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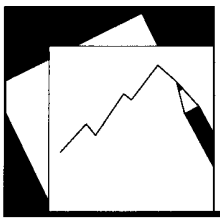

# IMF Working Paper

# Credit Market Imperfection and Sectoral Asymmetry of Chinese Business Cycle

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European Department

# Credit Market Imperfection and Sectoral Asymmetry of Chinese Business Cycle

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## Abstract

This paper analyzes the role of credit market imperfection and sectoral asymmetry as a means through which shocks to the real economy are propagated and amplified. Drawing on firm-level data to calibrate the model, our simulations capture two key stylized facts of the Chinese economy: that credit constraints are more binding in nontradable sectors than in tradable industries and that output volatility is much greater in China than in industrial economies. We find that the driving force behind our simulation results is strongly related to the non-uniform nature of credit market imperfections in China and their implications for resource allocation and the way in which the economy reacts to shocks. Correctly capturing these macro-financial interactions are essential to understand the dynamic behavior of the Chinese economy.

JEL Classification Numbers: E, F4

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## I. Introduction

For the past two decades the Chinese economy has been characterized by its impressive growth rates and a cyclical growth pattern. Despite the export-led growth stories, investment has been found to be the main driving force of both economic growth and the volatility of the business cycle in China. Because the credit market facilitates investment financing, if we are to understand the dynamic behavior of the Chinese business cycle, it is important to study the linkage between the credit market and the real economy.

In spite of the recent development of China's financial sector, credit market imperfection is still common. Chinese firms, except for some very large publicly traded enterprises, have limited access to external funds. Firms mainly rely on internally generated funds to finance investments, which may explain why retained earnings in China are above international averages. However, credit market imperfection is not uniform for all firms. Firms with different ownership types, sizes, locations, and sectors have significantly different credit constraints. For example, it is widely believed that a deeply rooted political "pecking order" in credit allocation effectively discriminates against private firms in favor of state-owned enterprises. Government credit plans give priority to industries like manufacturing. Because larger firms can offer more collateral, and more credibility, than smaller ones, banks are more willing to grant them credit.

Credit market imperfection results in binding credit constraints that create a bottleneck to the economic growth and amplify the real business cycle. When credit market imperfection is not uniform, some firms experience much more volatile fluctuations than others. In fact, China's output volatility is twice as high as U.S. volatility. And in China the nontradable sector faces more binding credit constraints and larger investment and output fluctuations than the tradable sector. We find that one of the driving forces behind these stylized facts is closely related to the sectorally asymmetric nature of credit market imperfection in China. Another force is the pro-cyclical real exchange rate movement. Real exchange rate depreciation during economic downturns worsens the N sector balance sheet, which puts extra binding pressure on the credit constraint, resulting in a larger amplification effect.

This paper investigates Chinese firms' credit constraints at the firm level and develops a two-sector dynamic stochastic general equilibrium (DSGE) model to simulate the business cycle in China. Drawing on firm-level data to calibrate the parameters, this model is able to capture the main stylized facts of the Chinese macro-economy mentioned above. In what follows, Section 2 reviews the literature. Section 3 illustrates the macroeconomic patterns. Section 4 uses two firm-level datasets to test credit market imperfection and asymmetries across sectors, regions, sizes, and ownership types. In Section 5, we illustrate the underlying mechanism using a two-sector DSGE financial accelerator model, with parameters calibrated from the firm-level data. Section 6 presents impulse responses and simulation results, Section 7 discusses the policy implications of our findings, and Section 8 draws conclusions.

## II. Literature Review

Xu (2008) evaluated the sources of business cycle fluctuation over the entire post reform period (1978–2008) using the business cycle accounting framework. He found that China's business cycle is more volatile than the one in U.S. and the investment wedge (capital market frictions) is the largest source of output fluctuations after the efficiency wedge (total factor productivity (TFP)). In addition, the investment wedge gains more importance latter in the period (after 1992). However, very few papers illustrate the underlying mechanism that generated this volatile business cycle in China after 1978. The most representative papers studied the early and the late post-reform period separately. Brandt and Zhu (2000, 2001) found a positive comovement of inflation and real GNP growth during the transition and early post reform periods (1978–1995). They analyzed the boom-bust cycle during the period from a political perspective; central to their explanation of the comovement was the central government's commitment to the state sector and the growing tension between economic decentralization and the central government's imperfect control of local credit allocation. After 1995, the economy suffered a prolonged contraction (1996–2003) accompanied by a few years of deflation. Gong and Lin (2008) considered this period to be a deflationary expansion period, because even though the growth rate was relatively lower than in the boom years, it was still high (about 7 percent) compared to the world economy at the time. They attributed the coexistence of high growth and deflation in China to investment overshooting prior to this period. Both paper found positive co-movement between the inflation and the business cycle.

There is a growing literature investigating the Chinese credit market in the recent years. Most of empirical studies focus only on the credit market/financial system. Hericourt and Poncet (2009) using firm-level surveys, and borrowing the estimation framework from Harrison and McMillan (2002) found that foreign direct investment relaxes firms' credit constraints. Our paper contributes to the literature by analyzing credit market imperfection and asymmetries across a variety of dimensions using an estimation model derived from a micro-founded model.

Very few previous studies have discussed about the linkage between the credit market and the real economy in China. Aziz (2008) built a working capital channel into a Solow model and found that non-performing loans and borrowing constraints contributed to the investment wedge, which was quantitatively significant in explaining growth in China and India. Here we focus on how the credit market influences the dynamics of the Chinese business cycle as well as the differences across sectors. To incorporate the mechanism, we extend the financial accelerator mechanism of Bernanke, Gertler, and Gilchrist (1999) [BGG] into a two-sector version and calibrate the model using firm-level data. The simulation results reasonably match the first and second moments of key macroeconomic variables in the data.

## III. Macroeconomic Pattern

### A. Co-movement of Credit with Key Macroeconomic Variables

As a preliminary check, we investigate the co-movement of real credit with key macroeconomic variables by running univariate and multivariate ordinary least square (OLS) regressions.[1] Right- hand side variables include the GDP components: investment, consumption, fiscal deficits, net exports; interest rate measures and the real exchange rate.[2]

Table 1 shows that an increase in real credit is associated with a faster growth of the N-sector relative to the T-sector and appreciation of the real exchange rate. Moreover, the comovement of GDP and credit growth is largely driven by investment fluctuations rather than by variations in consumption, government spending or net export. As one expects, interest rate spread does not significantly commove with real credit. This is consistent with the fact that the quantity of credit has been directly controlled by the government (or through adjusting bank reserve ratios) rather than indirectly managed through the interest rate policies. Dickinson and Liu (2005) argue that an alternative interest rate measure, the central bank lending rate, became marginal effective in controlling bank credit late in the 1990s. Our regression result supports this argument. Despite direct or indirect credit control, positive credit shocks make external funds more available to firms, which help relaxing their borrowing constraints, stimulating investment and output.

### B. Phase and Sectoral Asymmetry

Follow Balke (2000), we use a two-regime threshold VAR model to investigate the asymmetric responses of output and prices to credit shocks during different credit regimes. The model specification is as follows:

$$Y_t = \mu_1 + A_1 Y_t + B_1(L) Y_{t-1} + \left(\mu_2 + A_2 Y_t + B_2(L) Y_{t-1}\right) I_t + \varepsilon_t \qquad (0.1)$$

where $Y_t$ is a vector of endogenous variables, and $I_t$ is an indicator that takes the value of 1 when the d-lagged threshold variable $c_t$ is lower than the threshold critical value γ and 0 otherwise. The indicator $I_t$ acts as a transitional variable identifying two separate regimes on the basis of the value of $c_{t-d}$ relative to γ. Asymmetry is introduced by allowing for the coefficients of the VAR to vary across the two regimes.[3] The threshold VAR is estimated using

[1] The sample covers 1984-2008 with annual data. Quarterly data on investment, fiscal deficit and net export is only available after 1999:Q3.

[2] All the series except interest rate measures and real exchange rate have one unit root. I take away the time trend and the resulting series are stationary.

[3] By specifying the $c_t$ as a function of one of the variables in $Y_t$, it is possible to model regime switching as an endogenous process determined by movements in the variables forming the model. In practical terms, the specification of the model requires several choice: (1) the list of variables to be included in $Y_t$; (2) the threshold variable $c_t$; (3) the delayed d of the threshold

(continued…)

quarterly data for the sample period 1992:Q2—2008:Q3 for the following sets of bivariate variables.

$$Y_t \equiv [\Delta y_t, \Delta DC_t], [\Delta RER, \Delta DC_t], [NTT_t, \Delta DC_t] \quad (0.2)$$

The threshold variable is typically specified as a moving average of one of the variables forming $Y_t$. Since we are interested in studying non-linearities in output and the real exchange rate at different stages of the lending cycle, we consider a moving average[4] of the rate of growth in real domestic credit, $\Delta DC_t$, as the threshold variable. The threshold critical value for the y-o-y growth of real domestic credit is estimated at 10.41 percent; threshold variable above 10.41 percent is considered to be in a loose phase of the credit cycle. (Figure 1)

This divides the credit cycle into four loose phases and four tight phases.[5] Figure 2 shows the impulse responses of real output, the N-to-T output ratio, and the real exchange rate to credit shocks over different phases of the credit cycle. The response of real GDP to a shock in real credit growth is somewhat bigger in the tight phase than in the loose phase. Also, in the tight phase, the amplification effect of credit shocks is stronger to the N sector than to the T sector; while in the loose phase, the sectoral asymmetry becomes less significant. Interestingly, signs of asymmetries in the real exchange rate are clearer, the magnitude of real exchange rate movement in the tight phase is much larger than in the loose phase.

## IV. Firm Level Evidence

We argued that the mechanism that contributes to the phase and sectoral asymmetries of output responses to credit shocks is based on three factors: (1) credit market imperfection, (2) sectorally asymmetric credit constraints, and (3) the real exchange rate effect. The real exchange rate effect was illustrated in the last section. In this section, we test credit market imperfection and its sectorally asymmetric features using two firm-level datasets.

