China's Debt: Structure, Determinants and Sustainability

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Abstract: In this paper, we analyse the evolution of China's debt structure in terms of a new comprehensive debt dataset and then identify the determinants of China's debt structure using stepwise multivariate regression; furthermore, employing a fiscal space framework and DSR approach, we assess the sustainability of China's domestic and external debt. The empirical results suggest that first, China's GDP growth rate, the borrowing costs and the financial markets' development are key common determining factors for China's debt structure; second, the highly indebted local governments and non-financial corporations could lead to potential risks for China's financial stability. Nevertheless, China's debt by sector is sound and sustainable in the near and medium term.

Keywords: Debt Structure; Debt Sustainability; Public and Private Debt; China's Economy

JEL Code: H63, H74, E62

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1. Introduction

The global financial crisis of 2008 and the European sovereign debt crisis have ignited growing research interest in the credit bubble and debt problem worldwide. Against this backdrop, China's debt problem has also attracted considerable concern, inasmuch as China's economic stimulus package implemented for weathering the global financial crisis has significantly expanded the leverage, particularly in the local government sector and the private sector. However, empirical studies on China's debt issues have been constrained by the lack of a detailed debt database covering long series and wide categories. In this paper, first, we collect debt data for China from all possible sources to construct a comprehensive debt dataset for China. Our debt dataset covers nearly all debt categories and spans the longest time periods until now. Second, we analyse the evolution of the debt structure in China since 1985. Third, we seek to examine various determinants of the debt structure and uncover their policy implications. Finally, we investigate the sustainability of China's debt in every sector in terms of international standards and various approaches.

Our main contributions are that our debt dataset for China tracks the development of all categories of China's debt, including public debt, non-financial private debt and financial debt domestically, and the external debt to the rest of the world. Based on this debt data set, we have introduced a set of indicators to describe and explain China's debt structure and its evolution from multiple perspectives. Employing stepwise multivariate

regression, we have identified certain important macroeconomic and policy factors, financial factors, institutional factors, and international factors that are the main determinants of China's debt structure and its evolution. We have estimated the long-run and the maximum sustainable debt levels of China's public debt and evaluated the sustainability of public debt in China within a fiscal space framework. Using the debt service ratio approach, we have assessed the sustainability of China's non-financial private debt. The sustainability of the financial sector debt and the external debt have also been analysed using universal approaches. Our empirical results suggest that China's domestic debt (except the non-financial firm sector) and external debt are sound and sustainable in the near and medium term. Nevertheless, policymakers and regulators should focus more on the highly indebted local governments, non-financial firms and shadow banks.

The remainder of the paper is structured as follows. Section 2 discusses the literature. Section 3 describes China's debt data in details. Section 4 analyses the debt structure in China. Section 5 studies the determinants and implications of the debt structure. Section 6 examines the sustainability of all sorts of debt in China. Section 7 provides the remarks and the conclusion.

2. Literature Review

Historically, economic and financial crises are closely connected with excess indebtedness and the defaults of the public and private sectors. Excess indebtedness often triggers a debt crisis, currency crisis and financial distress on the one hand; the bailouts of government on the financial sector during the crisis and the expanding expenditures of the government for enhancing the aggregate demand after the crisis increase the public debt level on the other

hand. Therefore, a sustainable debt level is a key factor for preventing financial distress and promoting stable economic growth. As the international regulator of the financial markets, IMF has compiled and published many guidelines and papers on the assessments of public debt sustainability for advanced countries, emerging countries and low income countries (IMF(2002), IMF (2003a,b), IMF(2010), IMF(2011), IMF (2013). Notably, a handbook by Burnside (2005) provides many useful approaches and instruments for fiscal sustainability analysis. Ostry et al. (2010) and Ghosh et al. (2011) developed a "fiscal space" framework for conducting public debt sustainability analysis by using estimated fiscal response functions and the concepts of a long-run debt level and a maximum sustainable debt level. In addition, in accordance with the framework of fiscal space, IMF (2011) has provided a range of 49 to 58% for the long-run debt level and 63 to 78% for the maximum sustainable debt level by re-estimating public debt thresholds for a sample of Emerging Markets (EM) for the 1993–2009 period. Although no standard approach exists for assessing the private debt sustainability, the destabilising effects of excessive indebtedness build-ups in the private sector have been recognized in theory and practice (for example, the debt-deflation hypothesis by Fisher (1932); and the recent study by Clemons and Vague (2012)). Literature regarding China's debt sustainability analysis is scarce, except that the sustainability of local government debt in China has recently attracted much attention (Zhang et al. (2014), Lu and Sun (2013)).

Debt structure and its evolution play important roles in debt sustainability analysis. However, there have been very few research studies conducted on the evolution of domestic government debt and domestic private debt in emerging markets. Missale (1999)

conducted a comprehensive study of the structure of domestic government debt in OECD countries. Cowan et al. (2006) examined the evolution of sovereign debt in the Americas. Claessens, et al. (2003) studied the role of institutional and macroeconomic factors in explaining the currency composition of government bonds. Guscina (2008) employed the new Jeanne-Guscina EM Debt Database 2006 to analyse the evolution of sovereign debt structure in emerging market countries, where certain important determinants of sovereign debt structures are identified for emerging markets. The prior literature on the structure of external debt in emerging markets primarily focused on two aspects: the maturity structure (Blanchard and Missale (1994), Rodrik and Velasco (1999)) and the currency composition (Eichengreen and Hausmann (1999), and Eichengreen, Hausmann, and Panizza (2003)). Most prior studies did not cover China, except the cross-country panel analysis by Gusina (2008), which did not reach far back in time and provided minimal information that exclusively involved China's debt structure. Motivated by this, we conduct a detailed investigation on China's debt structure, determinants and its sustainability in this paper.

3. China's Debt Dataset

Due to the limitation and incompleteness of data released by China's authorities, we exert considerable efforts to collect China's debt data from every possible source including official publications and individual literature. We combine a number of other datasets and information from original sources. These include the databases from IMF, BIS, World Bank, China's Statistical Authorities, regarding academic papers, and consultant reports. Therefore, we must extend certain data by statistical technique to complete the dataset.

The first part of our data set focuses on the public debt at the general government

level, which consists of the central government and local governments. The central government debt data (domestic and external) after 2005 were compiled from the official publication by the National Bureau of Statistics of the People's Republic of China (NBSC hereafter), and IMF's historical public debt database. The data prior to 2005 for the central government debt were collected from Lin (2010). The local government debt data were compiled from several sources: the recent data for the 2010-2013 period are linked to the Audit Findings on China's Local Governmental Debts (2010) and the Audit Findings on China's Local Governmental Debts (2013) by National Audit Office of the People's Republic China (hereafter NAOC); the data between 2000 and 2009 were available from Goodstadt (2014); the data for 1999 were estimated by the author; and the data for the 1996-1998 period were not available until now. Prior to 1996, because China's central government and local government shared the mutual tax revenue, the debt data were consolidated, and the central government debt level is taken as the general government debt level.

The second part of our data set involves the debt in the non-financial private sector, which is composed of household debt and non-financial corporate debt. The total private non-financial sector debt data were collected from the Bank for International Settlement database (hereafter BIS, 2013), titled as the "Long series on total credit and domestic bank credit to the private nonfinancial sector" database. In addition to BIS (2013), other databases were employed for collecting household debt and non-financial corporate debt, for example, Clemons and Vague (2012) for the period after 2004 and He et al. (2012) for the 1999-2004 period. The household debt data for the 1986-1998 period were estimated

by the difference between the total non-financial private debt and the non-financial corporate debt. The non-financial corporate debt data for the 1985-1998 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).

The third part of our dataset concentrates on financial sector debt. In accordance with the definition by MGI (Mckinsey Global Institute, 2015), the financial sector debt covers the commercial papers, loans and bonds issued by banks and other parts of the financial sector, excluding the interbank borrowings. The data source is China's CEInet Statistics Database (hereafter CEIN).

The fourth part of our data set provides data regarding China's international debt, which is composed of central government external debt, private non-financial sector external debt and financial sector external debt. We collected the data from the database of China's State Administration of Foreign Exchange, the Global Financial Development Database (hereafter GFDD) of the World Bank, and the database of NSBC.

4. Styled Facts about the Structure of China's Debt

Prior to the global financial crisis of 2008, researchers mainly focused on international debt problems because most currency crises during the last century resulted from the defaults of the lower income and developing countries in the international debt markets. The international financial crisis and the European sovereign debt crisis have turned the focus towards domestic public debt and private debt. In addition, certain economists stressed that certain major financial crises are preceded by a run up in private debt, rather

than in public debt[2]. Because the debt level and the debt structure (shares) have significant implications for both economic stability and financial stability, in this section, using our new China's debt dataset, we describe and summarize the size and structure of China's debt in terms of borrowers, maturity and currency.

