Corporate Deleveraging and Macroeconomic Policies: Evidence from China

Sun, Lixin

Shandong University

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Lixin Sun[1]

Abstract: In this paper, we estimate the dynamic equilibrium debt level for China's non-financial corporates using an error correction model (ECM), and then analyse China's corporate deleveraging and its consequence. Furthermore, we examine the effects of macroeconomic policies on China's corporate deleveraging with a VAR model. The empirical results suggest that contractive monetary policy and fiscal policy rather than easy macroeconomic policies help reduce the non-financial corporate leverage in China.

Keywords: Corporate Deleveraging; VAR/VEC Model; Dynamic Equilibrium Debt Level; Macroeconomic Policies; China's Economy

JEL Code: E62, E63, E32

[1] Lixin Sun (corresponding author) is an associate professor of macroeconomics from the Center for Economic Research, Shandong University. E-mail: sunlixin@gsm.pku.edu.cn or lxsun@sdu.edu.cn. Address: The Center for Economic Research, Shandong University, 27# Shandananlu, Jinan, 250100, P.R.China

1. Introduction

The increasing leverage of China's non-financial firm sector in recent years has attained more concerns over the process and the measures of corporate deleveraging in China. In this paper, first, we estimate the dynamic equilibrium debt level for China's non-financial corporate sector using a VEC model. Comparing the actual non-financial corporate debt level with the equilibrium level, we analyse whether, when and how much to deleverage for the firm sector. Furthermore, we examine the effects of China's macroeconomic policies on corporate deleveraging with a VAR model, and thereby providing policy suggestions.

Deleveraging in China has some special situations that should be considered. The indebtedness of local governments has attained concerns recently, but given that the leverage of China's central government is low, at the general government level the ratio of public debt to GDP was approximately 40% at the end of 2014, so China's public debt is mild and sustainable by the international standards. However, the private non-financial debt has a different story. It reached 192.69% at the end of 2014 (percent to GDP), to which household debt (36.01% at the end of 2014) contributed less and non-financial corporate debt contributed more, the latter had attained approximately 156.68% by the end of 2014, which is one of the highest level around the world. That's why our study focuses on China's corporate deleveraging. Secondly, the increasing corporate leverage in recent year was mainly driven by a huge monetary and fiscal stimulus package taken by Chinese government for weathering against the Global Financial Crisis of 2008, not driven by market incentives likely in

most advanced economies. Thirdly, China's large non-financial firms and main commercial banks are state-owned, which could imply different pass-through for corporate deleveraging from that occurred in advanced countries. All these motivated our study on China's corporate deleveraging to extend the findings in literature on private debt deleveraging.

Our contributions in this paper are: 1) using temporal disaggregating approaches, we compiled a complete quarterly data series for China's corporate debt level (percent to GDP) since 1985q1, which set up a data foundation for our and other future empirical studies. 2) By identifying the long-run relationships between the corporate debt level and the fundamental macroeconomic variables with a Vector Error Correction model, we calculated the dynamic equilibrium (sustainable) debt level of China's non-financial corporates for the first time. The gap between the actual corporate debt level and the estimated equilibrium debt values measures the corporate deleveraging space to be filled, which would lead to a remarkable decline in China's growth rate of GDP in the future. 3) Our tests on the effects of monetary and fiscal policy shocks on corporate deleveraging suggest that contractionary macroeconomic policies help reduce China's non-financial corporate leverage in the context of unique transmission channels of macroeconomic policies and special economic structure where state-owned non-financial firms and commercial banks dominate China economy.

The remainder of the paper is structured as follows. Section 2 reviews the literature on deleveraging process and approaches. Section 3 descripts data and the

stylized facts. Section 4 estimates the dynamic equilibrium level for China's non-financial corporate debt. Section 5 examines the impacts of monetary and fiscal policies on corporate deleveraging. Section 6 concludes.

2. Literature Review

Leverage is a double-edged sword. On the one hand, a sustainable debt level for both the public sector and the private sector is not only the precondition but also the routine measures for improving public service and fostering economic growth. On the other hand, the overindebtedness could lead to default and bankruptcy, depressing the economic growth, producing economic instability and fluctuations, even could be followed by crises and disasters[2]. Therefore, a deleveraging process must occur if the debt level and debt burden are unsustainable. These rules also apply to corporate leverage and deleverage.

Although there have been many deleveraging processes throughout history to learn from, economists and policy-makers do not understand very well how those processes work, they often have a painful trial and error experience in deleveraging practice. Reihart et al. (2015) classified the deleveraging strategies mainly for public sector[3] into two groups, the first is orthodox strategy group comprising enhancing economic growth over the interest rate and running budget surplus. The second is heterodox strategy group, in which the deleveraging achieves through several processes or their mix including 1) debt reduction, 2) austerity, 3) debt monetization,

[2] Literature on the effects of excess indebtedness, See, for example, Reinhart and Rogoff (2010), Cecchetti et al. (2011), Clemons and Vague (2012).

[3] The private sector can apply the similar strategies.

and 4) wealth transfers[4]. Debt reduction for deleveraging can be achieved directly by debt defaults and debt restructuring, which often severely harm the creditor's benefits and could lead to a self-reinforcing deflation-depression spiral. Austerity is a natural and obvious choice for the overindebted private and public sector. To the public sector it means cutting the government expenditure and increasing the revenue, which implies a contractionary fiscal policy. To the private sector it also suggests the cut in spending or investing and the attempt to raise income. Historically, debt monetization by printing money is most frequent measure for deleveraging, which implies that an expansionary monetary policy frequently follows the excess indebtedness in the public or private sector. The recent notable example is the so called "Quantitative Ease" monetary policy taken by the FED, the Bank of England, and the European Central Bank. Ueda (2012) presents that a quickly and well monetization for deleveraging (like the US since 2008) derived much better results than those who did it late (like Japan since 1990s). Wealth transfer for deleveraging occurs in several forms, for example, increasing the tax burden on the riches to transfer the wealth from the haves to have-nots. For the firms, it can be carried out by financial support and tax reduction on those "too important to fail". Above discussions and lots of literature show that macroeconomic policies play important roles in deleveraging (Eggertsson and Krugman, 2012; Bouis et al., 2013; Goretti et al., 2013; Benigno et al., 2014). Specifically, Benigno et al. (2014) simulated the effects of monetary policy and fiscal policy during a dynamic debt deleveraging

[4] See, for example, Dalio (2012), Bouis et al. (2013), Buttiglione et al. (2014).

process in the household sector by generalizing a standard New Keynesian model. Their results suggest that an unconventional monetary policy with zero bound and a positive counter-cycle fiscal policy help accelerate the deleveraging.

Using a financial model developed by Leland (1994), Zhang et al. (2015) calculated the optimal corporate leverage ratio (debt-to-asset) based on the firm level data. Their empirical results suggest that China's corporate sector does not appear to be over-leveraged. They find that it is mainly state-owned enterprises (SOEs) that have increased leverage, while private enterprises have deleveraged in recent years, and the SOEs' leveraging has been mainly driven by implicit government support amid lower funding costs than private enterprises. Chivakul and Lam (2015) assessed China's corporate leverage and made a similar conclusion as in Zhang et al. (2015). To my knowledge, until now, no studies are conducted to explore the effects of macroeconomic policies on China's corporate deleveraging, which motivates my study.

