crisis. This will provide further theoretical insights into the possible role of different types of frictions.

5.1 Volatility

Table 3, Panel A, reports the standard deviation and the coefficient of variation (standard deviation/mean*100) of the credit flows. The volatility of reallocation is pronounced: over the full sample period, the coefficients of variation of gross and excess reallocation equal 22.64% and 49.96%. The corresponding figures for the United States are 31.88% and 45.43% (Herrera, Kolar, and Minetti 2011). Similar to what found by Herrera, Kolar, and Minetti, credit destruction is more volatile than credit creation. The volatility of gross and excess reallocation increased after the crisis, with the volatility of loan reallocation increasing more sharply than that of bond reallocation.[10]

As noted, the relative importance of credit reallocation within industries and size classes grew after the crisis. A related question is to what extent the increase in the volatility of credit reallocation was driven by idiosyncratic, firm-level debt changes. To assess this, following Davis and Haltiwanger (1992) and Herrera, Kolar, and Minetti (2011), we decompose the debt growth rate g_{ft} of each firm into the sector growth rate, g^s_{ft}, which captures sectoral and aggregate effects, and an idiosyncratic component, g^i_{ft}, that is, $g_{ft} = g^s_{ft} + g^i_{ft}$. We then recompute the credit flows in (1)–(5) using only the idiosyncratic component of firms' debt growth rates. With the help of simple algebra, the variance of (gross or excess) reallocation can be rewritten as the sum of the variance of the reallocation computed using the idiosyncratic effects, the variance of the reallocation due to sectoral or aggregate effects, and the covariance between the idiosyncratic and the sectoral or aggregate component. For instance, the variance of gross reallocation can be rewritten as

$$\begin{aligned}\text{var}(\text{SUM}_t) = \text{var}\left(\text{SUM}^i_t\right) + \ \text{var}(\text{SUM}_t - \text{SUM}^i_t) \\ + 2\text{cov}\left(\text{SUM}_t - \text{SUM}^i_t, \text{SUM}^i_t\right),\end{aligned} \tag{8}$$

10. Five-year and 10-year rolling standard deviations yield the same insights (see the Supporting Information).

TABLE 3

VOLATILITY OF CREDIT REALLOCATION

Panel A: Volatility

	Total credit					Loans					Bonds				
	POS	NEG	SUM	NET	EXC	POS	NEG	SUM	NET	EXC	POS	NEG	SUM	NET	EXC
			s.d.					s.d.					s.d.		
1981–2012	4.50	4.35	4.85	7.40	6.60	6.13	7.07	7.92	10.59	9.57	8.31	5.81	7.70	12.09	9.70
1981–96	2.39	1.21	2.07	3.16	2.42	3.92	4.07	3.21	7.32	6.12	7.45	5.46	8.23	10.15	10.70
1999–2012	5.41	3.81	4.36	8.27	4.84	6.37	5.76	4.12	11.43	5.57	6.56	5.04	6.92	9.43	8.03
			s.d./mean*100					s.d./mean*100					s.d./mean*100		
1981–2012	31.73	59.96	22.64	106.73	49.96	32.33	55.72	25.04	169.15	43.51	37.64	49.56	22.79	116.82	46.10
1981–96	17.39	29.06	11.59	33.05	29.06	23.76	49.78	13.00	88.24	39.54	29.64	57.48	23.75	64.88	56.58
1999–2012	39.27	109.08	25.28	80.48	69.27	37.28	78.45	16.85	117.28	37.89	33.24	96.40	27.73	64.96	76.83

(*Continued*)