The shares of China's aggregate debt level in 2007 and 2013 are summarised in Figure 1, which indicates that the debt shares changed minimally from 2007 to 2013 except for those of the financial sector and of the shadow banks; the latter increased dramatically and ignited concerns recently. Most importantly, China's total debt is dominated by the domestic debt from 1985 to 2013; the external debt represents less than 5% for the same period with a downward trend.

Figure 1 Shares of China's debt at the end of 2007 and 2013
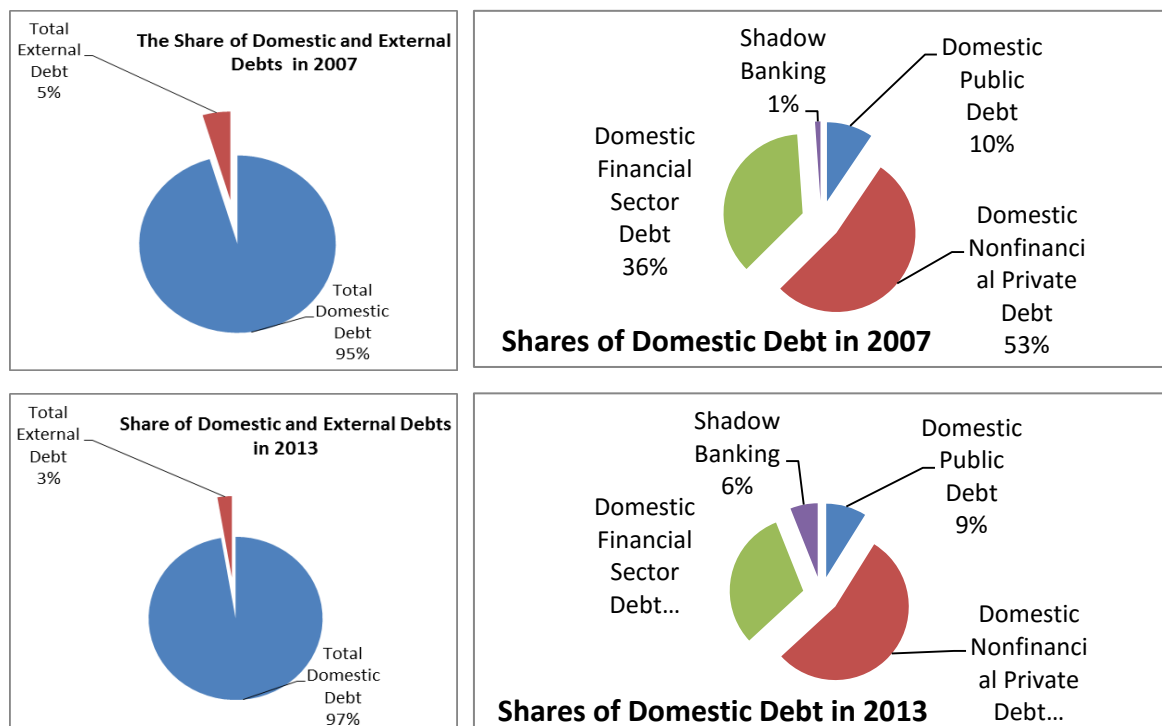
Source: Author's Dataset

China's aggregate debt level was not significant until the midterm of 2008. At 143.88% of GDP and 242.33% of GDP, respectively, in 2007, the domestic non-financial debt and the total debt (including the financial sector and the external sector) are lower than that in most emerging markets and developed economies[3]. Since then, both have increased dramatically. The two ratios had attained 215.38% and 337.65%, respectively, by the end of 2013 (Figure 3), with an annual average growth rate of approximately 12%, which is higher than most other important economies. Figure 2 depicts the aggregate debt by sector from 1985 to 2013. Figure 3 exhibits the change in the ratios of debt to nominal GDP (hereafter NGDP) by sector from 1985 to 2013.

Figure 2 China's debt by sector (Unit: 100 Million RMB Yuan)
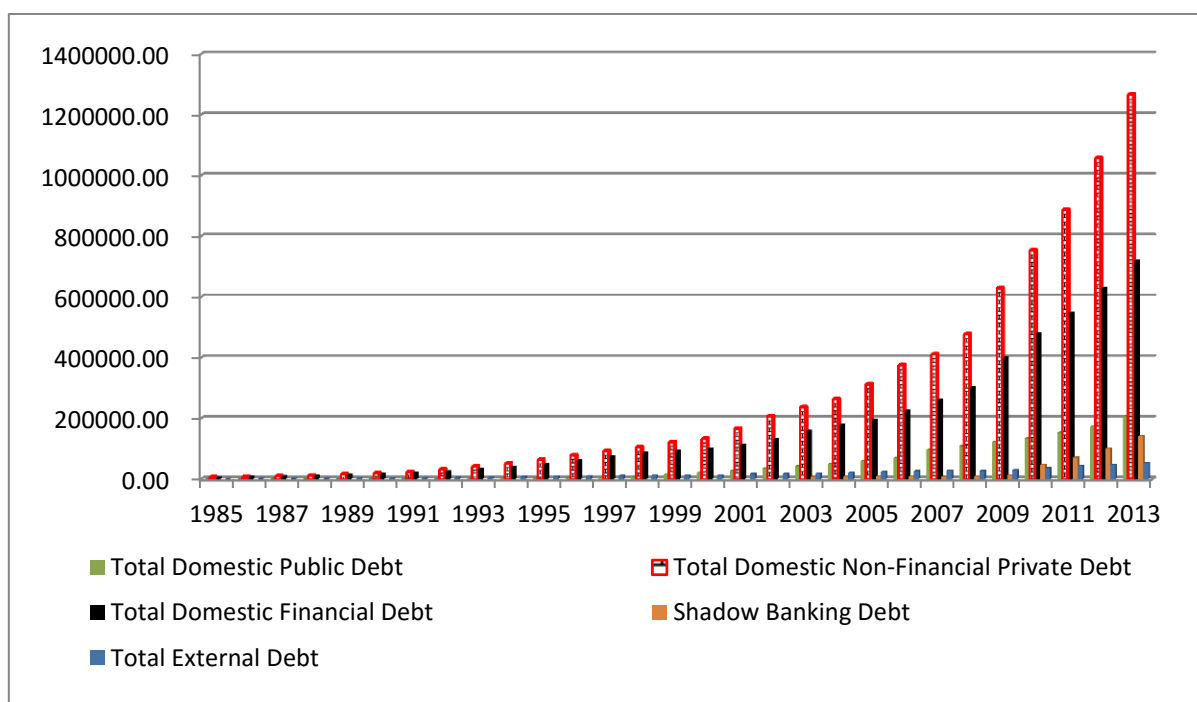
Source: Author's Dataset

In Figure 3, the public debt-to-GDP ratio and the external debt-to-NGDP ratio were relatively lower and flatter over the sample period, whereas the non-financial private

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[3], Refer to, for example, the MGI Report (2015) on the ratios of overall debt to nominal GDP across countries.

debt-to -NGDP ratio and the financial sector debt-to-NGDP ratio were relatively higher and steeper over the same period. Moreover, the two latter ratios have been rising at accelerated rates since 1985.