### A. Dataset

One dataset is provided by Sinofin and compiled by the China Center for Economics Research (CCER) at Peking University. It covers all Chinese firms listed on the Shenzhen and Shanghai stock exchanges. From 1994 to 2008, the number of listed firms increased more than six folds, from 291 to 1807. Most listed firms are large (99.58 percent), based on the census standard and

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variable; (4) the lag length of the VAR; and (5) the recursive ordering. We include real domestic credit, real GDP, N-to-T output ratio and real exchange rate in $Y_t$. To ensure stationality, we take first differences on the logged variables.

[4] The length of this moving average is determined jointly with the delay of the threshold variable and the lag structure of the VAR by applying standard information criteria to the models arising from the various possible combinations. The Schwartz criterion would suggest to use a 1-lag VAR and to construct the threshold variable as a 2-quarter moving average of $\Delta DC_t$, delayed by 2 quarters.

[5] The loose phases are: 1992:Q2—1993:Q2, 1995:Q3—1999:Q1, 2001:Q1—2003:Q3, and 2005:Q4—2007:Q2. The tight phases are: 1993:Q3—1995:Q2, 1999:Q2—2001:Q1, 2003:Q4—2005:Q4, and 2007:Q3—2008:Q3.

state-owned (84 percent). The listed firms come from all 31 provinces in China and represent 11 industries[6] from the census. The dataset provides the financial statement and corporate governance information.

The other dataset is constructed from the World Bank's 2003 Investment Climate Survey, which was done in collaboration with the Chinese National Bureau of Statistics. A total of 2400 firms were interviewed in 15 major Chinese provinces,[7] and cover all three economic regions (East, Central and West). The data include accounting information such as sales, investment, and assets and liabilities, and corporate governance information such as ownership structure, characteristics of labor, and relations with competitors, suppliers, and government. This dataset does not cover industries that are dominated by large state-owned enterprises (SOEs). Thus we need to introduce Sinofin- China Center for Economic Research (CCER) database to fill the gap. Firms were interviewed once in 2003 on the relevant information from 1999–2002 (see Table 2).

**Alternative Classification of T and N Sectors**

Based on the textbook definition, T-sector goods may be either exportable or importable, but N-sector goods are mainly consumed domestically. However, in practice it is very difficult to disentangle the two. For example, the service industry is usually classified as the N sector because services are consumed locally; however, services like tourism can also be exported or imported.

Classification by sector can vary. One approach is to simply follow the National Bureau of Statistics of China (NBS) or United Nations National Accounts Main Aggregates Database (UN-NAMAD). An alternative approach compares the variances of relative price movements. In theory, prices of tradable goods move more closely to world prices than do prices of nontradable goods. In other words, variances in relative tradable prices, $EP^T / P^*$, are likely to be larger than variances of relative nontradable prices, $EP^N / P^*$. We compare $EP^i / P^*$ across industries, $i$, and rank them by tradability. Rank 1 means the industry has the smallest variation of $EP^i / P^*$, and thus is more tradable (Table 3).[8]

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[6] the private-firm-dominated industries—manufacturing, IT, services, retail, real estate culture/entertainment; and state dominated industries—agriculture, mining, utility, transportation, construction

[7] Liaoning, Jilin, Heilonngjiang, Zhejiang, Jiangxi, Henan, Hubei, Hunan, Guangdong, Guangxi, Chongqing, Guizhou, Yunnan, Shanxi, Gansu

[8] To get rid of the unexplained trend of the price ratio, we compare variances of the percentage change of the price ratios across industries, creating a spectrum of industries with those toward the higher end being more N-sector oriented and those toward the lower end more T-sector oriented. We obtain monthly industry price levels $P^i$ (2002 Jan to 2008 Dec) from NBS. The U.S. CPI index for the same horizon, obtained from the Bureau of Labor Statistics, is treated as the world price, $P^*$. $E$ (the nominal exchange rate for USD/CYN) is from IFS. $P^i$s are price levels of goods in a representative consumption bundle used in computing the CPI index, namely foods (agriculture), clothing (manufacturing), general services, health care, transportation, culture/recreation, and residence (real estate and construction). We report the standard deviation simply because the variance in magnitude is too small.

(continued…)

Agriculture and manufacturing goods are thus more T-sector oriented; transportation, services, culture/recreation, construction, and real estates are more N-sector oriented. Because water and electricity spending are considered residence costs, we also group utilities in the N-sector. Because the mining industry produces such commodities as gold, coal, etc., whose prices tend to follow the world price, it is classified as T-sector. It is difficult to decide where to assign retailers. They sell manufactured goods (including clothing) domestically so can be considered either T or N sector.

### B. Summary Statistics

Table 2 suggests that the N Sector is more skewed towards small and private firms than the T sector, which explains why the N sector is more credit constrained than the T sector. Distributions across regions for T and N sector are similar.

We learn from NBS data that self-raised funds (from enterprise savings, family and friends, and the black market) is the most dominant financing source for Chinese firms, accounting for about over 70 percent of total funds in the past decade. Bank loans, the second largest funding source, account for 20–30 percent of the total. Foreign direct investment and state–directed funds each account for less than 5 percent (see Figure 3). The World Bank dataset provides a more detailed breakdown of sources of financing for working capital (WC) and fixed investment (FI) (see Table 4). It shows that SOE (34.46 percent WC, 24.61 percent FI), T sector firms (29.06 percent WC, 21.05 percent FI) and firms with larger sizes (34.76 percent WC, 25.34 percent FI) have larger exposure to the bank loans than the private (24.35 percent WC, 19.03 percent FI), N sector firms (20.27 percent WC, 18.51 percent FI) and firms with smaller size (14.17 percent WC, 11.90 percent FI), respectively. Moreover, private, N sector firms, and firms with smaller size are more reliant on "other" financing sources, which according to WB survey document are black market lenders who charge much higher interest rates than the banks.

The World Bank also asked firms what they believe to be the biggest obstacles to bank loan application. They cited collateral as the number one obstacle, especially for private, N-sector, and small firms (see Table 6). Table 5 summarizes the financial statement variables by ownership, sector, and region. Some financial ratios, such as labor expense-to-value added are used for calibration in the model section.

### C. Investment Function Estimation

Based on Modigliani and Miller (1958), if the credit market is efficient, internal and external funds are perfect substitutes, and a firm's investment decisions are independent of its financing decisions. However, in the real world external funds are usually more expensive than internal

funds. Gertler and Hubbard (1988), Calomiris and Hubbard (1990), Gertler (1992), Kiyotaki and Moore (1993), and Greenwald and Stiglitz (1988, 1993) attribute this credit market inefficiency to information and incentive problems among economic agents. Due to the lack of perfect information, firms with certain characteristics face more expensive external credit than others, even if they have the same growth opportunities. For example, it has been found that the external finance premium is an inverse function of a borrower's net worth. Firms facing a higher premium are regarded as more credit constrained, and a negative shock to their net worth will be amplified through the financial accelerator (Bernanke and Gertler, 1989, 1990), further reducing investment and output. Fazzari, Hubbard and Peterson (1989) first proposed the cash flow (CF) regression approach to empirically test the existence of credit constraint. The CF regression takes the following form:

$$\frac{I_{it}}{K_{it-1}} = \beta_0 + \beta_{CF}\frac{CF_{it}}{K_{it-1}} + \beta_Q Q_{it} + \varepsilon_{it} \tag{0.3}$$

In an efficient credit market, a firm's investment decisions $\frac{I_{it}}{K_{it-1}}$ depend only on the investment opportunities, $Q_{it}$, not the availability of internally generated cash flows $\frac{CF_{it}}{K_{it-1}}$. Credit market imperfection restricts firm access to the external credit. A firm's investment decisions rely on its ability to generate internal funds. In other words, if $\beta_{CF}$ is significantly positive for a group of sample firms, they are considered credit constrained.[9]

Instead of directly applying the FHP methodology, we estimate[10] the log-linearized investment function (4.4) derived from the Euler equation (4.2) of the micro-founded model presented in the next section, using GMM. These two approaches share the same merit.

$$\frac{\alpha^i P_t^i Y_t^i}{Q_t K_t^i} = \left(1 + R_t\right)\left(\frac{Q_{t-1}K_{t-1}^i}{P_{t-1}^i N_{t-1}^i}\right)^{\chi^i} \tag{0.4}$$

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[9] $Q_t$ is not readily available for firms that are not listed on the stock market, thus a variety of other measures are used to proxy the investment opportunities; for example, change of sales, value added, etc.

[10] Pooled OLS estimation of the equation (4.3) may lead to inconsistent coefficient estimates if the fixed effects are present and correlated with regressors. In our example, different firms may have different minimum levels of investment that are captured by the firm-variant intercepts, which can be correlated with the regressors, for example, firms' investment opportunities. Although the FE estimates are unbiased, they are not the most efficient ones due to the heterogeneity and endogeneity problems. Since the error term captures a TFP shock and a credit shock, it can be correlated with explanatory variables such as output and cash flow. Moreover, substantially different investment behaviors across firms can result in heterogeneity problems. To fix the heterogeneity problem, we can use the panel robust estimators for the variances. An alternative approach is to apply the GMM technique, which also solves the endogeneity problem at the same time that is, to introduce the excluded regressors from other periods as instruments in the current period. Here we use the lagged right hand side variables as instruments and perform 2-step GMM estimation, which is more efficient than the 1-step GMM. Before the estimation, we use two specification tests suggested by Arellano and Bond (1991) to check the validity of the instruments. Both tests support the model.

where i=T or N.

$$\left(\frac{\overline{Q}_t \tilde{I}_t^{\,i}}{\overline{Q}_{t-1} K_{t-1}^{\,i}}\right) = \beta_0 + \beta_Q \left(\frac{\overline{P}_t^{\,i} \overline{Y}_t^{\,i}}{\overline{Q}_{t-1} K_{t-1}^{\,i}}\right) + \beta_{CF} \left(\frac{\overline{P}_{t-1}^{\,i} \overline{N}_{t-1}^{\,i}}{\overline{Q}_{t-1} K_{t-1}^{\,i}}\right) \tag{0.5}$$

where $\overline{Q}_t \tilde{I}_t^{\,i}$ represents investm ent, $\overline{P}_t^{\,i} \overline{Y}_t^{\,i}$ value added, $\overline{P}_{t-1}^{\,i} \overline{N}_{t-1}^{\,i}$ net worth, $\overline{Q}_{t-1} K_{t-1}^{\,i}$ capita l stock, $\beta_Q$ dependency of i nvestment on inte rnal funds ava ilability and $\beta_{CF}$ dependency of investment on investment opportunities. Notice $\beta_{CF} \neq \chi^i$.