TABLE 3

CONTINUED

Panel B: Variance decomposition

		Size			Manufacturing			Chaebol affiliation			Profits to capital		
		Total	Loans	Bonds	Total	Loans	Bonds	Total	Loans	Bonds	Total	Loans	Bonds
Gross credit reallocation													
Sectoral effects	1981–2012	1.53	0.76	0.72	0.83	0.69	0.53	0.57	0.41	0.34	1.19	0.70	0.68
	1981–96	8.92	3.98	0.63	2.04	1.32	0.33	2.95	2.15	0.20	7.95	5.42	0.68
	1999–2012	0.46	1.40	0.36	0.37	0.86	0.56	0.29	1.11	0.44	0.65	1.40	0.39
Idiosyncratic effects	1981–2012	1.56	0.72	2.20	0.32	0.16	0.58	1.01	0.75	1.58	1.17	0.72	1.36
	1981–96	10.82	3.82	2.15	1.59	0.84	0.36	4.12	1.77	1.37	5.83	5.13	0.80
	1999–2012	1.58	1.98	1.40	0.48	0.40	0.20	1.52	1.86	1.52	1.48	1.85	1.16
Covariance term	1981–2012	−2.09	−0.48	−1.92	−0.15	0.15	−0.11	−0.58	−0.17	−0.92	−1.37	−0.42	−1.05
	1981–96	−18.73	−6.80	−1.77	−2.63	−1.16	0.30	−6.08	−2.92	−0.57	−12.78	−9.55	−0.47
	1999–2012	−1.05	−2.38	−0.76	0.15	−0.26	0.24	−0.80	−1.97	−0.96	−1.12	−2.25	−0.55
Excess credit reallocation													
Sectoral effects	1981–2012	1.08	0.93	1.34	0.99	0.77	1.10	0.79	0.53	1.29	2.39	1.70	2.50
	1981–96	3.71	2.20	1.20	1.55	1.00	0.85	1.77	0.93	1.08	6.62	3.60	1.70
	1999–2012	1.87	2.04	0.51	1.35	1.24	0.66	1.69	1.58	0.73	4.37	3.35	2.02
Idiosyncratic effects	1981–2012	0.40	0.43	0.87	0.06	0.09	0.30	0.33	0.39	0.97	0.85	0.69	1.10
	1981–96	3.52	0.99	0.75	0.52	0.15	0.22	1.73	0.18	0.85	3.85	1.08	0.67
	1999–2012	0.60	0.48	0.89	0.09	0.18	0.19	0.53	0.46	1.15	1.69	1.49	1.13
Covariance term	1981–2012	−0.49	−0.35	−1.21	−0.05	0.14	−0.41	−0.12	0.08	−1.26	−2.24	−1.39	−2.59
	1981–96	−6.23	−2.19	−0.94	−1.07	−0.15	−0.07	−2.51	−0.11	−0.93	−9.48	−3.68	−1.37
	1999–2012	−1.48	−1.51	−0.41	−0.44	−0.42	0.15	−1.23	−1.04	−0.88	−5.06	−3.84	−2.16

NOTES: Panel A of this table shows the standard deviation (s.d.) and the coefficient of variation (s.d./mean*100) of the credit flows. Panel B shows the variance decomposition of the gross and excess reallocation of total credit, loans, and bonds.

where SUM_t^i denotes gross reallocation computed using the idiosyncratic effects. Table 3, Panel B, summarizes the decomposition for different classification schemes. We find some evidence that the importance of idiosyncratic effects rose relative to the importance of sectoral or aggregate effects after the crisis. Using the classification in size classes, for example, before the crisis, idiosyncratic effects and sectoral or aggregate effects contributed equally to the variance of loan reallocation. After the crisis, the relative contribution of idiosyncratic effects increased.

In search models of the credit market, search frictions hinder the creation of credit matches, dampening the volatility of credit creation relative to that of credit destruction. Consistent with this, in our data, the volatility of credit destruction is higher than that of credit creation. The observed increase in the volatility of reallocation is also reminiscent of the increase in firm-level volatility in recent decades (Campbell et al. 2001, Chaney, Gabaix, and Philippon 2002).[11] Comin and Phillippon (2006) find that the rise in firm volatility is correlated with better access to credit, which could match the hypothesis that in Korea, credit reallocation became less frictional after the crisis and the associated reforms.

5.2 Cyclical Behavior

Table 4, Panel A, gathers the correlation coefficients between credit flows and GDP growth. Both in the precrisis and the post-crisis period, gross reallocation was mildly procyclical.[12] Using (4), we also decompose the correlation as follows:

$$\begin{aligned}\text{corr(SUM, GDP)} = &\frac{\text{sd(EXC)}}{\text{sd(SUM)}}\text{corr(EXC, GDP)} \\ &+ \frac{\text{sd(|NET|)}}{\text{sd(SUM)}}\text{corr(| NET| , GDP)}. \end{aligned} \tag{9}$$

The decomposition in Panel A suggests that the comovement of gross reallocation with GDP growth was especially driven by the net credit change before the crisis and by the excess reallocation after it. This is confirmed when we consider the correlation with GDP growth of excess reallocation in different size (sales) quintiles of firms (Table 4, Panel B). This pattern is suggestive, as the years of GDP expansion before the crisis featured a credit boom, whereas after the crisis, the recovery of economic activity was associated with an intensification in reallocation.