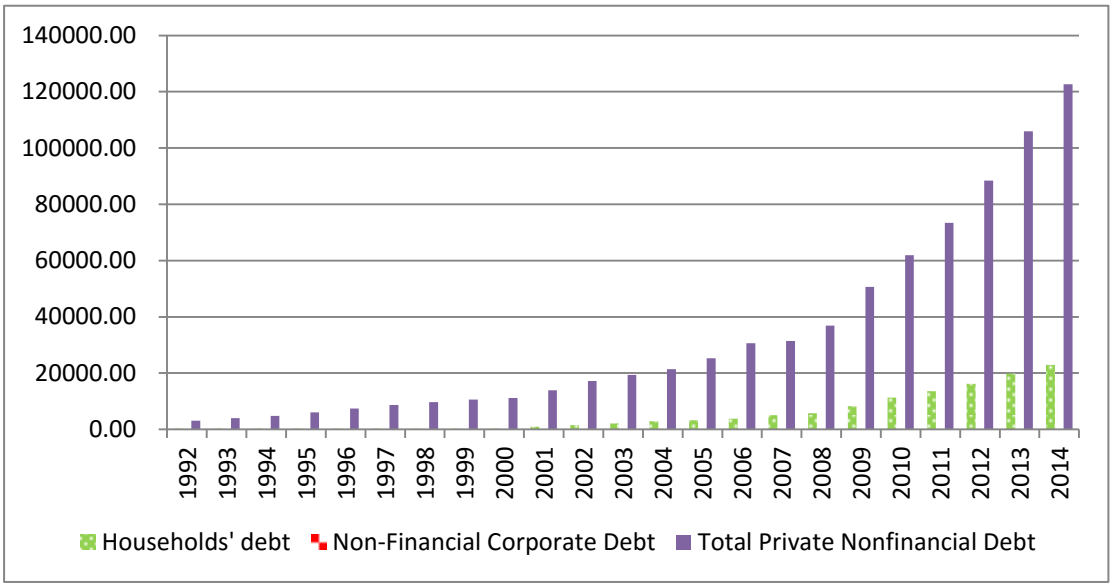
3. Data and Stylized Facts

The empirical studies on China's debt issues have been constrained by the lack of detailed times series debt data. In this paper, we compiled a complete data serie for China's non-financial corporate debt from the first quarter of 1992 to the second quarter of 2015, to match the available data for many other macroeconomic indicators, such as the growth rate of GDP, and so on. As such, we collect our data from several sources including official publications, international databases and individual

literature. The first database is the Bank for International Settlement database (hereafter BIS, 2015, entitled as the "Long series on total credit and domestic bank credit to the private nonfinancial sector" database), from which we compiled the total private non-financial sector debt data for whole period and the non-financial corporate debt for 2006-2015 period. The second group of dataset includes Clemons and Vague (2012) for the period after 2004 and He et al. (2012) for the 1999-2004 period. The data of non-financial corporate debt for the 1992-1998 period were proxied by the total loans to businesses from the database of the People's Bank of China (hereafter the PBC, China's Central Bank). Although BIS 2015 database provides quarterly data for non-financial corporate debt, it starts only from the first quarter of 2006. Therefore we have to disaggregate our annual data into quarterly for the 1992q1-2005q4 period.

The complete annual data series for China's non-financial private sector are depicted in Figure 1. Household debt had risen from 208.21 billion yuan (RMB) in 1992 to 22921.56 billion yuan in 2014, increasing more than 10 times for this period. Non-financial corporate debt has increased approximately 43 times since 1992, rising from 2057.60 billion yuan in 1992 to 99720.04 billion yuan in 2014. Despite that both household debt and non-financial corporate debt have remained an uptrend since the 1990s, it is the rapid increase in non-financial corporate debt that makes remarkable contributions to the rise in China's private non-financial debt rather than the increase in household debt.

Figure 1 Household Debt, Non-financial Corporate Debt and Total Private Non-Financial Debt Stocks (Unit: Billion Yuan RMB)



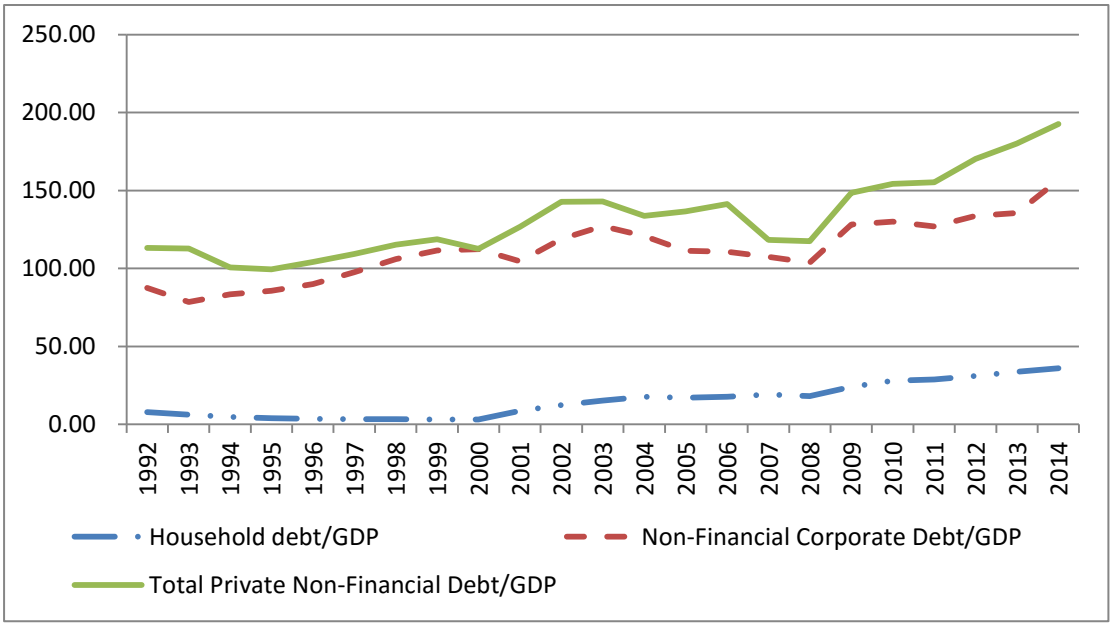
Source: Author's Collection

Figure 2 plots the evolutions in the ratios of household debt, non-financial corporate debt and total private non-financial debt to GDP from 1992 to 2014. The non-financial private debt-to-GDP ratio had increased 80 percentages by the end of 2014, attaining 192.69% of GDP. The ratio of household debt to GDP rose from 7.73% in 1992 to 36.01% in 2014 due to the increase in mortgage volumes. The leverage in the non-financial corporate sector has increased from 87.57% (to GDP) in 1992 to 156.68% in 2014, which is one of the highest levels of corporate debt in the world.[5] The highest leverage in non-financial corporates may produce severe dragging effects on China's sustainable economic growth. Figure 3 displays China's growth rates of GDP since 1992q1. Comparing Figure 3 with Figure 2, we find that the slowing growth rate of GDP follows the increasing leverage ratio in China's non-financial