Table 7 compares the results for the CCER dataset (stock market listed firms) and World Bank survey datasets (unlisted firms). Regressions 1-4 indicate that the investment decisions made by firms that are not listed significantly depend on the availability of internal funds but not investment opportunities; in other words, they are constrained by external credits. The CF coefficient estimates stand for the percentage change of investment given 1 percentage point change in a T sector firm's internally generated cash flow. Notice that the interactive term between CF and the N-sector dummy is introduced to capture the sectoral difference in levels of credit constraint. A positive coefficient estimate suggests that firms in the N-sector face a more restricted credit constraint than those in the T-sector; a 1 percentage point CF increase would stimulate investment in the N-sector by about 0.32 percent (as a fraction of total capital stock) more than in the T-sector. Regressions 2, 3, and 4 add sector, region, and size dummies and their interaction terms with the cash flow to illustrate credit market asymmetries in other dimensions. We found that besides sectoral asymmetries, small firms in the West regions are more credit constrained than the rest. Ownership asymmetry is washed out once the firm size is controlled. In other words, with the same size, SOEs' are not superior to private firms in accessing external funds. This indicates that size matters more than ownership type. More details on the credit market imperfection and asymmetries are included in another paper of mine: Zhang (2009).

Results from the CCER dataset indicate that unlike unlisted firms, listed firms' investment decisions depend significantly on the investment opportunities. The fact that the CF coefficients of the control group are not significant indicates that the control group (e.g., T sector firms in regression 5) is facing no significant credit constraint. In addition, regional and sectoral credit market asymmetries remain but the size asymmetry disappears because the sample is highly skewed towards super-large firms in China.

## V. Macroeconomic Model

### A. Core Mechanism

The principal objective of this section is to show that credit market imperfections and sectoral asymmetry can significantly amplify credit shocks to the real economy during downturns. Our framework is an extension of the BGG "financial accelerator" mechanism. This involves the link between external finance premium (the difference between the cost of external funds and

the opportunity of internal funds) and the net worth of potential borrowers. With credit-market frictions, standard models of lending with asymmetric information imply an inverse relationship between the external finance premium and a borrower's net worth. This inverse relationship arises because when borrowers have little wealth to contribute to project financing, the potential divergence of interest between the borrower and the lender of external funds is greater, implying increased agency costs to compensate the lenders. This external finance premium generates the nonlinear upward portion of the capital supply curve when internal funds are not sufficient to finance a capital purchase. Therefore, the borrower's net worth is pro-cyclical and the external finance premium is counter-cyclical, enhancing the swings in borrowing, and thus in investment, and total output (see Panel 1 and 2 of Figure 4).

Swings can be further amplified after introducing sectorally asymmetric credit constraints and the real exchange rate effect. Following the initial impact of credit shocks, real exchange rate depreciation further reduces the net worth of N sector firms, resulting in increasing external finance premium. In addition, the N sector faces a more restricted credit constraint than the T sector; in other words, the external finance premium is more responsive to a change of net worth in the N sector. The nonlinear portion of the cost-of-fund curve is steeper. These two effects reinforce each other, resulting in higher borrowing cost, and larger investment and output drop in the N sector relative to the T sector (compare panel 3 of Figure 4 with panels 1 and 2).

## B. Complete Model

### Entrepreneurs

Entrepreneurs are the key to the amplification mechanism in the model. They produce final outputs and sell them to households for consumption and to capital producers as inputs for capital production. Entrepreneurs finance capital purchase partly with internal funds and partly with external borrowing (bank loans). They are risk-neutral and choose external borrowings and capital purchase to maximize profits. In each sector, entrepreneurs' problem is characterized by a capital demand equation and a net worth evolution equation. The only difference between the T and N sectors lies on the asymmetric balance sheet effect caused by the real exchange rate adjustment. T- and N-sector entrepreneurs both need internal funds, $N_t^i$, and, external borrowings, $B_t^i$, to finance its capital purchase $Q_t K_t^i$:

$$P_t^i N_t^i + B_t^i = Q_t K_t^i \qquad (1.1)$$

for i=T,N. We normalize $P_t^i$=1.

How much capital to purchase is based on the Euler equation. Return on capital has two components, gross return on production and capital appreciation. The cost of borrowing depends on both the risk free rate and a firm-specific risk premium that is a negative function of the availability of internal funds.

$$\frac{\frac{\alpha^i P_t^i Y_{t+1}^{\ i}}{K_t^{\ i}} + (1-\delta) Q_{t+1}}{Q_t} = (1+r_{t+1})(1+\eta_{t+1}^{\ i}) \tag{1.2}$$

where

$$1+\eta_{t+1}^{\ i} = \left(\frac{Q_t K_t^{\ i}}{P_t^i N_t^{\ i}}\right)^{\chi^i} \tag{1.3}$$

and $\chi^i$ takes cares of the force of the financial accelerator. The entrepreneur has the probability $1-\delta^i$ of bankruptcy, and its net worth evolves based on the net return from capital (gross return on capital - gross borrowing cost).

Evolution of net worth:

$$P_t^i N_t^{\ i} = \delta^i \left\{ \frac{\frac{\alpha^i P_t^i Y_t^i}{K_{t-1}^{\ i}} + (1-\delta) Q_t}{Q_{t-1}} * Q_{t-1} K_{t-1}^{\ i} - (1+r_t^l)(1+\eta_t^l)\left(Q_{t-1} K_{t-1}^{\ i} - P_{t-1}^{\ i} N_{t-1}^{\ i}\right) \right\} \tag{1.4}$$

Firm's production function:

$$Y_t^i = A_t^i \left(K_t^i\right)^{\alpha^i} \left(H_t^i\right)^{1-\alpha^i} \tag{1.5}$$

**Firm's labor demand is:**

$$W_t = \frac{\left(1-\alpha^i\right) Y_t^i}{H_t^{\ i}} \tag{1.6}$$

**Capital Producers**

Capital producers purchase final goods from both T- and N-sector entrepreneurs. $I_t^{\ ii}$ and $I_t^{\ ij}$ [11] are purchased, at the price of $P^i$ and $P^j$ respectively, to produce the capital $K_t^{\ i}$ and sell it to the i-sector entrepreneur at price $Q_t$. They choose $I_t^{\ ii}$ and $I_t^{\ ij}$ to maximize their expected profits, $E_t\left[Q_{t+1} K_{t+1}^{\ i} - P_{t+1}^{\ i} I_{t+1}^{\ ii} - P_{t+1}^{\ j} I_{t+1}^{\ ij}\right]$, taking the expected price of capital $E_t Q_{t+1}$ as given. We normalize $P_t^T = 1$. Assume the capital producing technology takes the form of the following with properties: $\Phi(0) = 0, \Phi'(\bullet) > 0, \Phi''(\bullet) < 0$.

$$\Phi\left(I_t^{\ i}\right) = \left(\frac{I_t^{\ i}}{K_{t-1}^{\ i}}\right)^{\theta} \tag{1.7}$$

where $I_t^{\ ii} = \gamma_i I_t^{\ i}$, $I_t^{\ ij} = (1-\gamma_i) I_t^{\ i}$, which suggests that the evolution of capital is

[11] Subscript $i$ stands for the own sector and j stands for the other sector

$$K_t^{\,i} = \Phi\left(I_t^{\,i}\right) K_{t-1}^{\,i} + \left(1-\delta\right) K_{t-1}^{\,i} \tag{1.8}$$

The first order condition is

$$E_t\left[ Q_{t+1}\left(\frac{I_{t+1}^{\,i}}{K_t^{\,i}}\right)^{\theta-1} K_t^{\,i} \right] = \gamma_i + \left(1-\gamma_i\right) E_t P_{t+1}^{\,12} \tag{1.9}$$

**Households**

$$\max E_0 \sum_{t=1}^{\infty} \beta^t \log\left(C_t^{\,T}\right)^u \left(C_t^{\,N}\right)^{1-u} \tag{1.10}$$

subject to the budget constraint:

$$C_t^{\,T} + P_t C_t^{\,N} + \frac{\phi}{2} D_t^{\,2} \le \Pi_t + D_t\left(1+r_t\right) - D_{t+1} + W_t \overline{H} \tag{1.11}$$

Given the large working population in China and the lack of reliable survey on labor supply, we assume that labor supply is exogenous. The first order condition gives:

$$\frac{1-u}{u}\frac{C_t^{\,T}}{C_t^{\,N}} = P_t \tag{1.12}$$

$$E_t\left[ \beta\left(1+r_t\right)\frac{1}{C_{t+1}^{\,T}} \right] = \frac{1}{C_t^{\,T}\left(1+\phi D_t\right)} \tag{1.13}$$

**Credit Policies**

Two credit policy instruments are found effective in practice: (1) the Central Bank lending rate and (2) quantity credit management. Direct or indirect credit policies can both be reflected through a common effective interest rate measure, which we assume follows the AR (1) shock process. The relationship between the effective interest rate and bank credit is derived as:

$$\frac{B^i}{Y^i} = QK^i - P^i N^i = \left[1 - \left(\left(1+R^i\right)\delta^i\right)^{\frac{1}{\chi^i}}\right] \alpha^i \Big/ \left[\frac{1}{\delta^i} - \left(1-\delta\right)\right] \tag{1.14}$$

Tightening credit policies, such as an increase in the required reserve ratio or the central bank lending rate, or a direct contraction of bank lending is associated with an increase in the effective interest rate, $R = f\left(\frac{B}{Y}\right) - 1$. In our model, we use the effective interest rate shock as the credit policy shock.