Figure 3 Evolutions in ratios of debt to nominal GDP (percentage) by sector
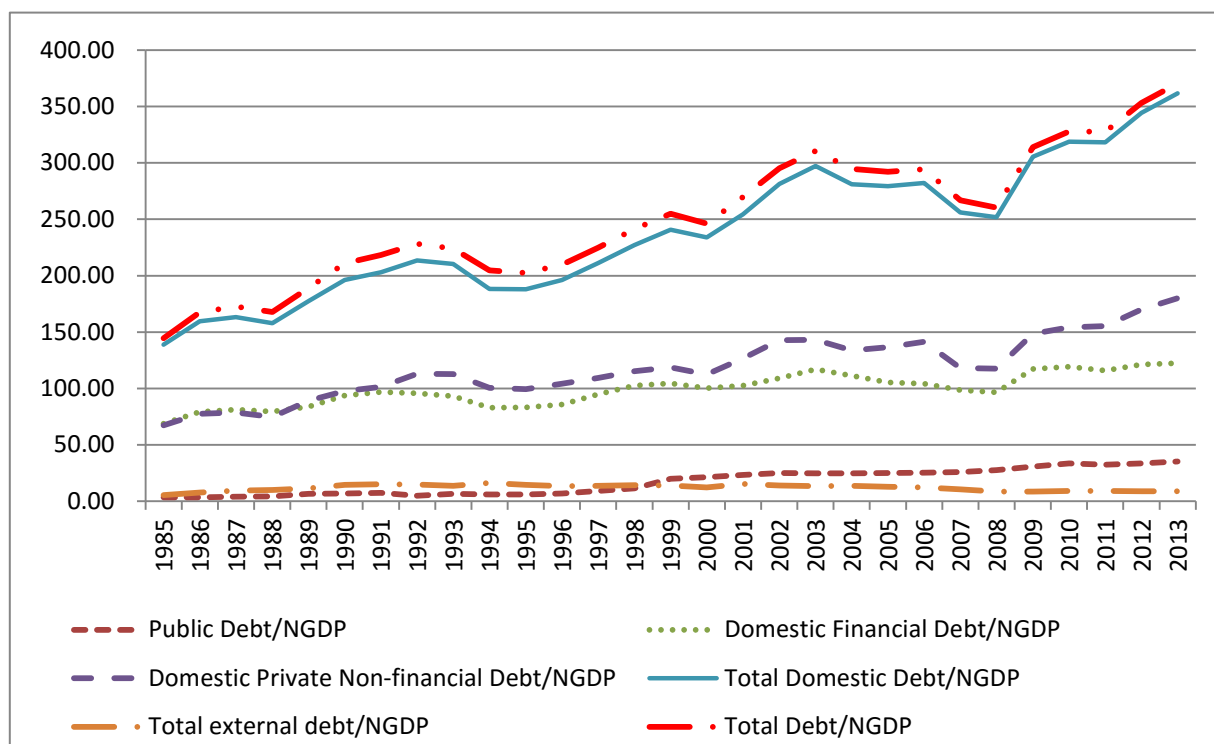
Source: Author's Dataset

China's aggregate debt contains public debt, non-financial private debt, financial sector debt (including shadow banking debt) and international debt by sector. In the following, we provide a detailed description on the structures of China's debt.

China's public debt includes central government debt and local government debt. These debt sources are combined as the general government debt according to the definition by IMF. Figure 4 depicts the evolution of central government debt and local government debt from 1985 to 2013. At the end of 2013, China's public debt attained 8674.69 billion yuan at the central government level and 12143.65 billion yuan at the local government level. The central government debt in 2013 is 1.67 times the level in 2007 and

283.3 times the level in 1985, growing annually at an average growth rate of 30.33%. The local government debt has soared since 2007 and grown annually at an average growth rate of approximately 45% since 1997! Since 2009, the local government debt level has exceeded the central government debt level. The rapid increase in local government debt has recently led to more attention from the inside and outside.   The evolutions in the ratios of government debt to nominal GDP and to the fiscal revenues are shown in Figure 5 in which we find that both the ratio of public debt to national fiscal revenue and the ratio of central government debt to central fiscal revenue nearly remain above 150% since 1999. This implies a potential risk for financial stability in China. In addition, the ratio of local government debt to local fiscal revenue has exceeded 150% since the global financial crisis of 2008. This finding could result in loan defaults at local government level. Nevertheless, given the 35.4% of nominal GDP, China's public debt remains low by international standards[4]. Notably, in Figure 5, the dramatic decrease in the ratio of the public debt level to the central government revenue from 1993 to 1994 is due to the remarkable increase in the central government revenue in1994, which is the consequence of the reform in the tax system in 1993. Prior to 1993, the general government tax revenue was shared by the central government and the local government. Since 1993, the tax distribution reform was implemented, and the central government and the local government have collected tax revenues separately. The new tax assignment system quadrupled the central government fiscal revenue in 1994 compared with that in 1993 and reduced the local fiscal revenue by approximately 25% in 1994.

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[4] The average ratio of public debt in OECD countries is above 100% in the same year.

Figure 4 Central government debt and local government debt

(Unit: 100 million yuan RMB)
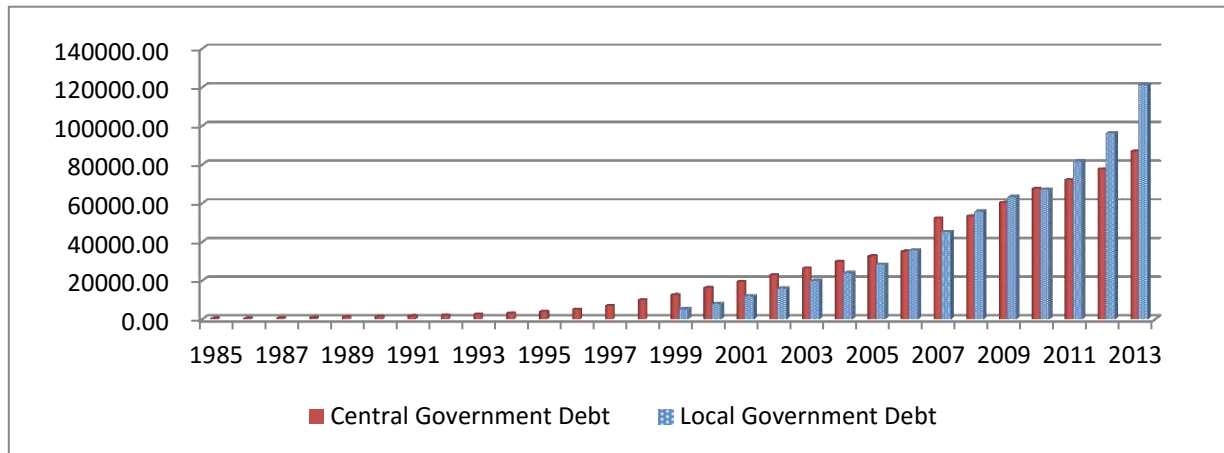
Source: Author's Dataset

Figure 5 Changes in Ratios of public debts to GDP and fiscal revenues (percentage)
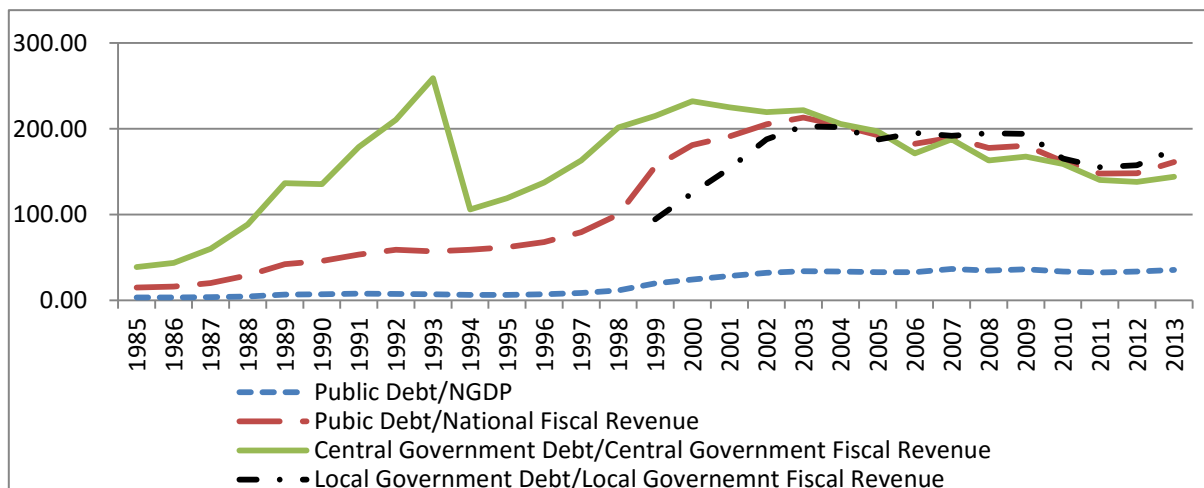
Source: Author's Dataset

The ratios of local debt to local GDP and to local fiscal revenue by region in June 2013 are plotted in Figure 6, which indicates that nearly all of the ratios of local debt to local GDP are lower than 50%, except that of Guizhu province (57.16%). Note that the ratio of local debt to local fiscal revenue is significantly high in many provinces, particularly for Qinghai (332.72%), Hainan (218.33%), Guizhou (383.17%), Yunnan (237.32%), Ganshu (201.08%), Hubei (235.07%), Jilin (223.08%), Chongqing (211.14%), and Tianjin (249.84%).

These provinces with the ratio of debt to fiscal revenue greater than 200% would be accorded more concerns by the regulators. Given that China's local government revenues heavily rely on land sales and extensively use off-balance sheet local government financial platforms (LGFPs: Local government financing platforms)[5], which are unstable and unsustainable, local governments should transform their fiscal models and seek more reliable revenue sources to reduce debt accumulations and repayment burdens.