[5] See, for example,

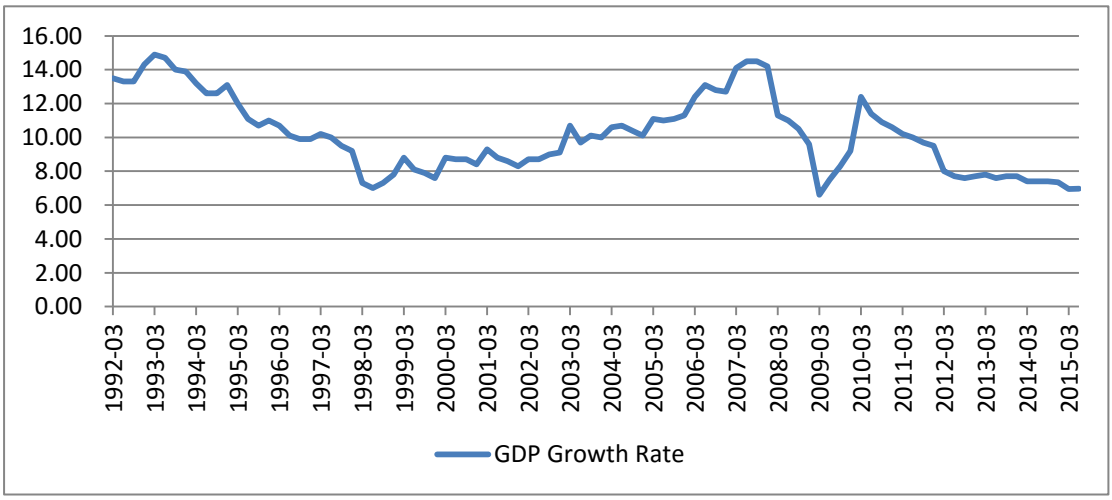
corporate sector since 2008. This implies that a deleveraging process could be necessary for China to restore its long-run equilibrium growth.

Figure 2 Evolutions of Household Debt, Non-Financial Corporate Debt and Private Non-Financial Debt



Source: Author's Collection

Figure 3 Growth Rates of GDP in China (1992-2015)



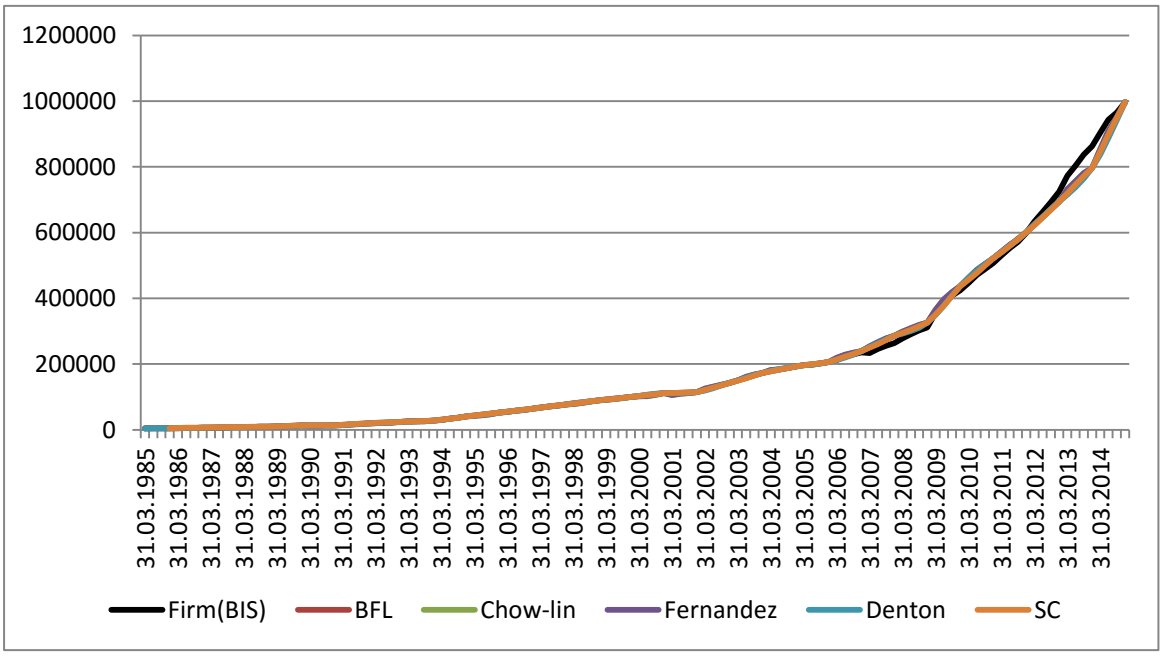
Source: Wind Database

As abovementioned, BIS (2015) database provides the quarterly data for China's non-financial corporate debt only from the first quarter of 2006, we have to obtain the

complete quarterly data series by disaggregating our annual data to match our sample period of 1992q1-2015q2. Our disaggregating employs Boot-Feibes-Lisman (1967), Chow-Lin (1971), Fernandez (1981), Denton (1971) and Santos-Cardoso (2001), respectively. For four latter methods, we use the quarterly private non-financial debt level as the index. The disaggregated quarterly data series for China's non-financial corporate debt level are reported in Figure 4 together with the actual data from BIS (2015) database.

Figure 4 indicates that the disaggregated quarter data series from several methods are highly coincidental and are well fit with the quarterly data from BIS (2015) dataset that starts from 2016q1. To simplify, we use the data series estimated by Fernandez (1981) from 1992q1 to 2014 q2 in our study, and extend the data to 2015 q2.

Figure 4 Disaggregated Quarterly Data for China's Corporate Debt Levels



Source: Author's Calculation

4. Dynamic Equilibrium Debt Level for Non-Financial Corporations

Measuring the overindebtedness in the public and private sector and thereby simulating the deleveraging process remains one of the most challenging empirical problems in macroeconomics because the equilibrium debt level is not observable. However, economic theory suggests that the equilibrium debt level is determined by the fundamental macroeconomic variables, which are observable. In this study, referring to the relevant literature (Guscina, 2008; Leland, 1994, Sun lixin (2015), Albuquerque et al., 2015), we assume that the equilibrium debt level of China's non-financial corporate sector is determined by some fundamental macro forces, including economic growth, the interest rate, financial developments, then the long-run relationship between these fundamental variables and the corporate debt level suggests the equilibrium corporate debt level. As such, a VEC model can be employed to estimate the long-run relationship among these macro variables, and thereby calculating the dynamic equilibrium level of non-financial corporate debt. The chosen fundamental economic variables comprises the growth rates of GDP, the interbank interest rates, a development index of financial markets (proxied by the ratio of sum of total deposits and total loans to GDP), and the Shanghai Stock Index.

Specifically, the VEC model is given by

$$\Delta d_t = \alpha(d_{t-1} - \theta' Y_t) + \beta' \Delta Y_t + \upsilon_t, \tag{1}$$

where $\theta = \begin{bmatrix} \theta_1 \\ . \\ . \\ \theta_4 \end{bmatrix}$, $\beta = \begin{bmatrix} \beta_1 \\ . \\ . \\ \beta_4 \end{bmatrix}$ and $Y_t = \begin{bmatrix} Growth\ of\ GDP \\ Inter\text{-}Bank\ Interest\ Rate \\ Financial\ Development\ Index \\ Shanghai\ Stock\ Index \end{bmatrix}$

where d_t denotes the ratio of corporate debt to GDP at time t, Δd_t is the first

difference of d_t ($d_t - d_{t-1}$), β and θ are short-run error correction coefficients and long-run (cointegrating) coefficients, respectively. Y_t represents the set of fundamental explanatory variables determining the long-run equilibrium (sustainable) corporate debt level, and α controls the spend of adjustment from the short-run to the long-run. υ_t denotes the external shock, which is an independent identical distributed white noise.

The sample period in our study is from 1992q1 to 2015q2. We conducted the unit root tests by suing ADF tests, the results show that all the variables are I(1). Furthermore, Cointegration tests indicate that there exists one long-run cointegrating relationship, which has been estimated by the above VEC model[6].