**Clearing Conditions**

Here we use net exports to absorb the difference between the supply of and demand for T-sector goods. The imbalance of demand and supply of N-sector goods will be adjusted through the change of $P_t\left(P_t^N / P_t^T\right)$.

T-Sector:

$$I_t^{TT} + I_t^{TN} + C_t^T + EX_t = Y_t^T \tag{1.15}$$

where $I^{TT} = \gamma_1 I^T, I^{TN} = (1-\gamma_1) I^T$

N-Sector:

$$I_t^{NT} + I_t^{NN} + C_t^N = Y_t^N \tag{1.16}$$

where $I^{NT} = (1-\gamma_2) I^N, I^{NN} = \gamma_2 I^N$

**Labor Market**

$$H_t^T + H_t^N = \overline{H_t} \tag{1.17}$$

**Equilibrium**

A rational expectation equilibrium is defined as a set of endogenous variables $C_t^T, C_t^N, K_t^T, K_t^N, Q_t, P_t, N_t^T, N_t^N, I_t^T, I_t^N, Y_t^T, Y_t^N, H_t^T, H_t^N$, which satisfies entrepreneurs' and capital producers' decision rules in both the T and the N sector.

**Adjustment of $P_t$**

Imbalances between N-sector goods demand and supply lead to adjustment of $P_t$

From Equation (5.8):

$$I_t^{TN} = \frac{K_t^T}{(1-\gamma_1)\left(\frac{\gamma_1 + (1-\gamma_1) P_t}{Q_t}\right)^{\frac{1}{\theta}}} \tag{1.18}$$

$$I_t^{NN} = \frac{K_t^N}{(1-\gamma_2)\left(\frac{\gamma_2 + (1-\gamma_2) P_t}{Q_t}\right)^{\frac{1}{\theta}}} \tag{1.19}$$

---

[12] $P = P^N / P^T$

Lowering the cost of borrowing induces firms to purchase more capital, raising the cost of capital, and increasing the demand for investment goods, which shifts the N-goods demand curve to the right, resulting in the real exchange rate appreciation $P_t \uparrow$.

### C. Calibration

The share of tradable ($u$) and nontradable ($1-u$) consumption goods is obtained from the Bagnop, Chateau, and Sahin (2006). The elasticities of the external finance premium with respect to the ratio of capital to net worth, $\chi^T, \chi^N$ are estimated in the empirical section of the paper. The household discount factor (β) and the adjustment cost for net investment (θ) are taken from the literature. The remaining parameters are calibrated using the firm-level datasets chosen. The depreciation rate is about 7 percent. $\alpha^T, \alpha^N$ are the labor shares of T-goods and N-goods production respectively (calculated as labor compensation/value added from the micro-level dataset). Intuitively, the T sector should be less labor-intensive than the N sector. ($\alpha^T$=0.32, $\alpha^N$=0.37). For aggregation purposes, we would assume CRS and perfect competition; the capital shares of T- and N- goods production are therefore $1-\alpha^T$, and $1-\alpha^N$, respectively. This assumption is reasonable because the average profit margin is about 4 percent (close to 0). Survival rates in the T and N sectors ($\delta^T, \delta^N$) are calculated from the steady-state Value Added/Capital ratio:

$$\frac{P^i Y^i}{QK^i} = \frac{\frac{1}{\delta^i} - (1-\delta)}{\alpha^i} \quad \text{for } i=\text{T,N}$$

In the T sector, $Y^T / QK^T = 0.37$, thus $\delta^T$=0.95. In the N sector, $P^N Y^N / QK^N$=1.54, thus $\delta^N$=0.67. For the production of capit al in the T and N sector s, T sector inputs are $\gamma_1$=0.79 and $\gamma_2$=0.69 respectively (from the Table 9, 1- $\gamma_i$=building/total investment). For the production of capital in the T and N sectors, N sector inputs are 1-$\gamma_1$=0.21 and 1-$\gamma_2$=0.31.

## VI. Results and Sensitivity Analysis

### A. Impulse Responses

As one expects, investm ent, net worth, and out put in each sector re spond negatively to an increase of risk free interest rate. However, the magnitude of decline in investment and output is larger in the N secto r than in the T sector due to (1) larger investment sensitivity to firms' net worth (m easure of cred it friction) in the N sector and (2 ) the pro-cy clical real exchange rate movement. The introduction of extra N sector volatility in this two-sector model results in larger overall econom ic fluctuation than in the standa rd BGG one sector version. W e consider four

cases of financial accelerator (FA): (1) no FA [13]; (2) one sector FA [14] with $\chi = 0.12$; (3) two-sector FA with $\chi^T = \chi^N = 0.12$; and (4) two sector FA with $\chi^T = 0.12, \chi^N = 0.58$. The first two cases cannot bring about impulse responses of the same magnitude that observed from the data. The third case, which introduces two sectors, does a much better job of matching the magnitude of investment and the output impulse responses. However, the sectorally asymmetric credit constraints are needed to match the N-to-T output ratio impulse responses generated from the data (see Figures 5 and 6).

### B. Second Moment Properties

We calculate the second moment properties of the model (standard deviations and cross correlations with real credit) and examine how well the properties fit the Chinese data. Two-sector FA that captures the pro-cyclical real exchange rate movement (case 3 and 4) performs much better than one sector FA (case 2) or no FA (case 1) in matching the volatility observed in the data. (See table 8) Excessive credit frictions in the N sector contribute additional volatilities (case 4 versus case 3).

The simulated comovements of real GDP with investment and real credit reasonably match the data; however, the model seems to over-predict the comovements between the real GDP and consumption. This can be due to the counter-cyclicality of consumption since the later 1990s while the model suggests procyclicality over the entire sample period.

### C. Simulation

We estimate the shock processes[15] and some key parameters from the model by fitting the first and second moments of four variables: investment, output, N-to-T output ratio, and credit/GDP (see estimation result from Table 9).[16] We then compare the model-generated variables with the data (see Figure 7) and find that the model captures the dynamics of the key macroeconomic variables reasonably well.

## VII. Policy Implications

First, an expansionary credit policy that aims at relaxing N sector credit constraints is proven to be quite effective in the short term. Enterprise savings account for about one-third of total savings in China, and in recent years the proportion has been rising continuously. This signals that firms lack access to external funds. Despite the high deposit rate in China, it is still difficult

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[13] $\eta = 0$. With the external finance premium being zero, the borrowing cost will be flat to all the firms. Hence the financial accelerator is completely shut down.

[14] We shut down the N sector and remove the real exchange rate dynamic in this case.

[15] Three shocks are introduced. T-sector technology shock: $a_t^T = \rho^T a_{t-1}^T + \varepsilon_t, \varepsilon_t \sim (0, \sigma^T)$; N-sector technology shock: $a_t^N = \rho^N a_{t-1}^N + \varepsilon^N{}_t, \varepsilon^N{}_t \sim (0, \sigma^N)$; interest rate shock: $r_t = \rho^r r_{t-1} + \varepsilon^r{}_t, \varepsilon^r{}_t \sim (0, \sigma^r)$

[16] We use the Bayesian estimation approach that is built in Dynare.

for firms to access bank credit, especially the SMEs that dominate the N sector. Moreover, government credit allocation policy favors the T sector, which makes access to external funds even harder for the N sector. Hence, although there is much scope to improve the efficiency of credit allocation in China, the recent lending boom may not be as inefficient as people fear, because much credit has been injected into the N sector, which ought to relax its credit constraints and improve its productivity growth.

Second, lifting the downward pressure on the real exchange rate makes an expansionary credit policy more effective. The real exchange rate has been pressured downward by both government intervention and people's excessive savings—mainly the latter (Zhang 2009). An expansionary credit policy can be more effective for the N sector by enhancing its balance sheet through real exchange rate appreciation. Hence, policy implementations that reduce precautionary savings will raise demand in the N sector; cause the real exchange rate to appreciate, which improves firm balance sheets; and further relaxes credit constraints.

Third, as external demand weakens, there is a need to stimulate domestic demand, and a better social safety net tops the medium-term policy list. Household precautionary savings are partly responsible for the slow growth of the N sector in China. Rather than spending income, people let it remain idle in the bank, earning extremely low interest, which means that disposable income rises only slowly, and so does consumption demand—a big portion of which goes to the N sector. One driving force of precautionary savings, it has been argued in the literature, is the underdeveloped public welfare system (education, health, and pension programs, etc). Moreover, there are so few alternative financial instruments that bank accounts are the only investment option for most people. Thus a sounder public welfare system and wider investment opportunities would effectively free households from excessive savings and raise their income for consumption.

In sum, directly injecting credit into the N sector has proven to be quite effective in boosting output in the short run. When there is a lack of external demand, its effectiveness is enhanced by real exchange rate appreciation. However, the medium-term risks of asset bubbles are a major concern. Stimulating domestic demand is a more sustainable longer-term policy. It rebalances N sector demand and supply and restores the real exchange rate to equilibrium. More generally, boosting domestic demand helps China rebalance both internally and externally with the rest of world.