Figure 6 Debt/GDP and debt/fiscal revenues ratios by region, June 2013
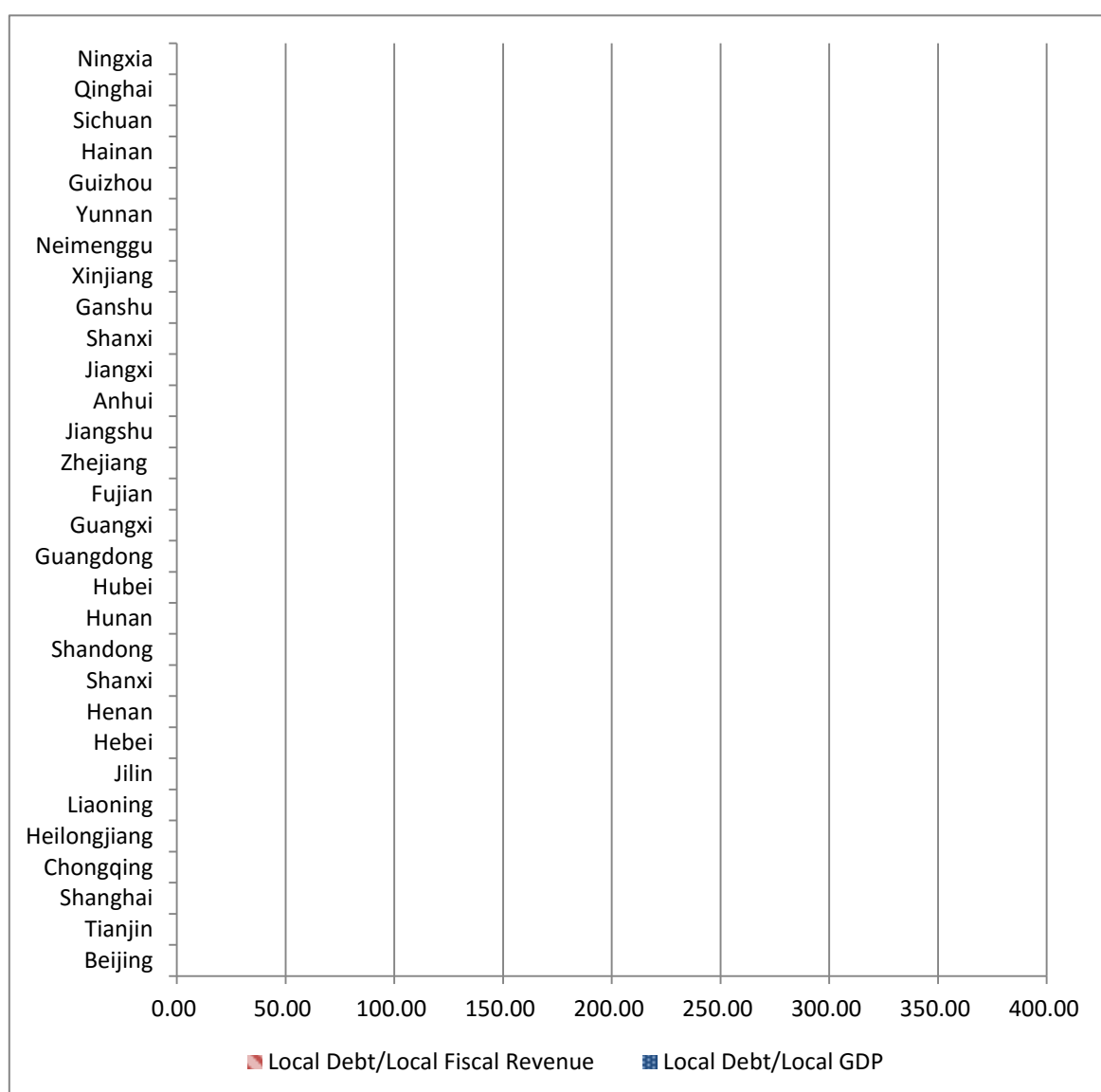
Source: Author's Dataset

[5] Refer to, for example, the research conclusions from the MGI Report (2015), Wu (2014).

China's non-financial private debt, consisting of household debt and non-financial corporate debt, has remained on an uptrend since the 1990s. Household debt has increased approximately 148 times since 1985 and nearly quadrupled from 2007 to 2013, rising from 133.45 billion yuan in 1985 to 19850 billion yuan in 2013. Non-financial corporate debt has increased nearly 167 times since 1985 and nearly tripled from 2007 to 2013, rising from 474.68 billion yuan in 1985 to 79646 billion yuan in 2013 (Figure 7).

Figure 7 Household debt, non-financial corporate debt (Unit, 100 Million Yuan)
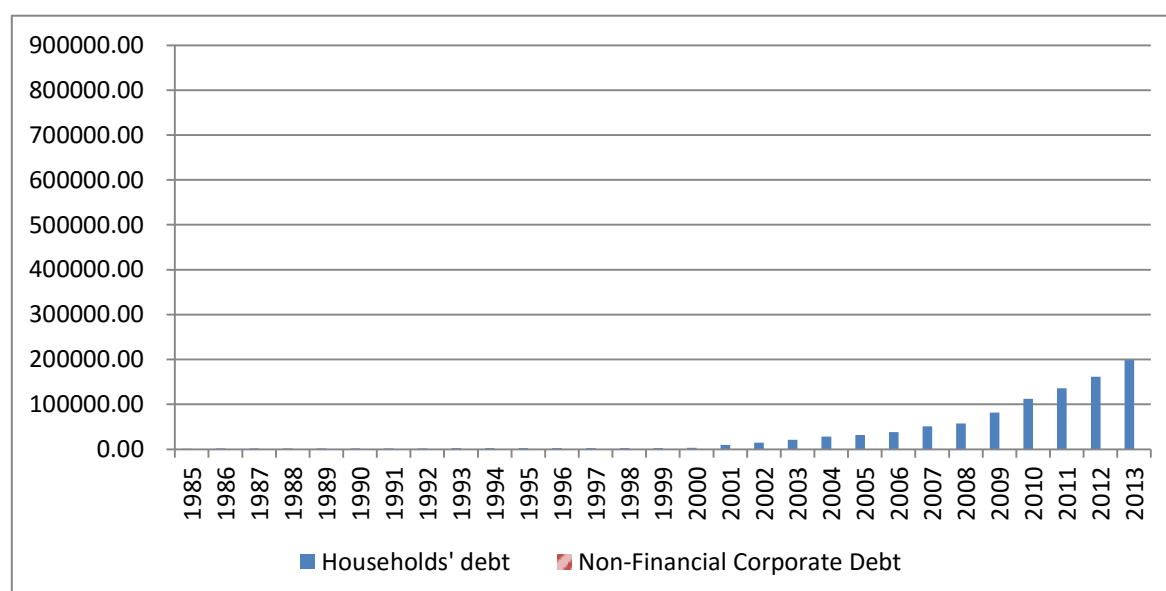
Figure 8 presents the changes in the ratios of household debt to disposable income, and of non-financial corporate debt to non-financial corporate annual revenue and of total non-financial private debt to nominal GDP. The non-financial private debt-to-NGDP ratio had tripled by the end of 2013, attaining 180% of NGDP. Driven by the increase in mortgage volumes, the ratio of household debt to household disposable income rose from 26.34% in 1985 to 78.43% in 2013. The leverage in the corporate sector has increased steadily since 1999, rising from 50% (to GDP) in 1985 to 140% in 2013, which is one of

the highest levels of corporate debt in the world.