The identified long-run relationship between the corporate leverage and the fundamental variables by the VEC model is

$$eqcorpdebtgdp = 36.648 - 1.18\,ggdp - 2.358ir + 0.468\,findex - 0.011\,ssindex, \quad (2)$$

where $eqcorpdebtgdp$ denotes the dynamic equilibrium level of corporate debt (percent to GDP), $ggdp$ denotes growth rates of GDP, ir represents the interbank interest rates, $findex$ is the development index of financial markets, and ssindex denotes the Shanghai Stock Index.

The cointegrating equation (2) implies a negative correlation between the corporate equilibrium leverage and the economic growth in the long-run in China. Therefore, *ceteris paribus*, corporate deleveraging helps raise China's economic growth to its long-run level.

[6] The results for unit root tests, cointegration tests, and the identified cointegrating equation and error correction models are shown in Appendix A.

In terms of the cointegrating equation (2), we calculated the equilibrium values of corporate debt level. Comparing the actual corporate debt level with its dynamic equilibrium values, we can judge if the corporate sector is overindebted, and if so, when and how much to deleverage for the corporate sector. Figure 5 presents the actual and equilibrium debt level of China's non-financial corporate sector from 1992q1 to 2015q2. The abrupt fall in the equilibrium level of corporate debt for the period of 2007q2-2008q1 is due to the dramatically fall in the Shanghai Stock Index from more than 7000 to approximately 2500 for the period, which reduced the market values of the listed firms and decreased their borrowing capability, thereby reducing the equilibrium debt level of the corporate sector.

Figure 5 Equilibrium and Actual Corporate Debt Level (percent to GDP)

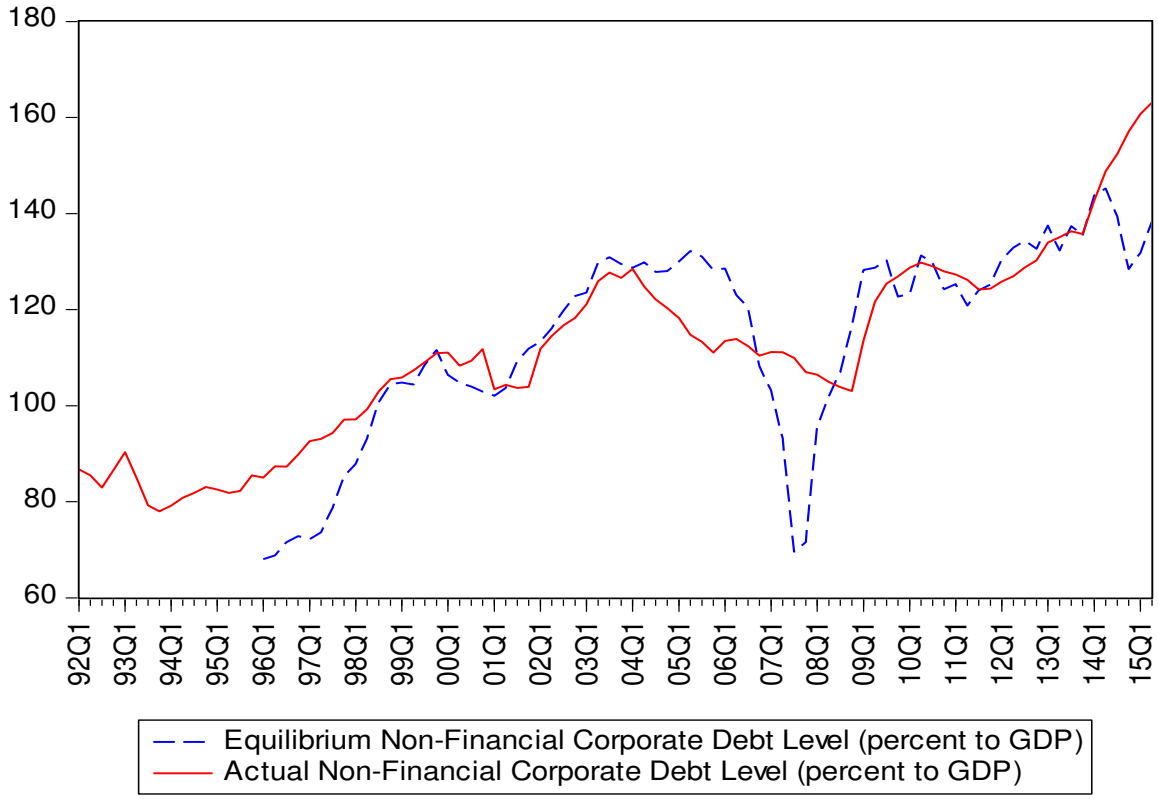


Figure 5 tells us that there are two periods in which the actual corporate debt level

exceeded the equilibrium debt level: the period of 1994q2-1998q4 and the period from 2013q4 onwards, implying two deleveraging processes over the sample period, respectively. The first deleveraging process had finished by the end of 1998, and the second one should have begun from the present (2015), on which is the focus of this study. At the standpoint of 2015q2, the gap between the actual leverage and the equilibrium level of China's corporate debt is approximately 25% (to GDP), which would lead to a large fall in the growth rate of GDP in the future in accordance with equation (2).

5. Effects of Macro Policies on Corporate Deleveraging

As we have discussed in the section 2, macroeconomic policies are the most important measures of deleveraging. In this section, we test the effects of alternative macroeconomic policies on China's non-financial corporate deleveraging and thereby provide the policy suggestions according to the empirical results.

We focus on the monetary policy and fiscal policy in this study. The inter-bank interest rate and the growth rates of M2 are chosen as the instruments of China's monetary policy. The respective instruments of China's fiscal policy are the growth rates of government expenditure and the growth rates of tax revenue. In addition, the CPI and the national saving rate are added to the variable set. All the variables for the VEC model in section 4 are also used in this section. The sample period remains same as in section 4 from 1992q1 to 2015q2.

Given the endogeneity of the chosen variables, we employ a VAR model to conduct our tests.

A representative VAR can be expressed as

$$BX_t = C(L)X_t + D(L)Z_t + \varepsilon_t \quad (3)$$

where X_t is a (m x 1) vector of endogenous variables, Z_t is an n vector of exogenous variables, B, C and D are matrices of the estimated coefficients, and L is a lag operator. The error term ε_t is a vector of innovations that are *I.I.D.*

Excluding the vector of exogenous variables, we obtain the reduced form of the VAR

$$X_t = A(L)X_t + \mu_t \quad (4)$$

where $A(L) = B^{-1}C(L) = A_1L + A_2L^2 + ... + A_iL^i$

where i is the number of lag or the order of the VAR.

Given

$$\mu_t = B^{-1}\varepsilon_t$$

Then, equation (4) yields a MA representation:

$$X_t = \frac{1}{[I - A(L)]}\mu_t = K(L)\mu_t \quad (5)$$

Equation (5) produces a structural form (an estimated VAR) which can provide the *impulse response functions* (hereafter IRF) for us to measure the effects of economic policies, and *variance decomposition functions* to trace the contributions of alternative shocks to economic fluctuations.

The lag choice for our VAR model follows the Schwarz Information Criterion (SIC), which suggests 2 lags for our quarterly data. Our estimated VAR model satisfies the mathematical stability, and passes the misspecification tests such as normal distribution, autocorrelation, ARCH and heteroscedasticity[7].

[7] The results of all diagnostic tests are reported in Appendix B.

5.1 Effects of Monetary Policy on Corporate Deleveraging

We examine the effects of monetary policy on corporate deleveraging by analysing the IRFs to the shocks from the growth rates of M2 and the interbank interest rate, which simulate an expansionary and a contractionary monetary policy operation, respectively.