The reader might have some concern that for the postcrisis period, the correlations rely on annual data from 1999 to 2012. We then recomputed the credit flows using quarterly data we have available for publicly traded firms from 2000Q1 to 2012Q4. The correlations in the Supporting Information confirm that after the crisis, excess reallocation was mildly procyclical, while the net credit change was essentially

11. By contrast, aggregate volatility has declined (see, e.g., McConnell and Perez-Quiros 2000).

12. Herrera, Kolar, and Minetti (2011) find that credit reallocation is mildly procyclical in the United States. Our result relates to the finding of some studies that physical capital reallocation and labor reallocation are procyclical (Foote 1998, Maksimovic and Phillips 2001, Eisfeldt and Rampini 2006).

TABLE 4

CYCLICAL BEHAVIOR OF CREDIT FLOWS

Panel A: Correlation of credit reallocation with GDP growth and decomposition

	$t-2$	$t-1$	t	$t+1$	$t+2$	$t-2$	$t-1$	t	$t+1$	$t+2$
	Total credit									
	1981–96					1999–2012				
corr (SUM,GDP)	0.004	−0.012	0.280	−0.243	−0.152	0.115	0.193	0.169	−0.188	0.199
	Decomposition									
corr (EXC,GDP)	0.182	−0.159	0.084	0.133	0.450	0.101	0.025	0.384	0.614*	0.063
sd(EXC)/sd(SUM)	1.165	1.165	1.165	1.165	1.165	1.108	1.108	1.108	1.108	1.108
corr (|NET|,GDP)	−0.136	0.113	0.119	−0.261	−0.443	0.002	0.112	−0.17	−0.585	0.087
sd(|NET|)/sd(SUM)	1.526	1.526	1.526	1.526	1.526	1.484	1.484	1.484	1.484	1.484
	Total credit (excluding 2008)									
	1981–96					1999–2012				
corr (SUM,GDP)	0.004	−0.012	0.280	−0.243	−0.152	0.113	0.187	0.400	0.162	−0.061
corr (EXC,GDP)	0.182	−0.159	0.084	0.133	0.450	0.153	0.083	0.316	0.464	0.390
	Loans									
	1981–96					1999–2012				
corr (SUM,GDP)	0.282	−0.011	0.160	0.051	−0.104	0.227	0.254	0.070	0.153	0.050
corr (EXC,GDP)	0.281	0.058	0.106	0.181	0.425	0.023	0.118	−0.018	0.579*	0.029
	Bonds									
	1981–96					1999–2012				
corr (SUM,GDP)	0.128	−0.139	0.153	0.324	0.423	0.361	0.113	0.020	0.172	0.131
corr (EXC,GDP)	0.046	−0.167	0.338	0.179	0.505*	0.290	0.125	0.366	0.313	−0.076

(*Continued*)

TABLE 4

CONTINUED

Panel B: Correlation of reallocation of total credit with GDP growth by size quintiles

	1981–96						1999–2012			
					All firms					
corr (EXC,GDP)	0.182	−0.159	0.084	0.133	0.450	0.101	0.025	0.384	0.614*	0.063
					First size quintile					
corr (EXC,GDP)	0.513	−0.449	−0.378	−0.288	−0.026	−0.118	0.222	−0.285	−0.195	−0.184
					Second size quintile					
corr (EXC,GDP)	0.572	−0.361	−0.347	−0.239	0.127	0.256	0.124	0.172	0.355	0.341
					Third size quintile					
corr (EXC,GDP)	0.588	−0.147	0.137	0.382	0.554	0.111	−0.074	0.373	0.525	0.312
					Fourth size quintile					
corr (EXC,GDP)	0.421	0.001	0.125	0.159	0.435	0.348	−0.083	0.243	0.508	0.181
					Fifth size quintile					
corr (EXC,GDP)	−0.042	−0.194	0.097	0.441	0.580	0.072	−0.049	0.493	0.667	−0.020