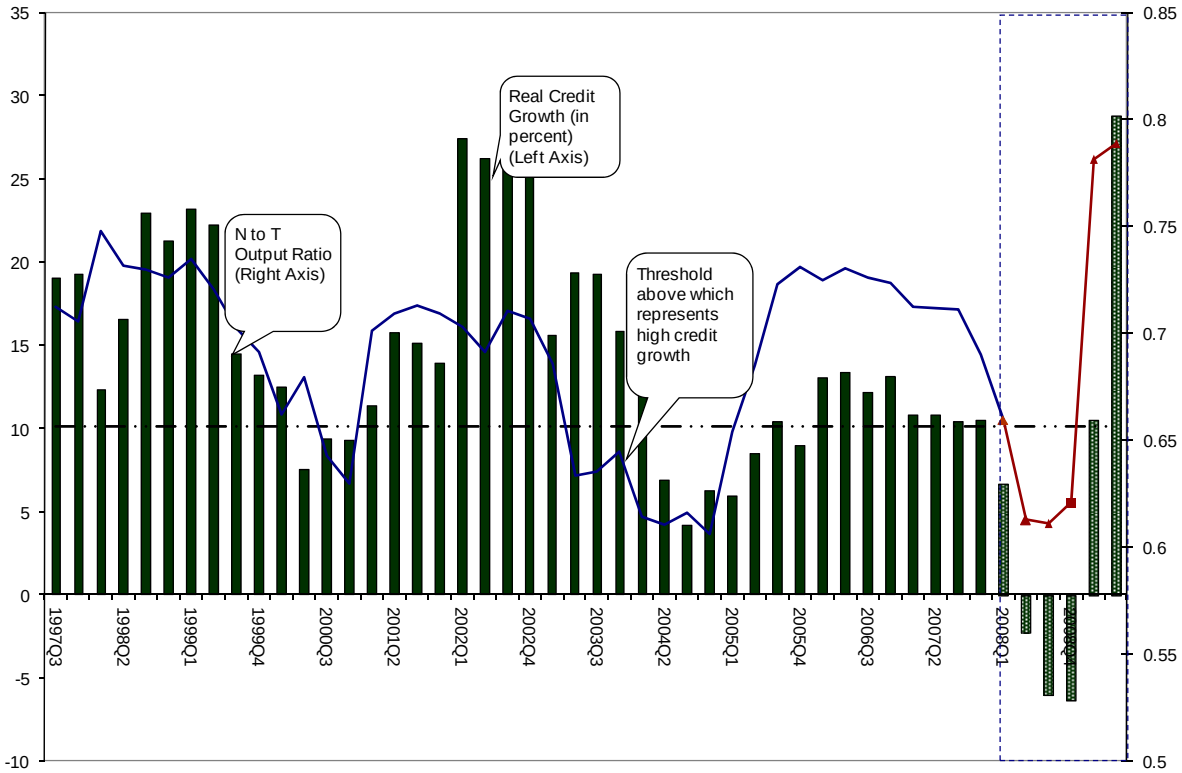
## VIII. Conclusion and Further Research

Together the non-uniform nature of Chinese credit market imperfection and the dynamics of the real exchange rate amplify the Chinese business cycle in a sectorally asymmetric fashion: the N sector experiences larger output swings than the T sector, particularly in an economic downturn. Drawing on firm-level data to calibrate a two-sector DSGE model that captures our stylized facts, we get simulation results that reasonably match the data in first and second moments.

With readily available firm-level data, the empirical and theoretical framework can be applied to study the macro-financial linkages[17] in emerging market economies. This paper leaves room for future research: (1) a study of the time-varying dynamics of the macro-financial linkage and its evolution with financial development, or (2) endogenizing investment sensitivity to the availability of internal funds, which in this paper is assumed to be constant.

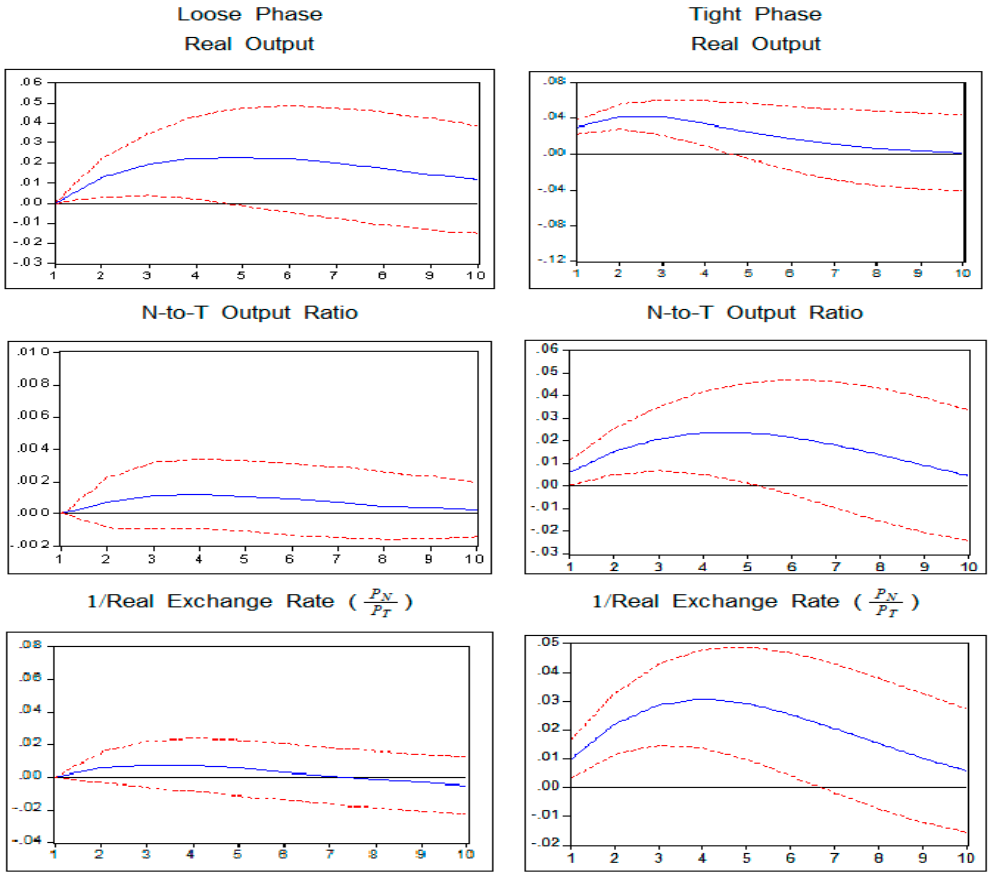
[17] Firm level datasets from the WB are readily available for 147 countries