Figures 6 and 7 show the effects of the shock from the growth rate of M2 and the shock from the interbank interest rate on the corporate deleveraging, respectively.

Figure 6 Effects of an Expansionary Monetary Shock (Innovation in Growth Rate of M2)

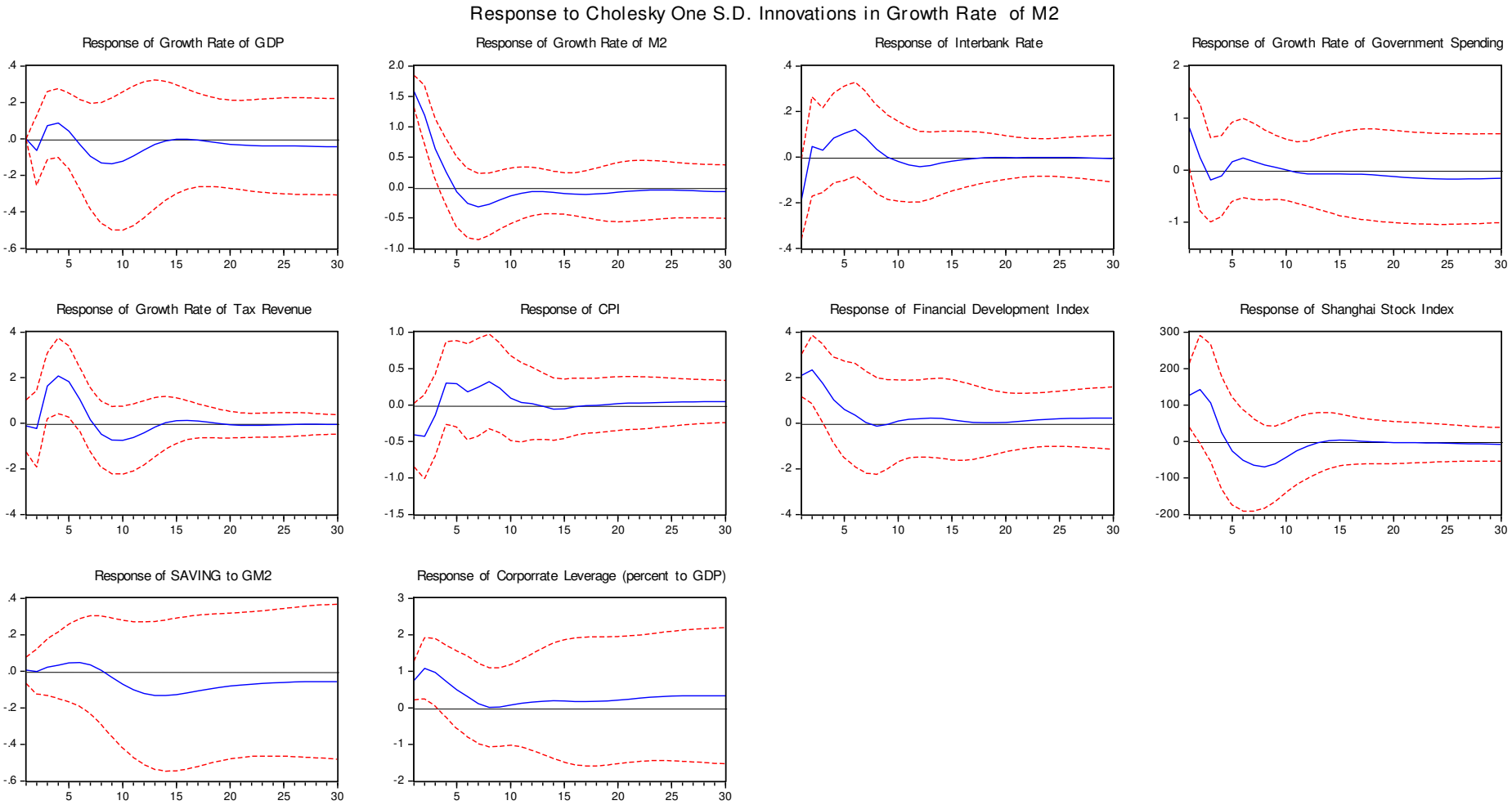
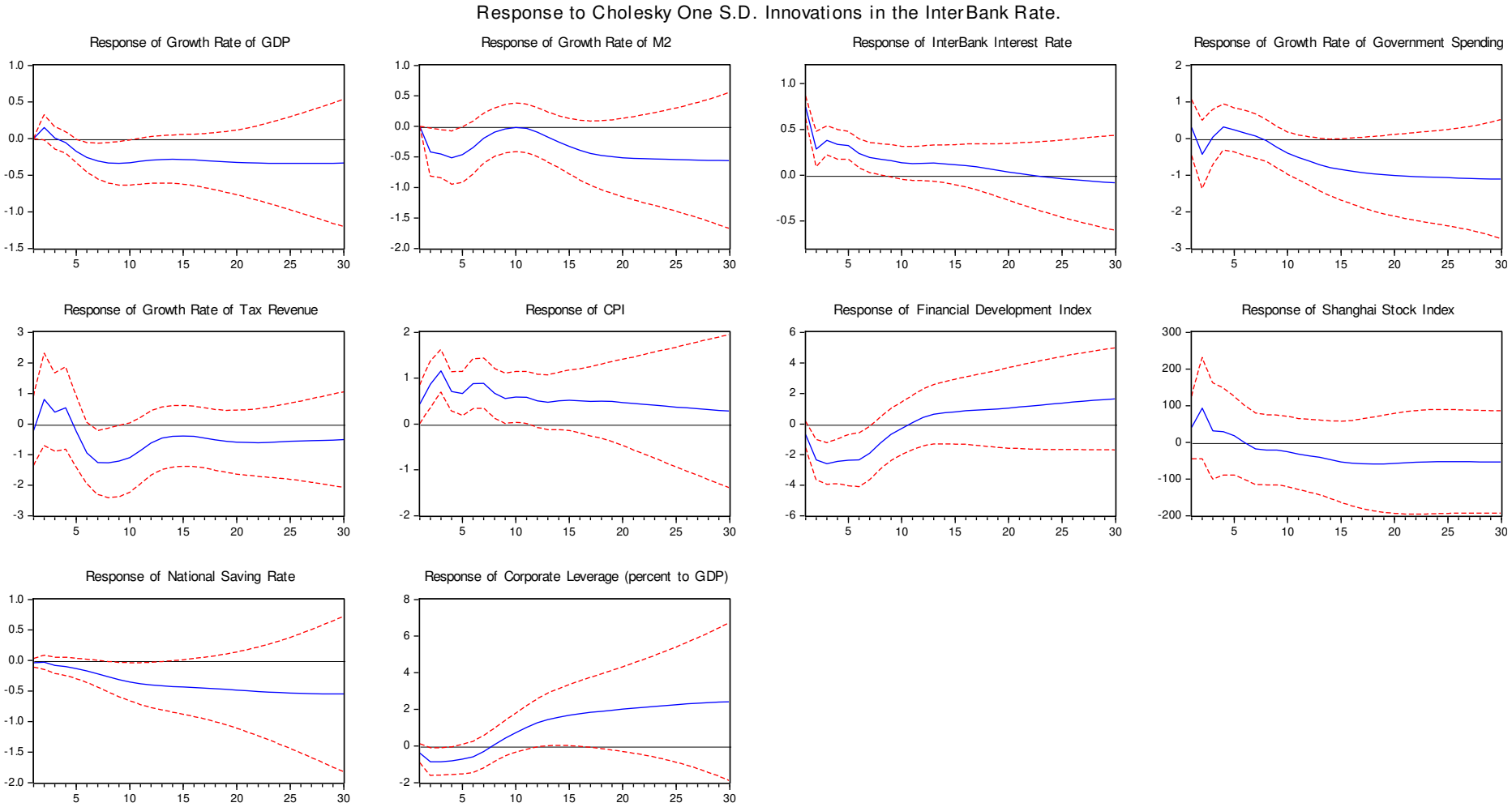