NOTES: This table, Panel A, reports the correlation coefficients of the gross and excess reallocation of total credit, loans, and bonds with the GDP growth rate. It also reports the same correlation for total credit after excluding 2008. The panel displays correlations for the precrisis (1981–96) period and for the postcrisis (1999–2012) period. For the gross reallocation of total credit, Panel A also reports the decomposition of its correlation with the GDP growth rate. Panel B of the table displays the correlation coefficients of the excess reallocation of total credit with the GDP growth rate, by size (sales) quintiles. * denotes statistical significance at the 5% level.

acyclical. And these patterns were confirmed when computing the correlation of forecast errors of a quarterly VAR at different horizons (following den Haan 2000).

To further explore the cyclical behavior of credit flows, following Covas and den Haan (2011), we estimate the following regression for firm-level debt changes:

$$\frac{F_{i,t}}{A_{i,t-1}} = \alpha_{0,i} + \sum_{j=1}^{J} \mathbf{I}_{i,t}(j) \left\{ \alpha_{j,1} t + \alpha_{j,2} t^2 + \alpha_{j,3} Y_t^c + \alpha_{j,4} \mathbf{Z}_t \right\} + u_{i,t},$$

where $F_{i,t}$ is the debt change of firm i in year t; $A_{i,t-1}$ denotes its assets in $t-1$; t and t^2 are a linear and a quadratic time trend; $\mathbf{I}_{i,t}(j)$ is an indicator that equals 1 if firm i belongs to the group j of firms (e.g., a sales quintile), 0 otherwise; Y_t^c is the GDP growth rate; and Z_t is a vector of firm characteristics. As in Covas and den Haan, in baseline regressions, we insert lagged values of cash flow and Tobin's Q as regressors. For unlisted firms, since we lack information on firms' market value for calculating the Tobin's Q, as a proxy for firms' growth and investment opportunities, we use the 2-year-ahead sales growth rate (see, e.g., Biddle, Hilary, and Verdi 2009 for an analogous approach and for a discussion). Moreover, we subtract the group mean from these regressors to purge the effect of aggregate conditions. In extended regressions, we insert further (demeaned) indicators of profitability and efficiency (sales to capital and profits to capital) and liquidity (current asset ratio and working capital ratio). Due to data availability, the sample spans from 1987 to 2012.

Table 5 shows the results for the baseline regressions (Panel A) and for the regressions with further controls (Panel B) for each sales quintile.[13] Panel C shows the results for the baseline regressions for other firm groups. To conserve space, we display the coefficient estimates for GDP growth ("cyclicality") and for selected firm characteristics. Two findings stand out. First, the results confirm the reduced procyclicality of the net credit change documented with the correlation coefficients: after the crisis, debt changes became less sensitive to the cycle in most size classes and other firm groups (Panels A and C). Second, the estimates in Panel C suggest that firms with very low profitability and efficiency (lowest quintile) do not gain access to credit during booms, unlike profitable and efficient firms. By contrast, low liquidity firms expand their borrowing during booms. We return to this below.

5.3 Further Theoretical Insights

The predictions of credit market theories about the cyclical behavior of reallocation are not entirely conclusive. Some studies show that countercyclical changes in allocative frictions can boost credit reallocation in good times. In Chamley and Rochon (2011), the procyclical reallocation is due to a switch from a regime with high loan rollover and low reallocation and output to a regime with lower rollover and higher reallocation and output. The switch is driven by increasing returns to matching in the credit market. These can be thought as a reduced form of

13. See Covas and den Haan (2011) for the usefulness of distinguishing across size classes.

TABLE 5

DEBT CHANGES: CYCLICALITY AND ROLE OF FIRM CHARACTERISTICS

Panel A: Debt changes, role of cyclicality, and profitability (baseline regressions, by size quintiles)