**Figure 1. Nontradable to Tradable Output Ratios over Credit Cycle**



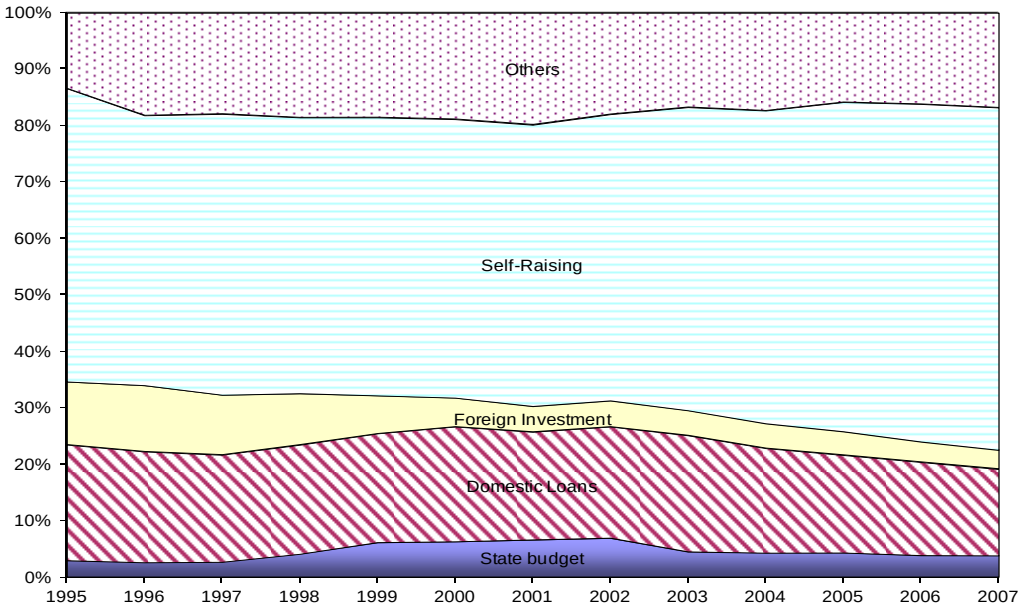

Source: IFS, CCER, and World Bank

## Figure 2. Impulse Responses from Threshold VAR



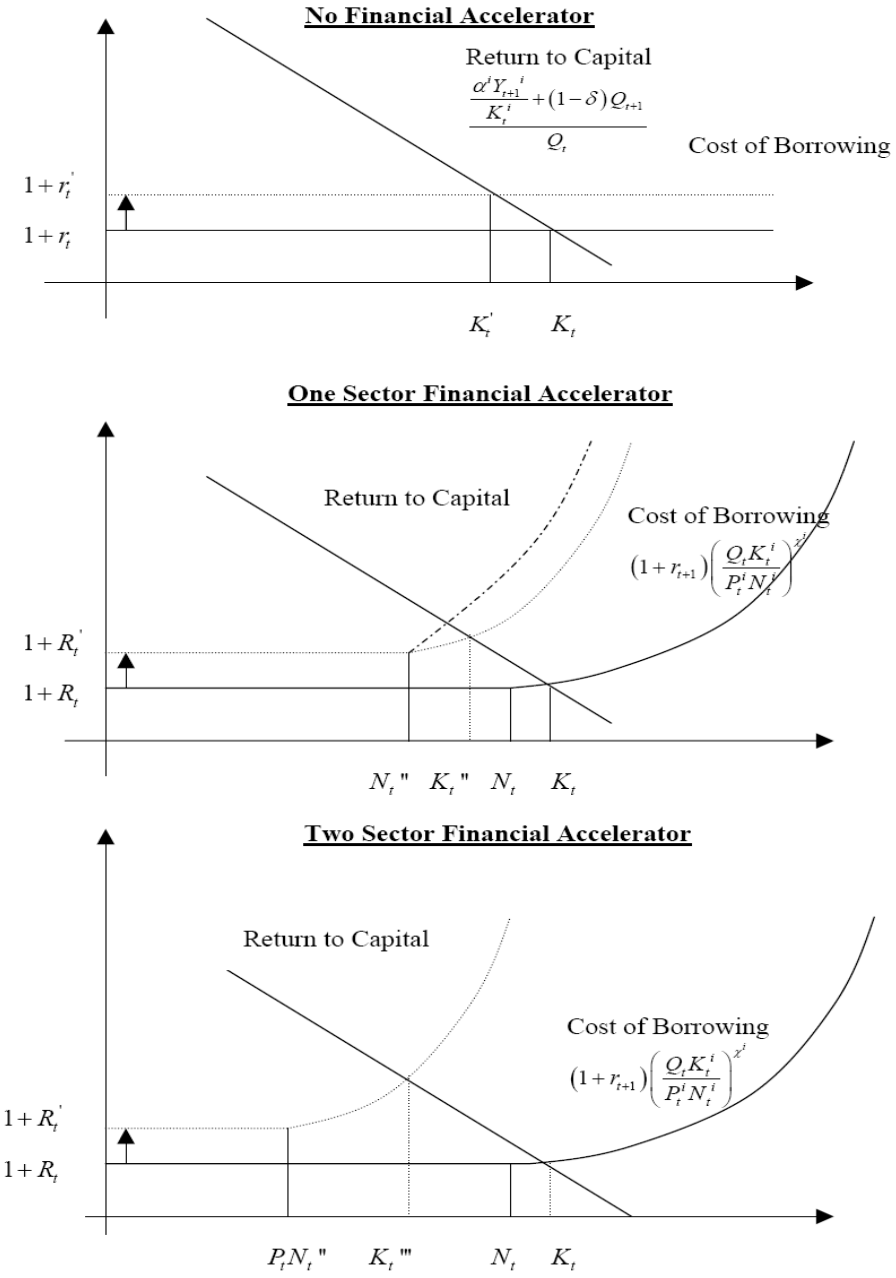

Sources: IFS, CCER, and IMF staff calculation

## Figure 3. Financing Sources for Fixed Investment: 1995-2007




Source: CCER

## Figure 4: Core Mechanism



## Figure 5. Impulse Responses

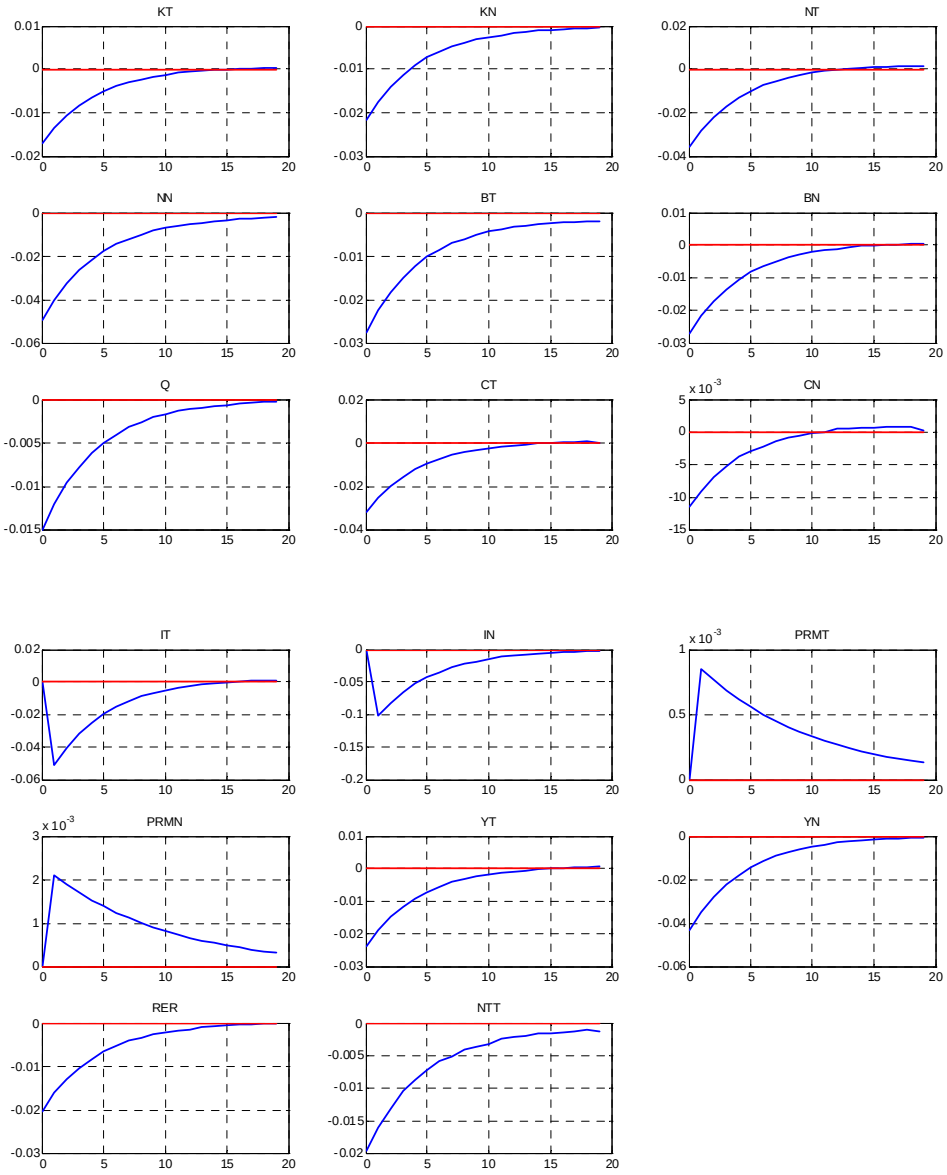


**Figure 6. Varying Financial Accelerator Scenarios: Impulse Responses for Key Variables**

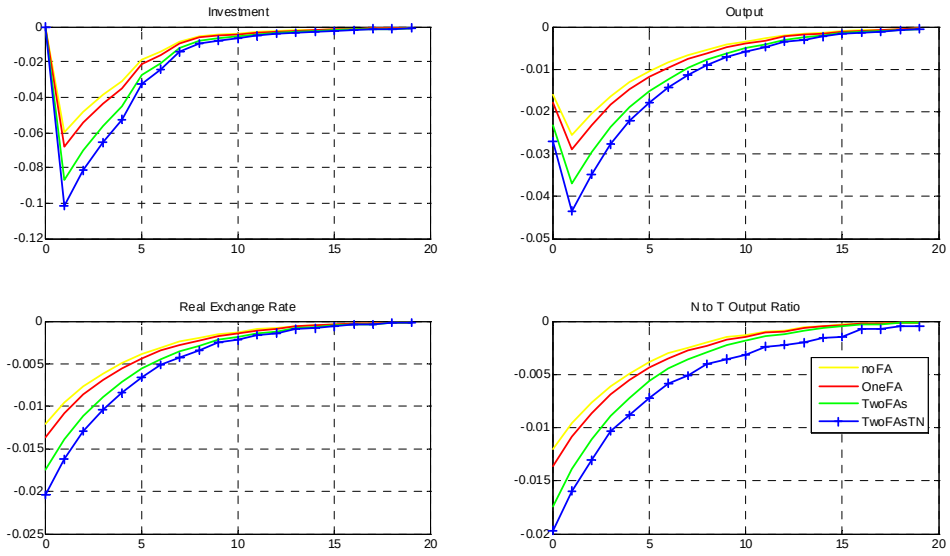
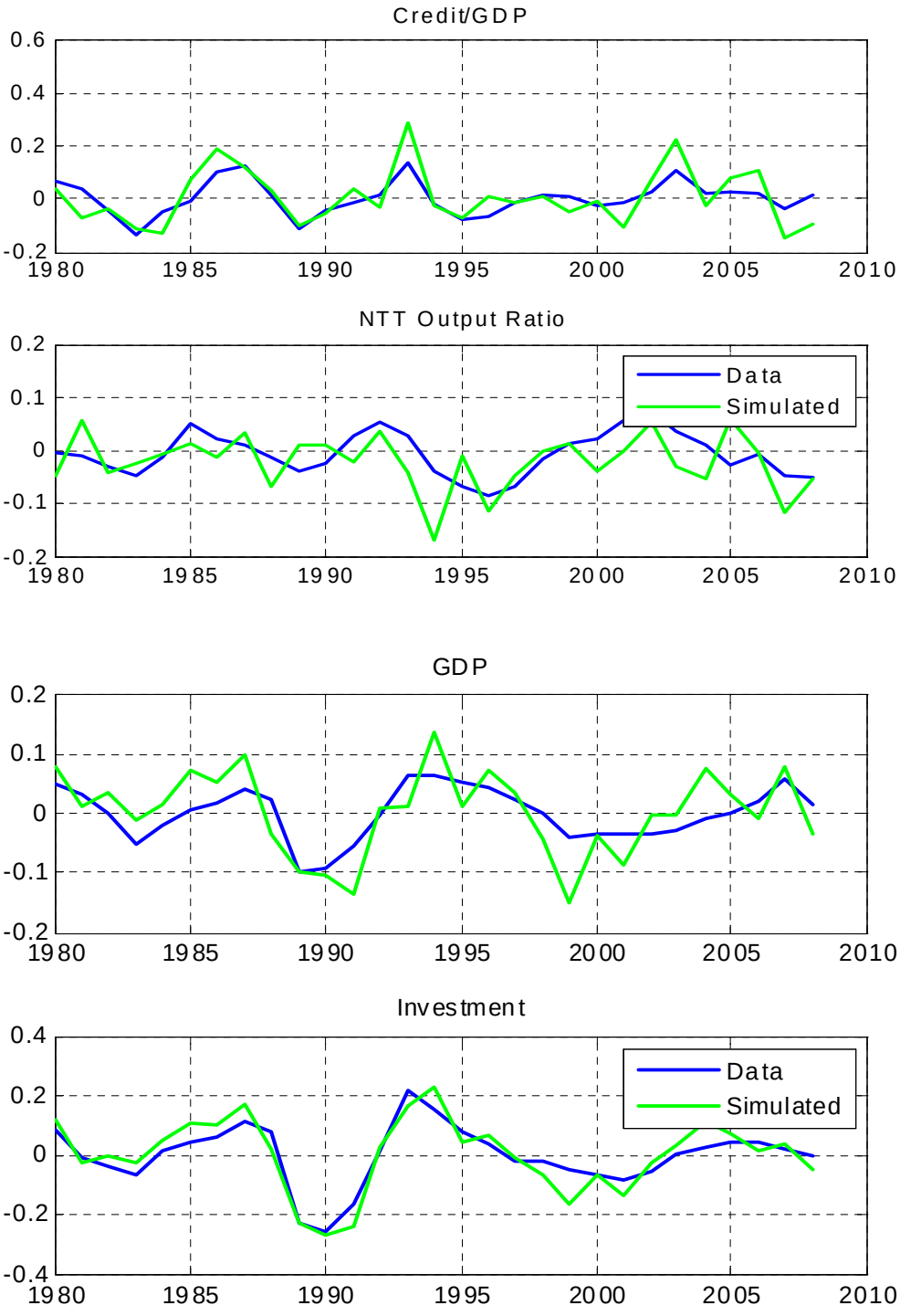