Figure 7 Effects of a Contractionary Monetary Policy Shock (Innovation in Interbank Rate)



In Figure 6, a one unit innovation in the growth rate of M2 increases the growth rate of M2 approximately 1.5%, which leads to an immediate fall in the interbank interest rate (approximately 2%), remarkable rises in the Shanghai stock index, the government spending and financial development index, and weak responses in the growth rate of GDP, CPI and the national saving rate, respectively. Most importantly, a positive monetary policy shock from the growth rate of M2 increases China's corporate leverage ratio approximately 1% immediately. This implies that the monetarization channel of corporate deleveraging does not work in China! Because the main transmission channel of China's monetary policy is the credit channel[8], given that the banking industry is dominated by the so-called state-owned "Big Four" commercial banks and most important and large firms are also state-owned, when the Central Bank of China (the People's Bank of China, hereafter the PBC) conducts an easy monetary policy, the loans are more easy available for these state owned firms, hence, the corporate leverage increases. This is a different story from that in most advanced economies, where the inflation effect (monetarizing the debtor's burden and redistributing the wealth) dominates and thereby the "ugly deleveraging" works.

Figure 7 shows that a positive shock to the interbank interest rate increases the interest rate approximately 0.8% (a contractionary monetary policy), which depresses the growth rate of GDP and the Shanghai stock index two quarters later, following by an immediate rise in these two indicators (hump shape). This contractionary monetary policy operation decreases the corporate leverage in the short-run (within 8 quarters),

[8] See, for example, Sun Lixin et al. (2010).

and then increases the corporate leverage in the medium term, implying an intertemporal trade-off between corporate deleveraging and leveraging.

5.2 Effects of Fiscal Policy on Corporate Deleveraging

Figures 8 and 9 depict the effects of a fiscal policy shock on China's corporate deleveraging.

A positive shock to the government spending increases the growth rate of government spending approximately 3.2%, thereby raising the growth rate of GDP immediately approximately 1.6%. The responses of other macro variables are weak, however, corporate leverage rises approximately 0.5% immediately, suggesting that a positive fiscal policy operation by expanding the government expenditure would lead to higher leverage in the corporate sector in China. This result justifies the explanations on why China's non-financial corporate sector accumulates one of the highest debt levels around the world: China had undertaken a huge fiscal stimulus package for weathering against the adverse spill over effects of the Global Financial Crisis. Therefore, an opposite direction operation in fiscal policy (contractionary fiscal policy) is expected to deleverage China's corporates (Figure 8).

The empirical results from Figure 9 support the policy implications from Figure 8: a negative fiscal policy by raising tax helps reduce the corporate leverage. An innovation in the growth rate of tax revenue increases the tax revenue and thereby depressing the growth rate of GDP. Approximately 5% rise in the growth rate of tax revenue leads to immediate fall (approximately 0.5%) in the corporate leverage (percent to GDP).

Figure 8 Effects of a Positive Fiscal Policy (Expanding Government Expenditure) Shock on Corporate Deleveraging

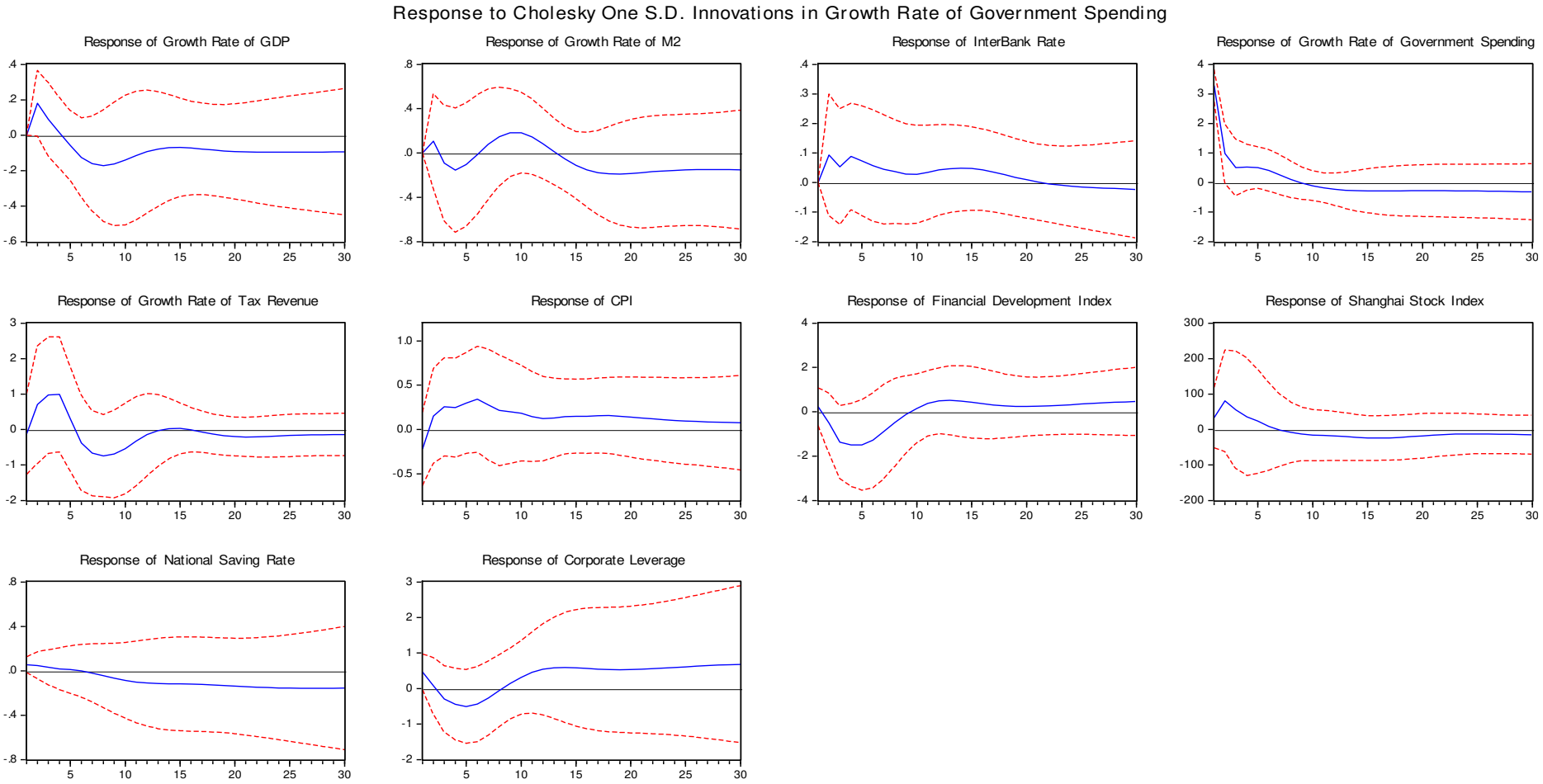
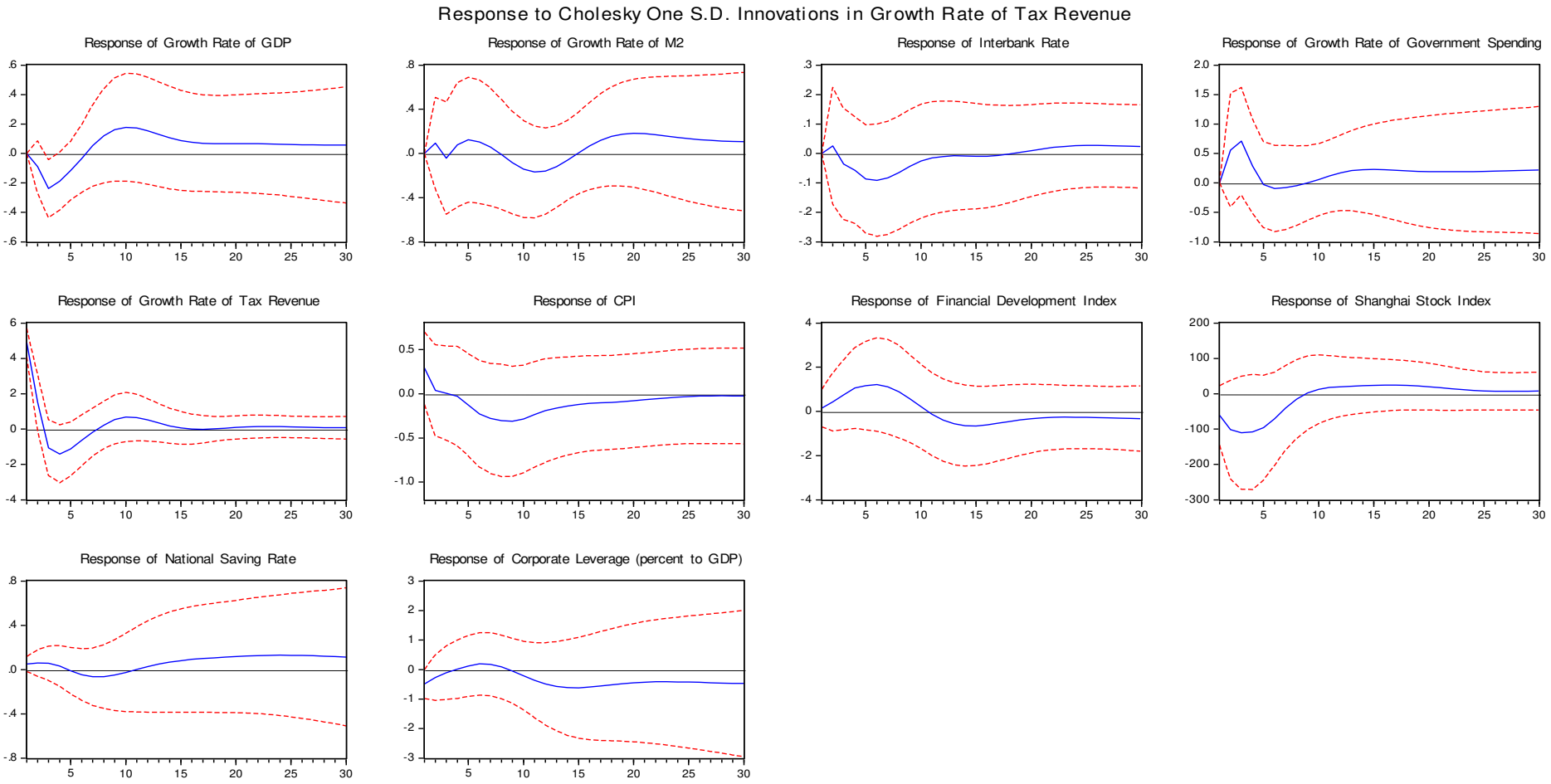