Figure 8 Evolutions in ratios of non-financial private debt to income (percentage)
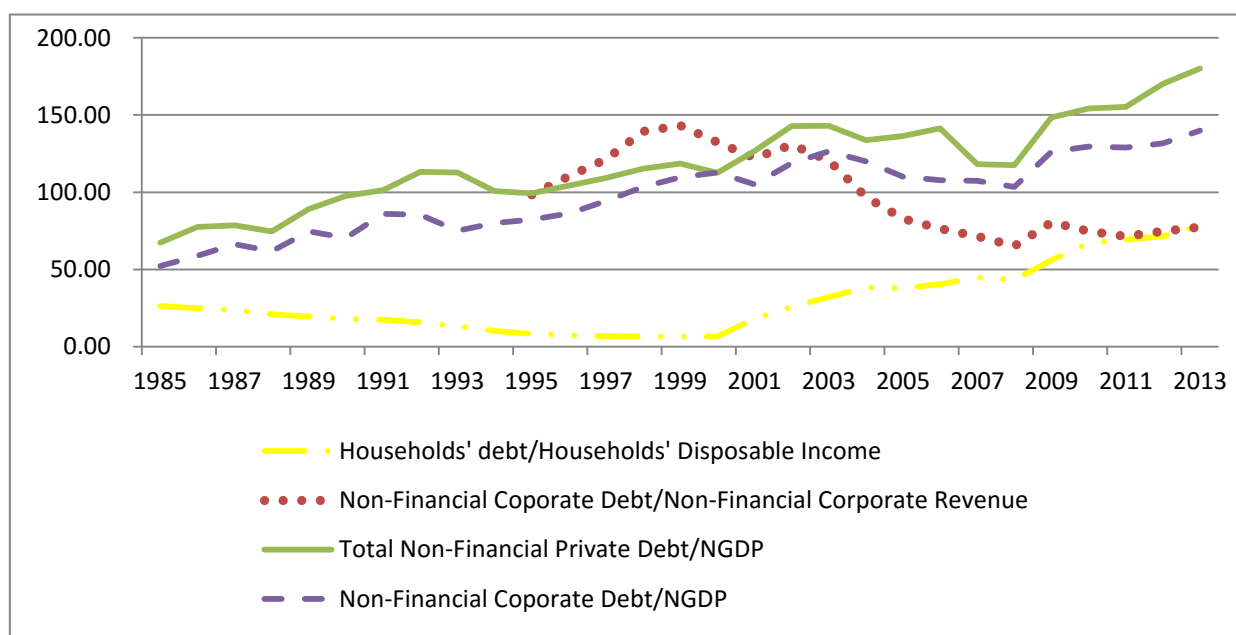
In accordance with the definition of MGI (2015), China's financial sector debt was calculated by combining loans, commercial paper, and banking bonds. Although the banking industry dominates the financial sector, certain non-bank lending institutions, the so-called shadow banks, have grown rapidly since the onset of the 21st century. The financial sector (excluding shadow banks) debt has nearly tripled since 2007, whereas the shadow banks debt has increased 17 times for the same period. The recent rapid growth of shadow banking is due to two factors: one is the constraint of liquidity in the credit market in terms of the highest required reserve ratio (approximately 20% from 2010 to 2013); the other is the high demand for higher-yield investment financial products (Figure 9).

Figure 9 Financial (Banks mainly) sector debt and shadow banking debt
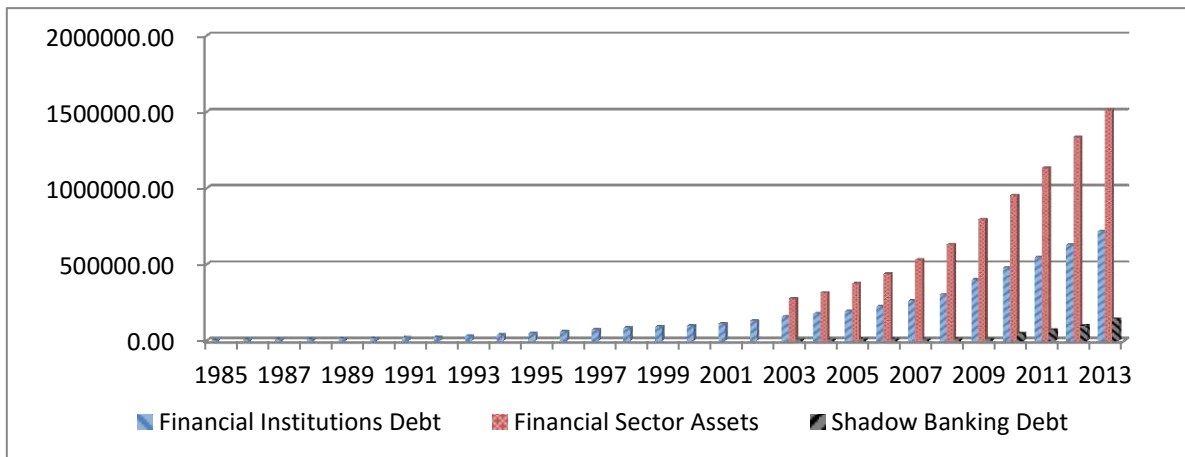
Figure 10 exhibits the debt-to-asset ratio in the financial sector and the debt-to-NGDP ratios in the financial sector and in the shadow banking. The financial sector debt-to-assets ratio decreased 10% during the past decade, which reflects the modification of assets quality and the steady reduction in the non-performing loans (NPL) in China's banking industry. The shadow banks debt-to-NGDP ratio has increased approximately 7 times since the global financial crisis of 2008. The rapid rise in the debt-to-NGDP ratio for the financial sector, particularly for the shadow banks, has important implications for financial stability.

Figure 10 Debt-to-assets ratio and debt-to-NGDP ratios for the financial sector
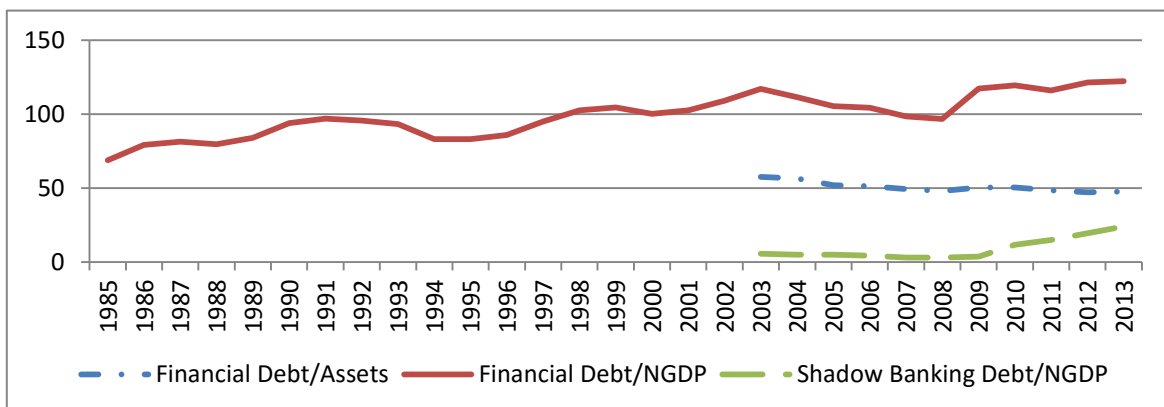
In particular, China's shadow banking is less complicated than that in advanced economies. China's shadow banking does not involve long intermediation chains, multiple layers of securitization, or highly leveraged players, and most loans involve a single intermediary and minimal or no leverage or currency risk according to the MGI report (2015). However, the debt-to-NGDP ratio of China's shadow banks increased approximately 7 times after the global financial crisis of 2008, attaining 23% in 2013. Due to the non-transparency, potential contagious effects to the official banking sector, and speculation motives, China's regulators should be cautious of the shadow banking development.

It is well known that international debt has played an important role in promoting China's rapid economic development beginning in 1978. Nevertheless, the external borrowings have been strictly controlled and remain a small proportion of China's debt. The ratio of external debt to nominal GDP has never exceeded 17%, attaining the peak in 1994 at 16.24% and the lowest point in 2013 at 8.91%. Importantly, the share of short-term external debt in overall external debt had grown to 78.39% by 2013, and the ratio of short-term external debt to national annual fiscal revenue has increased from 12% to 31% since 1990 (Figure 11).

The increase in the share of short-term external debt in total external debt has pros and cons. The increase can reduce the financial costs on the one hand but raise the rollover risk, particularly under an unstable macroeconomic environment, on the other hand. Fortunately, both the ratios of short-term external debt to NGDP and to national fiscal revenue are lower in China compared with the international criteria.

Fig.11 Shares of external debt and ratios of external debt to fiscal revenue and NGDP (%)
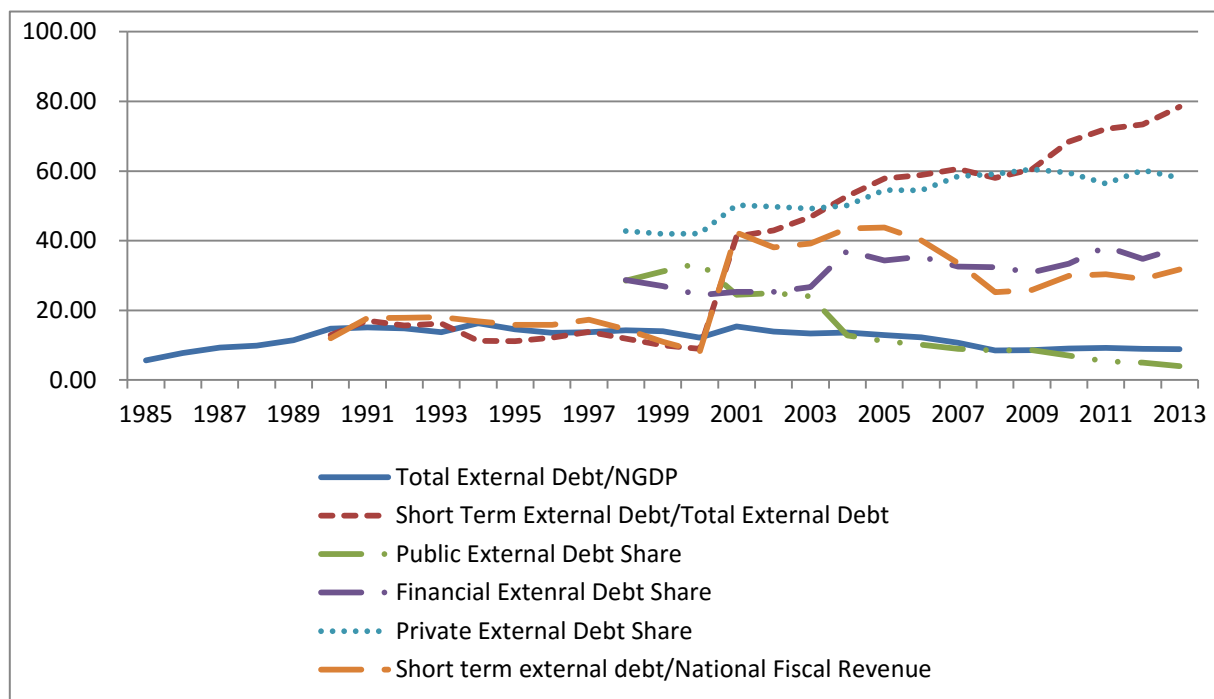
Source: Author's Dataset