**Figure 7. Simulation Results versus Data**




Sources: CCER, IFS

## Table 1. Comovement of Credit with Other Macroeconomic Variables

Dependent Variable: lnReal Credit, Period: 1984-2009

| | Univariate | Multivariate | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1/reer | 0.1371* | 0.1471 | | | | 0.1356 |
| | -0.0622 | -0.1218 | | | | -0.1823 |
| NT/T output ratio | 0.4943* | 0.4968** | | | 0.3369* | 0.3195* |
| | -0.2112 | -0.2088 | | | -0.2341 | -0.21 |
| Interest rate spread | -0.0202 | | -0.0114 | | | |
| | -0.0415 | | -0.0362 | | | |
| CB Lending Rate | -0.0692* | | | -0.0437* | -0.0447 | -0.0329 |
| | -0.0362 | | | -0.0235 | -0.0289 | -0.0216 |
| lnInvestment | 0.0738* | | 0.0641* | 0.0617* | 0.0645* | 0.0567* |
| | -0.0377 | | -0.0329 | -0.0364 | -0.0322 | -0.027 |
| lnConsumption | 0.0679 | | 0.0404 | 0.0369 | 0.0298 | 0.0236 |
| | -0.0643 | | -0.0873 | -0.0712 | -0.0643 | -0.0652 |
| lnFiscal Deficit | 0.0107 | | 0.0078 | 0.0092 | 0.0099 | 0.0082 |
| | -0.0119 | | -0.0089 | -0.0119 | -0.0105 | -0.0153 |
| lnNet Export | 0.0021 | | 0.0014 | 0.0013 | 0.0015 | 0.0009 |
| | -0.0037 | | -0.0024 | -0.0027 | -0.0032 | -0.0021 |
| Adj.R^2 | | 0.47 | 0.49 | 0.53 | 0.58 | 0.59 |
| #obs | | 24 | 24 | 24 | 24 | 24 |

Note: 1/ lnRealCredit, lnInvestment and lnConsumption and NT/T ratio are I(1). Thus we take first difference on the series

2/ Interest rate spread=lending rate-borrowing rate

3/ *: significant at 10% level; **: 5% level; ***: 1% level

Sources: CCER, IFS, and World Bank

## Table 2. Summary Statistics of Datasets

| Summary Statistics of T and N Sector | | | Comparison between Census and Datasets | | | |
|---|---|---|---|---|---|---|
| | T Sector | N Sector | | Census | WB | CCER |
| **Size** | | | **Size** | | | |
| SM | 45% | 60% | SM | 96% | 54% | 0% |
| L | 54% | 40% | L | 4% | 46% | 100% |
| **Ownership** | | | **Ownership** | | | |
| Private | 75% | 80% | Private | 81% | 77% | 16% |
| State Owned | 25% | 20% | State Owned | 29% | 23% | 84% |
| **Region** | | | **Region** | | | |
| East | 37% | 38% | East | 70% | 38% | 62% |
| Central | 37% | 37% | Central | 20% | 38% | 23% |
| West | 26% | 25% | West | 10% | 25% | 15% |
| | | | **Sector** | | | |
| | | | T | 44% | 68% | 69% |
| | | | N | 56% | 32% | 31% |

Source: CCER

## Table 3. Variances in Relative Tradable Prices Across Industries

| | Food | Clothing | Transport | Services | Recre/Cul | HealthCare | Residence |
|---|---|---|---|---|---|---|---|
| STDEV (Level) | 0.0085 | 0.0111 | 0.0116 | 0.012 | 0.0124 | 0.0127 | 0.026 |
| Rank (Level) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| STDEV (Percent Chg) | 0.0188 | 0.0911 | 0.0967 | 0.0981 | 0.1059 | 0.1042 | 0.1329 |
| Rank (Percent Chg) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Tradability | Tradable | | | | | | Nontradable |

Source: CCER

## Table 4. Financing Sources for Working Capital and Fixed Investment (Firm Level)

**Source of Financing for Working Capital**

(in percent)

| | By Ownership | | | By Sectors | | Sizes | |
|---|---|---|---|---|---|---|---|
| | SOE | Collective | Private | Tradable | Nontradable | Small | Large |
| Foreign banks | - | - | 0.26 | 0.24 | - | 0.01 | 0.26 |
| Investment Funds | 0.92 | 0.04 | 0.24 | 0.26 | 0.63 | 0.28 | 0.45 |
| TradeCredits | 0.98 | 1.59 | 2.96 | 3.00 | 0.73 | 1.66 | 2.70 |
| Friends | 0.82 | 5.51 | 7.75 | 6.34 | 4.39 | 10.41 | 2.41 |
| Informal | 1.63 | 1.06 | 2.15 | 1.99 | 1.58 | 2.10 | 1.70 |
| Retained Earnings | 10.55 | 13.32 | 14.02 | 13.14 | 12.90 | 13.03 | 13.09 |
| Local Banks | 34.46 | 20.15 | 24.35 | 29.06 | 20.27 | 14.17 | 34.76 |
| Equity | 6.74 | 6.57 | 14.89 | 9.77 | 15.81 | 14.48 | 9.73 |
| Other | 43.91 | 51.74 | 33.36 | 36.12 | 43.67 | 43.85 | 34.89 |

**Source of Financing for Net Investment in Fixed Asset**

(in percent)

| | By Ownership | | | By Sectors | | Sizes | |
|---|---|---|---|---|---|---|---|
| | SOE | Collective | Private | Tradable | Nontradable | Small | Large |
| Foreign banks | - | - | 0.20 | 0.18 | - | 0.02 | 0.19 |
| Investment Funds | 1.06 | 0.06 | 0.43 | 0.58 | 0.48 | 0.55 | 0.55 |
| TradeCredits | 0.19 | 0.54 | 1.48 | 1.38 | 0.28 | 1.05 | 1.02 |
| Friends | 0.94 | 6.42 | 7.83 | 6.65 | 4.25 | 11.99 | 2.15 |
| Informal | 1.99 | 0.97 | 1.96 | 2.35 | 0.76 | 1.75 | 1.90 |
| Retained Earnings | 11.24 | 15.63 | 16.81 | 16.39 | 12.77 | 13.48 | 16.31 |
| Local Banks | 24.61 | 17.27 | 19.03 | 21.05 | 18.51 | 11.90 | 25.34 |
| Equity | 7.13 | 10.46 | 14.95 | 11.79 | 13.64 | 13.91 | 11.46 |
| Other | 52.84 | 48.64 | 37.30 | 39.61 | 49.31 | 45.36 | 41.07 |

Source: CCER

## Table 5: Summary of Financial Statement

**Financial Statement By Sector , Sizes and Ownership Types**

| | By Ownership | | | By Sectors | | Sizes | |
|---|---|---|---|---|---|---|---|
| | SOE | Collective | Private | T | N | Small | Large |
| **Asset** | 453,633 | 54,048 | 281,274 | 418,156 | 370,799 | 154,314 | 634,641 |
| (Ast Turnover =Sales/Asset) | 0.32 | 0.79 | 0.97 | 0.48 | 0.71 | 0.97 | 0.49 |
| **Sales** | 146,469 | 42,456 | 273,811 | 199,930 | 262,806 | 149,503 | 313,233 |
| Raw Material | 84,644 | 22,379 | 142,464 | 138,609 | 110,878 | 82,064 | 167,423 |
| (RM/Sales) | 0.58 | 0.53 | 0.52 | 0.66 | 0.42 | 0.51 | 0.53 |
| **Value Added** | 61,825 | 20,077 | 131,347 | 61,321 | 151,928 | 67,439 | 145,810 |
| (VA/Sales) | 0.42 | 0.47 | 0.48 | 0.31 | 0.58 | 0.45 | 0.47 |
| (VA/Capital) | 0.31 | 1.77 | 2.24 | 0.36 | 1.54 | 3.45 | 0.58 |
| **Expenses** | | | | | | | |
| Labor Expense | 24,644 | 7,880 | 43,345 | 19,580 | 56,289 | 34,279 | 35,096 |
| (Lbexp/VA) | 0.40 | 0.39 | 0.33 | 0.32 | 0.37 | 0.51 | 0.24 |
| Service Expense | 39,548 | 11,317 | 76,554 | 33,134 | 94,285 | 25,907 | 101,512 |
| (Serexp/VA) | 0.64 | 0.56 | 0.58 | 0.54 | 0.62 | 0.48 | 0.70 |
| **Net Operating Profit** | (2,368) | 880 | 11,449 | 8,607 | 1,354 | 759 | 9,202 |
| (NOP/VA) | (0.04) | 0.04 | 0.09 | 0.14 | 0.01 | 0.01 | 0.06 |
| **Investment** | 18,506 | 2,847 | 12,442 | 23,632 | 10,163 | 6,830 | 26,965 |
| **(Invest Rate=INV/Capital)** | 0.09 | 0.25 | 0.21 | 0.14 | 0.10 | 0.35 | 0.11 |
| Building | 4,543 | 1,220 | 2,315 | 4,938 | 3,140 | 1,285 | 6,793 |
| (% of Total Investment) | 0.25 | 0.43 | 0.19 | 0.21 | 0.31 | 0.19 | 0.25 |
| Machinery, Equipment | 9,723 | 815 | 8,203 | 12,322 | 6,419 | 779 | 17,962 |
| Cars, trucks | 3,574 | 720 | 1,222 | 4,938 | 578 | 4,236 | 1,280 |
| Others | 666 | 92 | 702 | 1,434 | 26 | 530 | 930 |
| **Capital** | 199,347 | 11,338 | 58,623 | 170,489 | 98,819 | 19,524 | 249,784 |
| Building | 73,808 | 2,636 | 20,928 | 68,923 | 28,449 | 6,805 | 90,567 |
| Machinery, Equipment | 106,982 | 7,973 | 31,177 | 91,499 | 54,633 | 4,911 | 141,221 |
| Cars, trucks | 10,360 | 708 | 4,808 | 1,384 | 14,492 | 3,212 | 12,664 |
| Others | 8,197 | 21 | 1,710 | 8,683 | 1,245 | 4,596 | 5,332 |