	1987–2012	1987–96	1999–2012	1987–2012	1987–2012	1987–2012	1987–96	1999–2012	1987–2012	1987–2012
		Total credit		Loans	Bonds		Total credit		Loans	Bonds
	Debt cyclicality by firms' size					*Debt response to firm profitability by firms' size*				
First size quintile	0.0636**	0.0698**	0.0563**	0.0500**	−0.0034**	0.00051**	0.0007**	0.0005**	0.00018**	4.13e-06
	(0.00624)	(0.00907)	(0.00640)	(0.00520)	(0.00075)	(3.20e-05)	(0.00010)	(3.59e-05)	(2.63e-05)	(2.88e-06)
Second size quintile	0.0420**	0.0589**	0.0300**	0.0387**	−0.0025**	0.00039**	0.0007**	0.0003**	0.00012**	−4.99e-06
	(0.00521)	(0.00847)	(0.00476)	(0.00440)	(0.00075)	(2.94e-05)	(9.28e-05)	(3.33e-05)	(2.44e-05)	(3.28e-06)
Third size quintile	0.0414**	0.0405**	0.0185**	0.0307**	−0.00131	0.00049**	0.0006**	0.0004**	0.00017**	7.94e-06*
	(0.00501)	(0.00767)	(0.00446)	(0.00419)	(0.00082)	(3.00e-05)	(9.10e-05)	(3.42e-05)	(2.48e-05)	(3.94e-06)
Fourth size quintile	0.0436**	0.0256**	0.0089*	0.0260**	0.0027**	0.00054**	0.0007**	0.0005**	0.00020**	1.53e-05**
	(0.00506)	(0.00783)	(0.00439)	(0.00429)	(0.00102)	(3.16e-05)	(0.00011)	(3.56e-05)	(2.56e-05)	(4.87e-06)
Fifth size quintile	0.0402**	0.0123	−0.0110**	0.0374**	0.0010	0.00063**	0.0009**	0.0005**	0.00025**	4.52e-05**
	(0.00513)	(0.00721)	(0.00410)	(0.00433)	(0.00145)	(3.25e-05)	(0.00010)	(3.62e-05)	(2.54e-05)	(5.99e-06)

Panel B: Debt changes, role of other firm characteristics (extended regressions, by size quintiles)

	Debt response to firm liquidity (working capital ratio) by firms' size					*Debt response to firm liquidity (current asset ratio) by firms' size*				
First size quintile	−1.10e-06	−0.00018**	−8.09e-07	−1.62e-07	4.76e-08	−0.0719**	−0.0374	−0.0925**	−0.0942**	−0.0029**
	(2.32e-06)	(5.91e-05)	(2.03e-06)	(1.66e-06)	(3.16e-08)	(0.0130)	(0.0339)	(0.0180)	(0.0152)	(0.0009)
Second size quintile	−2.45e-05**	−0.00018**	−2.30e-05**	−1.64e-05**	−2.90e-08	0.00038	−0.0419	−0.0165	−0.0302**	−0.00185*
	(4.64e-06)	(4.60e-05)	(4.62e-06)	(3.44e-06)	(1.51e-07)	(0.0102)	(0.0268)	(0.0137)	(0.0085)	(0.0008)
Third size quintile	−2.09e-06	−0.00015**	−1.89e-06	−1.38e-06	2.60e-08	−0.0057	−0.0278	−0.0108	−0.0254**	−0.0017
	(1.81e-06)	(3.14e-05)	(1.67e-06)	(1.34e-06)	(2.60e-08)	(0.0086)	(0.0277)	(0.0116)	(0.0074)	(0.0010)
Fourth size quintile	−1.61e-05**	−0.00018**	−1.57e-05**	−1.40e-05**	2.16e-07	0.0128	−0.0091	0.0113	−0.0032	−0.0012
	(3.98e-06)	(5.26e-05)	(4.22e-06)	(3.03e-06)	(2.13e-07)	(0.0084)	(0.0232)	(0.0115)	(0.0071)	(0.0012)
Fifth size quintile	−8.46e-07	−0.00029**	−9.05e-07	2.16e-07	3.22E-07	0.0365**	0.0041	0.0366*	0.016	0.0010
	(2.64e-06)	(6.49e-05)	(2.58e-06)	(2.28e-06)	(1.71e-07)	(0.0111)	(0.0317)	(0.0156)	(0.0095)	(0.0016)

(Continued)

TABLE 5

CONTINUED

Panel C: Debt changes, role of cyclicality (baseline regressions, by other firm classifications)