5. Determinants of China's Debt Structure

In this section, we identify the determinants of China's debt structure by using the multivariate regression (OLS). To avoid the multicollinearity problems, we choose the stepwise regression approach. Our regressions satisfy the VIF tests and heterogeneity tests.

We focus on the following indicators of China's debt structure (shares/ratios): ratio of domestic debt to GDP (RDDG), ratio of external debt to GDP (REDG), share of domestic debt in total debt (SDD), share of public debt in domestic debt (SPD), share of private non-financial private debt in domestic debt (SNPD), share of financial sector debt in domestic debt (SFDD), ratio of public debt to GDP (RPDG), ratio of public debt to

national fiscal revenue (RPDNF), ratio of central government debt to central government fiscal revenue (RCGDCF), ratio of local government debt to local government fiscal revenue (RLGDLF), ratio of non-financial private debt to GDP (RNPG), ratio of household debt to disposable income (RHDDI), ratio of non-financial corporate debt to non-financial corporate revenue (RCDCR), ratio of financial sector debt to GDP (RFDG), ratio of financial sector debt to financial sector asset (RFDFA), ratio of shadow banking debt to GDP (RSBDG), share of short term external debt in total external debt (SSEDT), and ratio of short-term external debt to national fiscal revenue (RSEDNF). Table 1 in Appendix A summarizes the explained structural indicators of China's debt and data sources.

The set of independent variables for explaining China's debt structure is classified into four groups: macroeconomic and policy indicators, financial indicators, institutional indicators, and international trade indicators.

The macroeconomic and policy indicators consist of the growth rate of GDP (GGDP), growth rate of M2 (GM2), interest rate (IR), growth rate of CPI (PI), growth rate of capital formation (GCA), growth rate of urban infrastructure (GINFRA), real estate property index (REPI), and the ratio of government spending to fiscal revenue (GY). The exchange rate is not adopted because China had a fixed exchange rate regime for a long time. Since May, 2005, the fixed system has been replaced by a floating system; however, it is a manipulate floating.

The financial indicators are composed of the ratio of total deposits to GDP (RDGDP), ratio of total loans to GDP (RLGDP), Shanghai stock market index (SSINDEX), and the

financial crisis dummy (FC). The latter takes the value of 1 at 1990 (Asia Financial Crisis), 1998 (China's Bank Crisis[6]), and 2008 (Global financial crisis) and 0 at other years.

The institutional indicators contain the GINI coefficient (GINI), Governing efficiency of China's government (GOVERN), control of corruption indicator (CCORI), and the government succession dummy (GSD), which takes the value of 1 at 1997 (Deng's concession), 2001(Jiang's concession), and 2012 (Hu's concession) and takes 0 at other years.

The international trade indicators include the growth rate of FDI (GFDI), ratio of total export and import to GDP (REGDP), and ratio of foreign reserve to GDP (RFRGDP).

Table 2 in Appendix A exhibits the abovementioned explanatory variables for analysing the determinants of debt structure in China. The data are sourced from the China Economic Information Networks (CEIN) database, Wind database (WIND), and the World Wide Governance Indicators (2014) by World Bank (WGI). The identified determinants for China's debt structure are summarized in Tables 3 and 4 in Appendix A.

A. Common Determinants of China's Debt Structure Indicators

The results in Tables 3 and 4 suggest that nearly every indicator of China's debt structure is significantly influenced by the growth rate of GDP and the interest rate. Generally, the ratios of public debt and private debt to GDP are negatively correlated with the growth of GDP, implying that these ratios rise when the growth rate of China's economy falls. However, the growth rate of GDP has positive effects on the ratios of the central government and the local government debt to their fiscal revenues. The increase in the

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[6] This is identified by Laeven and Valencia (2008).

interest rate is followed by the decrease in the ratios of public debt and of the financial sector debt to GDP. This result is justified by the fact that the rise in interest rate increases the borrowing costs and thereby reduces the borrowing. Interestingly, the share of non-financial private debt and the share of financial sector debt in domestic debt, as well as the ratio of household debt to household disposable income are positively correlated with the interest rate. The first two positive relations could be explained by the remarkable decline in the share of the public debt in the domestic debt when the interest rate rises.

The third importantly influential indicator for China's debt structure is the development of China's banking system (proxied by the ratio of total deposits and total loans to GDP). The positive correlations indicate that a wider and deeper Chinese banking system stimulates the credit because the development in the banking sector increases the channels and the availability of borrowing.

B. Determinants of China's Public Debt Structure Indicators

In addition to the growth rate of GDP, the interest rate, and financial development, the governing efficiency has a positive impact on the share of public debt in the domestic debt; we did not find correlations between the real estate prosperity index and the ratio of local government debt to the local fiscal revenue. The ratio of the foreign exchange reserve to GDP as the assets of the government in China is significantly positively related to the ratio of public debt to GDP. The rate of inflation positively affects the share of public debt in domestic debt, the ratio of public debt to GDP and the ratio of central government debt to the central government fiscal income, which implies the effects of monetary policy on the debt ratios and distributions of debt burdens. The government spending has negative

impacts on both the share of domestic debt and the share of public debt in total debt. The growth of investment is negatively correlated with the ratio of external debt to GDP and positively related to the share of domestic debt. Specifically, the financial crisis dummy has a positive effect on the ratio of local government to local fiscal revenue. Finally and importantly, the government succession has minimal impact on the public debt structure indicators in China.

C. Determinants of China's Non-Financial Private Debt Structure

Our regression results show that the financial development indicator (proxied by the ratio of total deposits and loans to GDP) is a key factor in determining the non-financial private debt structure.   The depth and breadth of the banking system regulate the development in private debt market. The Gini coefficient has a positive impact on the ratio of the household debt to household disposable income, which suggests that the inequality in the income distribution increases the household leverage ratio in China. That the income equality helps reduce the household leverage level has important implications for China's economic development strategy. The rate of inflation is negatively correlated with the ratio of household debt to the disposable income. For the non-financial corporate debt and the overall non-financial private debt, the growth of capital accumulation (investment) is an important determinant. The financial crisis dummy is positively related to the share of non-financial private debt in domestic debt and negatively related to the ratio of non-financial private debt to GDP. It is reasonable that the rise in the growth rate of FDI reduces the share of non-financial private debt in domestic debt.

D.   Determinants of China's Financial Sector Debt Structure

It is not surprising that the share of financial sector debt in domestic debt is positively correlated with the real estate property index, which supports the empirical evidence that the loans from the banking sector are closely correlated with the development in the house construction in China. The growth of capital accumulation (investment) is positively connected with the ratio of financial sector debt to GDP and the ratio of financial sector debt to the assets. The correlations of the rate of inflation and the growth rate of M2 with the share of financial debt in domestic debt and the ratio of financial sector debt to financial sector assets prove that China's monetary policy has an important impact on the growth of credit in China (the credit channel). Interestingly, the financial crisis dummy has negative effects on the ratio of financial sector debt to GDP, and the corruption control ability of the Chinese government positively influences the leverage ratio of the financial sector.

Regarding the specific determinants of shadow banking debt, we find that the growth rate of broad money is negatively correlated with the ratio of shadow banking debt to GDP, uncovering the fact that the private sector will seek credit from the shadow banks when a contractionary monetary policy is implemented. The negative correlation between the financial crisis dummy and the ratio of shadow banking debt to GDP indicates that financial crises reduce loans from shadow banks.