Source: CCER

## Table 6. Bank Loan Obstacles by Sectors, Ownership Types and Sizes

**Bank Loans By Sectors, Sizes and Ownership Types**

| | By Ownership | | | By Sectors | | Sizes | |
|---|---|---|---|---|---|---|---|
| | SOE | Collective | Private | Tradable | Nontradable | Large | Small |
| Collateral | | | | | | | |
| Require collateral | 43% | 50% | 61% | 48% | 63% | 43% | 66% |
| Collateral Value % of Loan | 73% | 76% | 90% | 71% | 89% | 81% | 92% |
| Guaranteed by Government | 12% | 12% | 9% | 11% | 7% | 15% | 10% |
| Require deposit | 47% | 55% | 62% | 42% | 57% | 56% | 62% |
| Size of deposit % of loan Value | 29% | 38% | 44% | 34% | 40% | 29% | 42% |
| Bank Loan Application Obstacle | | | | | | | |
| Do not need Loan | 67% | 45% | 49% | 52% | 47% | 64% | 39% |
| Cumbersome Application Procedure | 18% | 25% | 29% | 22% | 25% | 21% | 26% |
| Collateral Requirement | 19% | 25% | 29% | 15% | 24% | 14% | 26% |
| Interest Rate too high | 16% | 14% | 19% | 15% | 18% | 15% | 17% |
| Corruption in Bank Credit Allocation | 8% | 9% | 11% | 6% | 12% | 6% | 13% |

Source: World Bank Survey

Note: Multiple Choices are allowed for surveying the bank loan application obstacles

## Table 7. Investment Function Estimation Results

### Asymmetries of Credit Market Imperfection

Dependent Variables: I/K(-1)

| | WB Dataset | | | | CCER Dataset | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| CF/K(-1) | 0.0727** | 0.0729* | 0.0873* | 0.0954* | 0.115 | 0.1099 | 0.1931 | 0.3882 |
| | 2.35 | 1.82 | 1.91 | 1.81 | 2.95 | 2.66 | 4.71 | 5.74 |
| Y/K(-1) | 0.0002 | 0.0002 | 0.0002 | 0.0005 | 0.0170*** | 0.0169*** | 0.0232*** | 0.0678*** |
| | 0.25 | 0.22 | 0.15 | 0.31 | 4.98 | 4.78 | 4.3 | 5.1 |
| (CF/K(-1))*NT | 0.5308*** | 0.5660*** | 0.4156*** | 0.4200*** | 0.3773*** | 0.3622*** | 0.1483** | 0.4217* |
| | 4.13 | 3.9 | 2.84 | 3.24 | 3.76 | 3.51 | 1.94 | 1.79 |
| (CF/K(-1))*SOE | | -0.5495 | -0.5385 | -0.1554 | | | 0.3475 | 0.7721 |
| | | -0.53 | -1.24 | -0.3 | | | 1 | 1.07 |
| (CF/K(-1))*WEST | | | 0.1272*** | 0.4051*** | | 0.6645 | 0.4387** | 0.2291* |
| | | | 3.89 | 3.77 | | 1.48 | 2.39 | 1.8 |
| (CF/K(-1))*CENT | | | 0.4501 | 0.2134 | | -0.318 | -0.5728 | -0.5299 |
| | | | 0.825 | 0.65 | | -1.39 | -1.48 | -1.39 |
| (CF/K(-1))*S | | | | 1.1933** | | | | -0.5783 |
| | | | | 2.14 | | | | -0.11 |
| (CF/K(-1))*SM | | | | 1.1273*** | | | | 0.1285 |
| | | | | 2.8 | | | | 0.53 |
| (CF/K(-1))*ML | | | | 0.2134 | | | | -0.226 |
| Firm Fixed Effect | Y | Y | Y | Y | Y | Y | Y | Y |
| Constant | -0.6761 | -0.3642 | -0.1933 | -0.4332 | 0.5594 | 0.7878 | 0.6718 | 0.8724 |
| Within R^2 | 0.0695 | 0.0707 | 0.0529 | 0.0464 | 0.0691 | 0.0484 | 0.0438 | 0.0618 |
| Obs | 1117 | 1117 | 1117 | 1117 | 9430 | 9430 | 9430 | 9430 |

Sources: World Bank Survey, CCER

Note: P Value below the coefficient estimates

S: <1M; SM: 1M-10M; ML:10M-100M; Control Size Group is L: >100M

CF is defined as the operational cash flow; Y =value added=sales-cost on raw materials

## Table 8. Second Moment Properties

**SD % of Each Variable from the HP filtered Trend (Annual: 1980-2008)**

| | Data | No FA | One Sector FA | Two Sectors FA |
|---|---|---|---|---|
| Real GDP | 3.18 | 1.29 (0.08) | 1.79 (0.13) | 2.87 (0.21) |
| Investment | 8.07 | 3.62 (0.44) | 4.78 (0.46) | 8.79 (0.74) |
| NTT Output Ratio | 7.44 | 0 | 0 | 6.23 (0.68) |
| Real Credit | 6.23 | 1.37 (0.23) | 1.51 (0.14) | 2.85 (0.19) |

**Cross Correlation With Real Cedit (Annual-Data 1987-2007)**

| | Lead -2 | Lead -1 | 0 | Lag 1 | Lag 2 |
|---|---|---|---|---|---|
| Real GDP | 0.08 | 0.65 | 1.00 | 0.65 | 0.08 |
| Investment | -0.10 | 0.49 | 0.90 | 0.67 | 0.18 |
| NTT Output Ratio | -0.08 | 0.09 | 0.27 | 0.10 | 0.13 |
| Consumption | -0.23 | 0.04 | 0.37 | 0.42 | 0.31 |
| Real Credit | -0.68 | -0.53 | 0.07 | 0.43 | 0.40 |

**Cross Correlation With Real GDP (Annual- Simulated Two Sector)**

| | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| Real GDP | 0.09 | 0.74 | 1.00 | 0.74 | 0.09 |
| | (0.08) | (0.28) | (0.00) | (0.28) | (0.08) |
| Investment | -0.11 | 0.49 | 0.94 | 0.70 | 0.18 |
| | (0.12) | (0.28) | (0.11) | (0.19) | (0.22) |
| NTT Output Ratio | -0.14 | 0.19 | 0.44 | 0.17 | 0.12 |
| | (0.12) | (0.08) | (0.07) | (0.09) | (0.14) |
| Consumption | -0.13 | 0.14 | 0.36 | 0.38 | 0.17 |
| | (0.16) | (0.12) | (0.08) | (0.13) | (0.20) |
| Real Credit | -0.62 | -0.45 | 0.23 | 0.39 | 0.24 |
| | (0.34) | (0.23) | (0.07) | (0.12) | (0.22) |

Sources: IFS, CCER, and IMF staff calculation

## Table 9. Bayesian Estimation

| Parameter | Description | Value | Source |
|---|---|---|---|
| $\alpha^T$ | Labor Share of T goods Production | 0.320 | Micro |
| $\alpha^N$ | Labor Share of N goods Production | 0.370 | Micro |
| $\delta$ | Depreciation | 0.070 | Micro |
| $\delta^T$ | Survival Rate of T Sector Entrepreneur | 0.950 | Micro |
| $\delta^N$ | Survival Rate of N Sector Entrepreneur | 0.670 | Micro |
| $u$ | Household Preference for T goods | 0.690 | Macro |
| $\beta$ | Discount Rate for Households | 0.995 | Literature |
| $r$ | Real Risk Free Rate | 0.005 | Macro |
| $\chi^T$ | T Sector Elasticity of Risk Premium | 0.070 | Micro |
| $\chi^N$ | N Sector Elasticity of Risk Premium | 0.610 | Micro |
| $\theta$ | Adjustment Cost for Net Investment | 0.900 | Literature |
| $\gamma_1$ | Input from T Sector for T sector Capital Production | 0.790 | Micro |
| $\gamma_2$ | Input from T Sector for N sector Capital Production | 0.690 | Micro |
| $\frac{Y^T}{QK^T}$ | T Sector Value Added/Capital Ratio | 0.360 | Micro |
| $\frac{PY^N}{QK^N}$ | N Sector Value Added/Capital Ratio | 1.540 | Micro |

Sources: CCER, IFS, and IMF staff calculation

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