	1987–2012	1987–96 Total credit	1999–2012		1987–2012	1987–96 Total credit	1999–2012		1987–2012	1987–96 Total credit	1999–2012
	Debt cyclicality by firms' governance				*Debt cyclicality by firms' liquidity*				*Debt cyclicality by firms' profitability and efficiency*		
Nonchaebol	0.0409**	0.1160**	0.0365**	First liquidity quintile	0.0375**	0.0273**	0.0144*	First profitability quintile	0.00677	0.00394	0.00934
	'(0.00295)	(0.01330)	(0.00498)		(0.00639)	(0.00901)	(0.00596)		(0.00591)	(0.00820)	(0.00540)
Chaebol	0.0528**	0.1150**	0.0256	Second liquidity quintile	0.0573**	0.0412**	0.0237**	Second profitability quintile	0.0230**	0.0234**	0.0133*
	'(0.00967)	(0.02580)	(0.0198)		(0.00628)	(0.00878)	(0.00625)		(0.00573)	(0.00812)	(0.00559)
				Third liquidity quintile	0.0593**	0.0273**	0.0294**	Third profitability quintile	0.0381**	0.0225**	0.0171**
					(0.00630)	(0.00846)	(0.00672)		(0.00577)	(0.00850)	(0.00567)
				Fourth liquidity quintile	0.0767**	0.0499**	0.0399**	Fourth profitability quintile	0.0521**	0.0473**	0.0261**
					(0.00662)	(0.00907)	(0.00723)		(0.00624)	(0.00915)	(0.00624)
				Fifth liquidity quintile	0.0633**	0.0510**	0.0504**	Fifth profitability quintile	0.0709**	0.0629**	0.0421**
					(0.00695)	(0.00889)	(0.00796)		(0.00782)	(0.0113)	(0.00784)
								First sales/capital quintile	0.0550**	0.0319**	0.0136**
									(0.00576)	(0.00968)	(0.00496)
								Second sales/capital quintile	0.0357**	0.0349**	0.0106*
									(0.00558)	(0.00859)	(0.00508)
								Third sales/capital quintile	0.0441**	0.0347**	0.00358
									(0.00482)	(0.00821)	(0.00501)
								Fourth sales/capital quintile	0.0371**	0.0476**	0.00794
									(0.00474)	(0.00904)	(0.00570)
								Fifth sales/capital quintile	0.0363**	0.0468**	0.00517
									(0.00525)	(0.0118)	(0.00752)

NOTES: This table shows the coefficient estimates of firm-level credit changes on the GDP growth rate (cyclicality), on Tobin's q (profitability) and on other firms' characteristics. Panel A reports estimates from the regression in (10) for sales quintiles. Panel B reports estimates from the regression in (10) augmented with other firm characteristics for sales quintiles. Panel C reports estimates for firms' subsamples by firm governance (chaebol and nonchaebol firms), profitability and efficiency, and liquidity. The numbers in parentheses denote standard errors. * and ** indicate 5% and 1% statistical significance. The first and the fifth size quintiles are the quintiles of the smallest and the largest firms, respectively (and similarly for other firm characteristics).

mechanisms that in good times mitigate allocative frictions, such as lower informational rents of banks about credit usage (Eisfeldt and Rampini 2006). In Caballero and Hammour (2005), reallocation rises during upturns because hold-up problems in credit matches soften, favoring the creation of matches. Besides countercyclical changes in allocative frictions, a second force that can drive a procyclical reallocation is the impact of shocks on credit market participation (Becsi, Li, and Wang 2013). However, positive shocks can increase credit market participation but also alter firm composition, favoring the access to credit of low productivity firms when reallocation rises (Becsi, Li, and Wang 2005). All in all, credit access and market participation effects will tend to induce a positive correlation between output and credit reallocation, while firm composition effects will tend to induce a negative correlation.