E.   Determinants of China's International Debt Structure

Without doubt, in addition to the growth rate of GDP, the foreign exchange reserve is a key determinant in China's external debt. Both the ratio of international debt to GDP and

the share of short-term external debt in the total external debt are positively correlated with the ratio of foreign exchange reserves to GDP. In particular, our empirical results indicate that the international trade has minimal impact on the external debt ratios in China.

6. The Sustainability of China's Debt

Sustainable debt often refers to that which can be serviced by the current issuer and in the future without adjustment. The sustainability of public debt is also defined as fiscal sustainability, which is a traditional and official focus on debt sustainability analysis (DSA). In this section, we test and assess not only the fiscal sustainability but also the non-financial private debt sustainability and the external debt sustainability.

Prodigious literature on the DSA of public debt exists. In accordance with the IMF (2011) and Ostry (2010), we conduct our evaluation on China's public debt sustainability within the fiscal space framework. On the sustainability of non-financial private debt in China, we employ the debt service ratio approach.

A. Assessment on the Sustainability of China's Public Debt

Our methodology to assess the sustainability of China's public debt is in accordance with the IMF (2011), Ghosh et al. (2011), Ostry et al. (2010), and Abiad and Ostry (2005) in which a fiscal space framework has been developed. Two concepts of the sustainable level of public debt are defined in the fiscal space framework: the long-run debt level and the maximum sustainable debt level. The former is the level to which the debt-to-GDP ratio converges in the long run, the latter is the level beyond which a debt distress event is likely or inevitable.

In this subsection, first, we estimate the fiscal response function for China, by which we calculate the long-run sustainable debt-to-GDP ratio and the maximum sustainable debt-to-GDP ratio. Second, we compare China's public debt structure indicators with these sustainable thresholds and judge the sustainability of China's public debt.

The long-run sustainable public debt (percentage to GDP) is defined by

$$d^* = \frac{pb}{r^* - g}, \tag{1}$$

where d^* is the long-run debt level (percentage to GDP), pb is the historical average primary balance (percentage to GDP), r^* is the historical average risk-free interest rate, and g is the historical average growth rate of GDP.

Given that the historical average risk-free interest rate is 5.30 for the 1985-2013 period, and the historical average growth rate of GDP for the same period is 9.93, equation (1) produces: $pb = -4.63d^*$, in terms of which the long-run sustainable debt is obtained.   .

A fiscal reaction function in the fiscal gap framework is given by

$$pb_t = f(d_{t-1}) + x_t + \varepsilon_t \tag{2}$$

where $x(t)$ is a vector of control variables capturing all systematic determinants of the primary balance other than lagged debt, $f(d_{t-1})$ is the response of the primary balance to lagged debt, which is a continuous function, and $\varepsilon(t)$ is an i.i.d. shock to the primary balance.

For the determinant case, the maximum sustainable debt level can be obtained by the higher intersection between $x_t + f(d_{t-1})$ and $(r^* - g)d_t$ schedule:

$$x_t + f(d_{t-1}) = (r^* - g)d_t \tag{3}$$

The lower solution to (3) is also defined as the long-run sustainable debt level, in contrast to the definition by equation (1).

Using equations (1) and (3), we can obtain the long-run sustainable public debt level and maximum sustainable debt level, in terms of which we assess the sustainability of public debt for China.

Employing equation (1), we obtained that China's long run sustainable public debt ratios (percentage to GDP) are 25.96% and 67.66% at the general government level and the local government level, respectively, for the 1985-2013 period. Furthermore, we estimated the fiscal reaction functions for China by using the approach suggested by Ghosh et al. (2011). The results are presented in Table 5 in Appendix B.

In estimating China's fiscal response function, we first employ an H-P filter to calculate the output gap and the government expenditure gap. In doing so, the λ is taken to be 100 due to the annual data frequency. The lagged debt is one period lag.

The estimated fiscal response functions for China are:

$$pb_t = -0.155d_{t-1} + 0.021d_{t-1}^2 + 0.00046d_{t-1}^3 + 0.0262\hat{y}_t - 0.021\hat{g}_t \quad (4)$$

and

$$pb_t = -0.065d_{t-1} + 0.15d_{t-1}^2 - 0.00036d_{t-1}^3 + 0.027\hat{y}_t - 0.097\hat{g}_t + 0.0415\pi_t + 0.565fc_t \quad (5)$$

where pb_t denotes the primary balance at the general government level (percentage to GDP) at time t, $\hat{y}_t$ denotes the output gap, $\hat{g}_t$ represents the government expenditure gap, π_t is the rate of inflation, and fc_t denotes the financial crisis dummy.

Combining equation (3) and the estimated fiscal response equations (4) and (5) (detailed in Table 5), we estimate the maximum sustainable debt level, which is 77.27% or

93.43% for the two specified fiscal response functions, respectively.

Given that China's public debt level (percentage to GDP) is 35% in 2013, which is located in the sustainable scope [25.96% 93.43%], it is a reasonable conclusion that China's public debt at the general and local government levels is sustainable at the moment and in the near and medium future. Moreover, the fiscal space (58.43%) for China is significantly larger than other advanced economies and emerging countries. This provides a large space for China public debt adjustments in the future.

We consider the contingent liabilities of China's government, which include the potential costs associated with nonfinancial SOE debt; policy banks' liabilities; fiscal costs of recapitalizing banks, and liabilities of state-owned asset management companies[7]. According to the estimation by Li et al. (2012), the contingent liabilities were approximately 100 percent of GDP in 2010 in China; hence the overall ratio of public debt to GDP at that moment could exceed the maximum sustainable debt level (93.43%). Obviously, this implies a potential vulnerability to China's debt sustainability.

B. Assessment on the Sustainability of Non-Financial Private Debt

No standard threshold level has been developed for the DSA of non-financial private debt; we employ the debt service ratio (DSR) to examine the sustainability of non-financial private sector indebtedness. The DSR measures household (firm) debt-servicing costs as a percentage of its disposable income (revenue). In accordance with Drehmann and Juselius (2012), we calculate the DSR by

$$DSR_t = DSC_t / Y_t = \frac{I_t D_t}{[1-(1+I_t)^{-M_t}]Y_t},$$
(6)

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[7] Refer to, for example, Zhang and Barnett (2014).

where D_t is an aggregate borrowing stock, I_t is the average interest rate per year on the stock, M_t denotes the average remaining maturity in years in the stock and Y_t denotes annual aggregate income. I_t is given by

$$I_t = \alpha\, I_{t+1} + (1 - \alpha)\, I_t^m + \mu \qquad\qquad (7)$$

beginning with the initial value $I_0 = I_0^m + \mu$. In equation (7), α is set as 0.8 following Drehmann and Juselius (2012), and I_t^m denotes the short-term interest rate.

For simplicity, we assume the average maturity for household debt to be 10 years, and the average maturity for non-financial corporate debt to be 3 years. The banking lending rate is used to calculate the debt service costs for both sectors. The results are reported in Table 6 in Appendix B.

In Table 6, we find that the DSRs for households are lower than 10.5% from 1985 to 2013; this suggests that a majority of Chinese households have comfortable or modest debt burdens. The DSRs for Chinese non-financial firms are between 20% and 50% during the sample period, which implies comparatively heavy burdens for non-financial firms. It needs to be stressed that these are average estimations; the potential vulnerabilities of non-financial private debt from the tail distribution are ignored.

Notwithstanding that the ratio of the debt-to-disposal income for households has increased dramatically since 2000 (from 6.62% in 2000 to 78.43% in 2013), the current ratio of 78% remains far lower than the average level of 110% in advanced countries, but higher than the average level of 42% in emerging countries[8]. In addition, the modest DSRs and the lower ratios of household debt to financial assets (less than 30% from 2004 by

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[8] According to the MGI report (2015), these data are for 2014

Table 6) ensure the sustainability of household debt in China.

Although the debt burdens (by DSR) of China's non-financial corporations have declined since 1998 from the peak of 50%, it remains close to 30% in 2013. In addition to the heavy debt service burdens, the non-financial corporate debt had attained 140% of GDP by the end of 2013, which is one of the highest levels across countries. Hence, a deleverage process is required and more concerns should be accorded to the potential risk from the excess indebtedness of China's non-financial corporations.