Figure 9 Effects of a Contractionary Fiscal Policy (Raising Tax) Shock on Corporate Deleveraging



6. Conclusions

Our study estimated the dynamic equilibrium debt level for non-financial corporates in China within a VEC model. The gap between the actual corporate debt-to-GDP ratio and the equilibrium debt level measures the magnitude of corporate deleveraging. Our estimation results suggest a reduction of 25% (of GDP) in corporate debt level, which would produce remarkable dragging effects on the growth rate of GDP in the future.

Given that China's corporate sector and banking industry are dominated by large state-owned firms and big state-owned commercial banks, respectively. The effects of macroeconomic policies on China's corporate deleveraging have different pass-through from that occurred in advanced economies. It is contractionary monetary policy and fiscal policy that help reduce the leverage in China's corporate sector. This is also because the increasing accumulation of debt in the corporate sector in recent years was driven by the monetary and fiscal stimulus package taken by China's government to tackle with the spill over effects of the Global Financial Crisis. Thus, opposite macroeconomic policy stances, that is, the contractionary macroeconomic policies are suitable for current corporate deleveraging.

It is unknown that our unique findings in the effects of macroeconomic policies on corporate deleveraging source from China's unique economic structure or from the unique accumulation mechanism for current corporate debt. Our further research will focus on this issue.

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Appendix A

Table 1 Augmented Dickey Fuller Tests on Unit Roots for all variables

No	Variables	Level	First Difference	Integration Order I( )
1	Growth Rate of GDP	-1.7844	-8.5581*	1
2	Growth rate of M2	-2.2468	-8.4086*	1
3	Inter-Bank Interest rate	-3.0228	-11.669*	1
4	CPI	-2.1570	-2.0115	>1
5	Financial Development Index ((total loans + total deposits)/GDP)	-0.2975	-4.0892*	1
6	Shanghai Stock Market Index	-1.454	-5.888*	1
7	Corporate Debt Level (corporate debt-to-GDP ratio)	1.2167	-7.005	1
8	National Saving Rate	-0.8857	-3.7629*	1
9	Growth Rate of Government Spending	-4.1847*		0
10	Growth Rate of Tax Revenue	-4.2884*		0
	1% Critical Value*	-3.502238	-3.502238	
	5% Critical Value**	-2.892879	-2.892879	
	10% Critical Value***	-2.583553	-2.583553	

Table 2 Philips-Perron Tests on Unit Roots for CPI

No	Variables	Level	First Difference	Order I( )
1	CPI	-2.0742	-9.869*	1
	1% Critical Value*	-3.502238	-3.502238	
	5% Critical Value**	-2.892879	-2.892879	
	10% Critical Value***	-2.583553	-2.583553	

Table 3 Results of Cointegration Tests.