Florian-Hoyle and Francis (2017) and Brand, Isore, and Tripier (2017) quantify the above effects in DSGE models with credit search frictions and frictions within credit relationships. We can also gain some intuition on the role of these effects in our data. We explore whether the reallocation process especially entails the flow of credit to firms with difficult access to liquidity (credit access and market participation effects) or reshufflings across classes of firms characterized by different productivity (composition effects). The estimates in Table 5 suggest that low liquidity firms, but not low productivity ones, gain access to credit during booms. To further explore, we partition firms based on the external financial dependence of their industry (Rajan and Zingales 1998) and on the asset tangibility in the industry, a proxy for collateral pledgeability (Braun 2002). We find that after the crisis and the reforms, the rise in reallocation was more pronounced in industries with higher financial dependence and with lower asset tangibility, that is, industries where a more flexible reallocation can significantly increase the market participation of firms short of liquidity (see the Supporting Information for details). Next, we examine whether the increase in reallocation entailed large composition effects, that is, credit flows toward classes of firms with low productivity. The rise of the W_t index for sales to capital and profits to capital ratios after the crisis (Table 2, Panel B) suggests, however, that the rise in reallocation was associated with a drop in the importance of reallocation across classes with different productivity. In our data, credit access and market participation effects thus appear to be more important than composition effects. This could help explain why reallocation exhibits a mildly procyclical pattern (Becsi, Li, and Wang 2005).

The above-mentioned theoretical studies focus on the cyclical behavior of reallocation in normal times and can help explain why reallocation may be mildly procyclical in normal times. Relative to the above literature, Chamley and Rochon (2011) also show that major crises can trigger a spike in credit destruction and reallocation. In particular, in Chamley and Rochon, a crisis triggers a drop in loan rollover and a spike in credit destruction, which pave the ground for the recovery. In line with this prediction, in our data, a spike in credit destruction and reallocation occurred at the onset of the crisis.

TABLE 6

EFFICIENCY OF CREDIT REALLOCATION

			Chaebol affiliation		Size quintile				
Panel A: Total credit		All	Chaebols	Nonchaebols	1st	2nd	3rd	4th	5th
				Operating profits					
Average	1987–96	1.022	0.958	1.004	0.490	0.420	0.462	0.385	0.481
	1999–2012	1.120	1.163	0.947	0.926	0.765	0.980	0.924	0.474
				Sales					
Average	1985–96	0.987	0.948	0.957	1.202	1.589	1.364	1.010	0.770
	1999–2012	1.072	1.030	1.004	1.381	1.179	1.321	1.297	0.584
Panel B: Loans			Chaebols	Nonchaebols	1st	2nd	3rd	4th	5th
				Operating profits					
Average	1987–96	1.038	0.942	0.983	0.513	0.432	0.444	0.436	0.518
	1999–2012	1.129	1.011	0.977	0.767	0.745	0.977	0.845	0.659
				Sales					
Average	1985–96	1.012	0.965	0.980	1.127	1.688	1.399	1.012	0.798
	1999–2012	1.078	1.058	0.982	1.440	1.167	1.363	1.209	0.625

NOTES: This table displays the values of the efficiency index of credit reallocation constructed using the profits to capital ratios and the sales to capital ratios of the firms. Panel A refers to total credit, and Panel B to loans. Each panel reports the values of the index for all firms, for *chaebol* and non*chaebol* firms, and for firms of different size. It also reports values of the index for the precrisis and the postcrisis periods.

6. CREDIT REALLOCATION AND EFFICIENCY

The findings suggest that after the crisis and the reforms, the Korean credit market became more flexible in reallocating funds. If that is the case, the reader could expect that lenders gained better ability to match their funds with efficient and productive firms. To explore this hypothesis, we construct an index for the efficiency of the allocation of credit adapting the index for the efficiency of investment allocation in Galindo, Schiantarelli, and Weiss (2007). The index is a ratio. In the numerator, in year t, it includes the weighted sum of the sales (or profits) to capital ratios of the firms, with the weight for each firm given by the contribution of the firm debt to the total debt of the firms in that year (c_{ft}/C_t). In the denominator, it includes the sum of the sales (or profits) to capital ratios of the same firms weighted by the contribution of the firm debt to the total debt in the previous year (c_{ft-1}/C_{t-1}). For example, using the sales to capital ratio (s_{ft}/k_{ft}),

$$\mathbf{I}_t = \frac{\sum_f \frac{s_{ft}}{k_{ft}} \frac{c_{ft}}{C_t}}{\sum_f \frac{s_{ft}}{k_{ft}} \frac{c_{ft-1}}{C_{t-1}}}. \tag{10}$$

A value of the index greater than one signals that credit was allocated more efficiently in year t than if the credit distribution had remained as in year $t-1$.