Sample (adjusted): 1997Q1 2015Q2
Included observations: 74 after adjustments
Trend assumption: Linear deterministic trend
Series: GGDP IR FINDEX SSINDEX RCOPORDEBTGDP
Lags interval (in first differences): 1 to 3
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.402683	75.82958	69.81889	0.0153
At most 1	0.215382	37.69686	47.85613	0.3154
At most 2	0.142653	19.74758	29.79707	0.4401
At most 3	0.105205	8.358089	15.49471	0.4279
At most 4	0.001785	0.132227	3.841466	0.7161

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.402683	38.13272	33.87687	0.0146
At most 1	0.215382	17.94928	27.58434	0.4994
At most 2	0.142653	11.38949	21.13162	0.6084
At most 3	0.105205	8.225862	14.26460	0.3562
At most 4	0.001785	0.132227	3.841466	0.7161

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4 Cointegrating Equation and the Error Correction Equations

Vector Error Correction Estimates
Sample (adjusted): 1997Q1 2015Q2
Included observations: 74 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,5)=1
Convergence achieved after 1 iterations.
Restrictions identify all cointegrating vectors

Cointegrating Eq:	CointEq1
GGDP(-1)	1.180371
	(1.02745)
	[1.14883]
IR(-1)	2.357810
	(0.73712)
	[3.19867]
FINDEX(-1)	-0.468351
	(0.05814)
	[-8.05529]
SSINDEX(-1)	0.011190
	(0.00242)
	[4.63333]
RCOPORDEBTGDP(-1)	1.000000
C	-38.64839

Error Correction:	D(GGDP)	D(IR)	D(FINDEX)	D(SSINDEX)	D(RCOPORDEBTGDP)
CointEq1	-0.040319	-0.036572	-0.010124	-13.58470	-0.043549
	(0.01039)	(0.01352)	(0.08226)	(5.94062)	(0.04051)
	[-3.88148]	[-2.70457]	[-0.12307]	[-2.28675]	[-1.07498]
D(GGDP(-1))	-0.035595	0.182840	-0.985775	-46.89014	-0.497792
	(0.10808)	(0.14070)	(0.85589)	(61.8103)	(0.42151)
	[-0.32934]	[1.29954]	[-1.15175]	[-0.75861]	[-1.18097]
D(GGDP(-2))	-0.039585	0.008678	-0.276067	103.1247	-0.377677
	(0.10835)	(0.14105)	(0.85806)	(61.9668)	(0.42258)
	[-0.36533]	[0.06152]	[-0.32173]	[1.66419]	[-0.89375]
D(GGDP(-3))	-0.190724	0.062990	-0.094961	-70.83227	-0.042261

	(0.10450)	(0.13603)	(0.82754)	(59.7625)	(0.40754)
	[-1.82514]	[0.46305]	[-0.11475]	[-1.18523]	[-0.10370]
D(IR(-1))	0.231367	-0.287157	-1.399503	35.69259	-0.672655
	(0.10447)	(0.13599)	(0.82729)	(59.7445)	(0.40742)
	[2.21473]	[-2.11154]	[-1.69168]	[0.59742]	[-1.65100]
D(IR(-2))	-0.025008	0.169263	-0.631050	-53.03450	-0.660814
	(0.10667)	(0.13886)	(0.84473)	(61.0043)	(0.41601)
	[-0.23445]	[1.21894]	[-0.74704]	[-0.86936]	[-1.58845]
D(IR(-3))	-0.162503	0.064181	0.650750	-49.16541	0.282590
	(0.11120)	(0.14475)	(0.88058)	(63.5929)	(0.43367)
	[-1.46141]	[0.44338]	[0.73900]	[-0.77313]	[0.65163]
D(FINDEX(-1))	0.001643	-0.022792	0.268668	-11.71731	-0.028176
	(0.02236)	(0.02911)	(0.17706)	(12.7868)	(0.08720)
	[0.07349]	[-0.78306]	[1.51738]	[-0.91636]	[-0.32313]
D(FINDEX(-2))	-0.021775	-0.028425	-0.458232	-11.09347	-0.048268
	(0.02533)	(0.03298)	(0.20061)	(14.4878)	(0.09880)
	[-0.85955]	[-0.86193]	[-2.28414]	[-0.76571]	[-0.48855]
D(FINDEX(-3))	0.034289	-0.050741	0.068156	-4.284061	-0.028915
	(0.02613)	(0.03402)	(0.20693)	(14.9441)	(0.10191)
	[1.31219]	[-1.49165]	[0.32936]	[-0.28667]	[-0.28373]
D(SSINDEX(-1))	0.000950	4.48E-05	-0.000895	0.552691	-9.52E-05
	(0.00024)	(0.00031)	(0.00187)	(0.13470)	(0.00092)
	[4.03263]	[0.14608]	[-0.47979]	[4.10306]	[-0.10359]
D(SSINDEX(-2))	-0.000259	0.000193	0.000529	-0.225683	0.000247
	(0.00025)	(0.00033)	(0.00200)	(0.14465)	(0.00099)
	[-1.02251]	[0.58598]	[0.26433]	[-1.56019]	[0.25082]
D(SSINDEX(-3))	0.000998	0.000692	-0.003318	0.250646	-0.000978
	(0.00026)	(0.00033)	(0.00203)	(0.14629)	(0.00100)
	[3.89963]	[2.07835]	[-1.63784]	[1.71333]	[-0.98066]
D(RCOPORDEBTGDP(-1))	0.025916	0.105075	0.207682	15.08017	0.288891
	(0.04331)	(0.05637)	(0.34294)	(24.7665)	(0.16889)
	[0.59845]	[1.86386]	[0.60559]	[0.60890]	[1.71051]
D(RCOPORDEBTGDP(-2))	0.038081	0.040734	0.537662	45.83166	0.159484

	(0.04577)	(0.05958)	(0.36245)	(26.1748)	(0.17850)
	[0.83203]	[0.68368]	[1.48343]	[1.75098]	[0.89349]
D(RCOPORDEBTGDP(-3))	-0.007170	0.030091	0.281303	0.583638	0.316874
	(0.04797)	(0.06244)	(0.37987)	(27.4329)	(0.18708)
	[-0.14947]	[0.48189]	[0.74053]	[0.02128]	[1.69383]
C	-0.186778	-0.131434	1.266273	7.723060	0.334440
	(0.09115)	(0.11866)	(0.72183)	(52.1284)	(0.35548)
	[-2.04913]	[-1.10768]	[1.75426]	[0.14815]	[0.94080]
R-squared	0.508052	0.306749	0.372823	0.357399	0.357419
Adj. R-squared	0.369961	0.112152	0.196773	0.177020	0.177045
Sum sq. resids	26.44481	44.81462	1658.420	8649234.	402.2254
S.E. equation	0.681134	0.886691	5.393985	389.5394	2.656424
F-statistic	3.679120	1.576329	2.117713	1.981378	1.981544
Log likelihood	-66.92826	-86.44481	-220.0550	-536.7514	-167.6405
Akaike AIC	2.268331	2.795806	6.406892	14.96625	4.990284
Schwarz SC	2.797644	3.325118	6.936204	15.49557	5.519596
Mean dependent	-0.039624	-0.136351	2.172998	45.40816	0.991589
S.D. dependent	0.858122	0.941029	6.018533	429.3948	2.928257

Appendix B Diagnostic Tests for VAR model

Table 5 Mathematical Stability Tests:

Roots of Characteristic Polynomial
Endogenous variables: GGDP GM2 IR GGOVERN GTR CPI2000 FINDEX SSINDEX SAVING RCOPORDEBTGDP
Exogenous variables: C T
Lag specification: 1 2

Root	Modulus
0.974715 + 0.029458i	0.975160
0.974715 - 0.029458i	0.975160
0.874157 + 0.190873i	0.894753
0.874157 - 0.190873i	0.894753
0.817438 - 0.252113i	0.855433
0.817438 + 0.252113i	0.855433
0.701229 - 0.401512i	0.808043
0.701229 + 0.401512i	0.808043
0.024250 - 0.783853i	0.784228
0.024250 + 0.783853i	0.784228
0.184287 + 0.490836i	0.524291
0.184287 - 0.490836i	0.524291
-0.424485	0.424485
0.413533 + 0.043019i	0.415765
0.413533 - 0.043019i	0.415765
-0.221882 + 0.315248i	0.385504
-0.221882 - 0.315248i	0.385504
-0.107667	0.107667
0.019505 + 0.105022i	0.106818
0.019505 - 0.105022i	0.106818

No root lies outside the unit circle.
VAR satisfies the stability condition.