Table 6 reports the average value of the index before and after the crisis (it also reports the averages obtained using loans, sales quintiles, and chaebol and

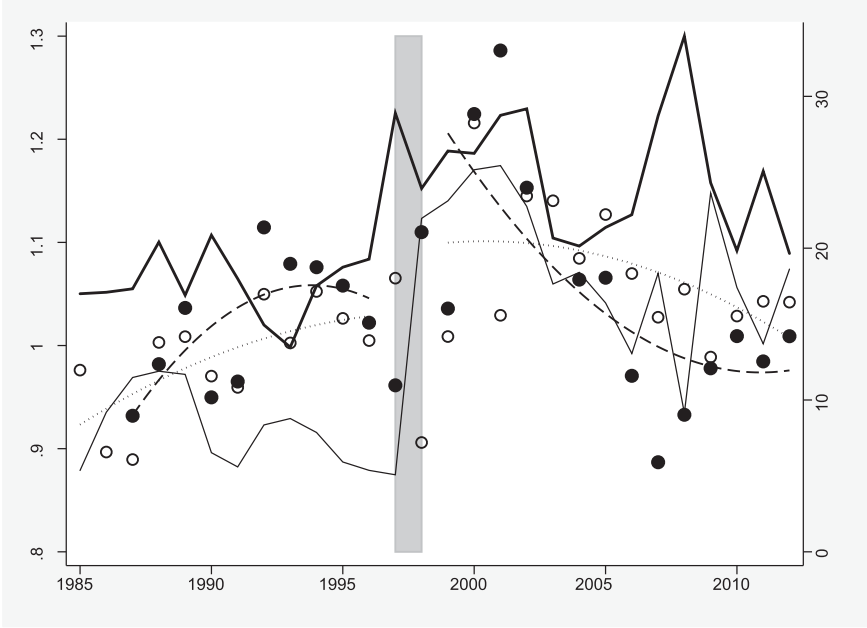

FIG. 4. Efficiency of Credit Reallocation.

NOTES: This figure shows the annual values of two efficiency indexes of credit reallocation computed using firms' sales to capital ratios (circles) and profit to capital ratios (bullet points). The figure shows four quadratic fitted lines for each index in the precrisis period and the postcrisis period (dotted lines for sales and dashed lines for profits). The efficiency index using profit to capital ratios starts in 1987 due to data availability. The right *Y*-axis provides the scale for the magnitude of gross credit reallocation (solid bold line) and excess credit reallocation (solid light line).

nonchaebol firms). Figure 4 plots the index values together with quadratic fitted lines. The figure suggests that before the crisis, the efficiency of reallocation often worsened from 1 year to the next ($\mathbf{I}_t < 1$). It then jumped up after the crisis and continued to improve in the following years ($\mathbf{I}_t > 1$), suggesting that the intensification of reallocation was associated with enhanced efficiency of the reallocation process. Indeed, Figure 4 shows that the pattern of the index tracks that of reallocation. Finally, Table 6 reveals that this increase in efficiency was most pronounced for chaebol firms. This corroborates the idea that the reforms reduced the tendency to rollover credit to inefficient chaebol-affiliated and government-protected firms.

7. CONCLUSION

This paper has studied the effect of a financial crisis and of the associated reforms on interfirm credit reallocation. During the credit boom that preceded the 1997 Korean crisis, credit reallocation was depressed. After the crisis and the reforms, credit reallocation rose significantly, while credit growth slowed down (deleveraging).

The intensification in reallocation cannot be explained by "flights to quality" but reflects a structurally higher flexibility of the credit market in reallocating liquidity. The analysis has also revealed that before the crisis, credit growth comoved with the business cycle more than excess credit reallocation, while after the crisis, excess reallocation was more procyclical than credit growth. Finally, the intensification of reallocation was associated with enhanced efficiency in the reallocation process.

A large body of research has recently investigated the relation between financial crises and credit boom-and-busts. Our results suggest that financial crises and the subsequent reforms can play a pivotal role not only in credit growth but also in credit reallocation. A credit boom characterized by depressed reallocation could be very different from a credit boom characterized by a smooth reallocation of liquidity. Similarly, a creditless recovery characterized by an intense credit reallocation could spur growth, despite the reduced flow of liquidity to the business sector. Macroeconomic models that reproduce the behavior of credit reallocation can further our understanding of the build-up and aftermath of financial crises.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.