C. Assessment on the Sustainability of International Debt

Because the share of the international debt in overall debt in China is very low and declines over time, and because China has a huge stock of foreign exchange, fewer concerns have been given with the DSA for China's external debt. According to the IMF (2002), the standard thresholds of external debt sustainability indicators include the ratio of NPV external debt to exports (the threshold value at 150%) and the ratio of NPV of external debt to government revenue (the threshold value at 250%). According to these two ratios we conduct the assessment on China's external debt. The results are presented in Table 7 in Appendix B. Although we did not calculate the NPV of China's external debt to exports and government revenue[9], given that the ratios of short-term debt to exports, fiscal revenue and aggregate foreign exchange reserves are 4.93%, 5.24% and 17.71%, respectively, in 2013, and the ratios of total external debt to exports, fiscal revenues and foreign exchange reserves are 38.18%, 40.54% and 137.09%, respectively, in 2013, it is reasonable to conclude that the ratios of nominal external debt to exports and the

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[9] This is because the ratios of the external debt to GDP, exports and fiscal revenue are nearly stable and have gradually declined since 2005 in China. Refer to Table 7.

government revenue are comparatively significantly lower than the international standards (150, 250%) for the external debt sustainability. Although China's current account deteriorates and the exchange rate of RMB depreciates in the future, China's external debt burdens would be modest and sustainable in the near and medium term.

7. Concluding Remarks

Debt and leverage, whether at the micro or macro level, have important implications to economic sustainability and stability. Due to the limitation of historical data, studies on the effects and sustainability of China's debt are scarce. To fill this urgent gap, we collect a comprehensive debt data set for China, which covers the entire range of debt categories and spans the longest series to our knowledge.

Relying on the newly constructed debt data set, we have employed a set of indicators to describe and explain the structure of China's debt and its evolution. By using a multivariate stepwise regression, we have identified the determinants of China's debt structure. We find that the growth rate of GDP, interest rate, and the depth and extent of the financial sector are the most important common determinants of China's debt structure. These developments suggest that sustainable rapid economic growth, easy monetary policy and mature financial markets could help improve China's debt structure. Furthermore, our empirical results suggest that the determinants for different debt structures by sector are heterogeneous and diverse, which implies diverse policy choices for reducing the excess indebtedness in different sectors.

By estimating fiscal response functions within a fiscal space framework, we have identified the long-run debt level (25.96%) and the maximum sustainable debt level

(93.43%) for China's public debt. China's practical public debt level (debt-to-GDP percent) over time is in between these two values; hence, we can conclude that China's public debt is sustainable in the near and medium term. We employ the debt service ratio to assess the sustainability of non-financial private debt. The empirical results indicate that China's household sector has lower and modest debt burdens, whereas the debt burdens for non-financial firms are comparatively heavy. Moreover, given 140% of GDP by 2013, China's non-financial corporate debt is one of the highest levels in the world. By using the thresholds developed by the IMF, we confirm that China's external debt is sustainable at the moment and in the medium future. In sum, China's domestic debt (except the non-financial firm sector) and external debt are sound and sustainable in the near and medium term. Nevertheless, policymakers and regulators should focus on the highly indebted local governments, non-financial firms and shadow banks.

Looking ahead, further studies are necessary for exploring the connection between the debt level and China's economic growth, and the implications of China's debt to China's economic and fiscal stabilities.

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Appendix A. Debt Structure Indicators, Determinants, and Data Sources

Table 1 Explained indicators for analysing China's debt structure

Indicators	Description of Indicators and Variables	Data Source
RDDG	ratio of domestic debt to GDP	Author
REDG	ratio of external debt to GDP	Author
SDD	share of domestic debt in total debt	Author
SPD	share of public debt in domestic debt	Author
SNPD	share of private non-financial debt in domestic debt	Author
SFDD	share of financial sector debt in domestic debt	Author
RPDG	ratio of public debt to GDP	Author
RPDNF	ratio of public debt to national fiscal revenue	Author
RCGDCF	ratio of central government debt to central government fiscal revenue	Author
RLGDLF	ratio of local government debt to local government fiscal revenue	Author
RNPG	ratio of non-financial private debt to GDP	Author
RHDDI	ratio of household debt to disposable income	Author
RCDCR	ratio of non-financial corporate debt to non-financial corporate revenue	Author
RFDG	ratio of financial sector debt to GDP	Author
RFDFA	ratio of financial sector debt to financial sector asset	Author
RSBDG	ratio of shadow banking debt to GDP	Author
SSEDT	share of short term external debt in total external debt	Author
RSEDNF	ratio of short term external debt to national fiscal revenue	Author

Table 2 Explanatory variables for China's debt structure analysis

Type of Variables	Variables	Description of Variables and Indicators	Data Source
Macroeconomic Condition	GGDP	growth rate of GDP	CEIN
	IR	interest rate of deposits	WIND
	GM2	growth rate of M2	CEIN
	REPI	real estate property index	CEIN
	PI	growth rate of CPI	CEIN
	GY	ratio of government spending to fiscal revenue	CEIN
	GCA	growth rate of capital formation	WIND
	GINFRA	growth rate of urban infrastructure	WIND
Financial Indicators	RDGDP	ratio of total deposits to GDP	CEIN
	RLGDP	ratio of total loans to GDP	CEIN
	FC	Financial crisis dummy	Author
	SSINDEX	Shanghai stock market index	CEIN
Institutional Indicators	GINI	GINI coefficient	WIND
	GOVERN	governing efficiency of China's government	WGI
	GSD	government succession dummy	Author
	CCORI	control corruption index	WGI
International Indicators	GFDI	growth rate of FDI	CEIN
	REGDP	ratio of total export and import to GDP	CEIN
	RFRGDP	ratio of foreign reserve to GDP	CEIN

Table 3 Empirical Results for Determinants of China's Public Debt

	RDDG	REDG	SDD	SPD	RPDG	RPDNF	RCGDCF	RLGDLF
Constant	55.92**	9.66	100.1***	39.52	27.94***	191.89**	508.32***	468.04
	(28.54)	(11.02)	(5.34)	(14.92)	(4.275)	(100.58)	(167.43)	(359.18)
GGDP	-2.12**	0.501***	-0.279**	-0.22	-0.517**	-1.097	5.85**	10.17***
	(1.08)	(0.193)	(0.099)	(0.150)	(0.278)	(1.789)	(2.82)	(4.28)
IR	0.245	-0.193	-0.093	-1.75***	-2.49***	-23.17***	-16.98***	-33.88***
	(1.30)	(0.160)	(0.081)	(0.417)	(0.458)	(3.82)	(4.625)	(15.19)
GM2								
PI				0.37***	0.364**	4.044***		
				(0.115)	(0.185)	(1.302)		
GCA		-0.057*	0.0335**					
		(0.031)	(0.0161)					
REPI								-3.03
								(3.49)
GY		0.038	-0.074*	-0.22***				
		(0.081)	(0.035)	(0.085)				
GINFRA								
RDGDP +RLGDP	1.137***	-0.001	0.0246***	0.0369***		-0.401***	-0.739***	
	(0.137)	(0.015)	(0.006)	(0.014)		(0.178)	(0.303)	
SSINDEX								
FC								61.06**
								(29.01)
GOVERN				0.201		2.71*	-2.53	
				(0.144)		(1.706)	(3.258)	
CCORI								
GSD	-10.02		0.250					
	(8.74)		(0.377)					
GINI								
GFDI								
REGDP	-2.067**							
	(0.757)							
RFRGDP	0.452	0.154***			0.436***			
	(0.435)	(0.042)			(0.062)			
Adj. R2	0.945	0.79	0.86	0.93	0.93	0.92	0.37	0.45
F-Statistic	82.28	14.86	22.79	49.46	97.69	56.47	4.31	3.85

Table 4 Empirical Results for Determinants of China's Private Debt

	SNPD	RNPG	RHDDI	RCDCR	SFDD	RFDG	RFDFA	RSBDG	SSEDT	RSEDNF
Constant	52.84*** (11.03)	53.43** (24.82)	-325.3*** (90.20)	325.23*** (35.98)	12.38 (12.72)	137.4*** (6.32)	34.01** (0.068)	114.1** (42.99)	-64.5** (28.94)	20.10 (6.25)
GGDP	0.0206 (0.189)	-4.50*** (1.391)	-1.435 (1.423)	-2.973 (2.01)	-0.013 (0.323)	-3.27*** (0.82)	0.068 (0.264)	-2.27** (0.88)	-0.461 (1.146)	3.21* (1.68)
IR	0.299* (0.182)	0.839 (1.154)	8.551*** (2.301)	-6.899*** (1.684)	1.29*** (0.24)	-2.70*** (0.39)	-3.06** (0.708)		1.488 (1.136)	-3.108* (1.582)
GM2							-0.58** (0.163)	-0.646* (0.312)		
PI			-1.562* (0.749)		-0.39*** (0.125)					
GCA		0.571** (0.246)		-1.31* (0.620)		0.56*** (0.138)	1.05*** (0.241)			
REPI	0.048 (0.084)		0.950 (0.689)		0.247* (0.136)			-0.737 (0.512)		
GY										
GINFRA										
RDGDP +RLGDP		0.455*** (0.079)	0.728*** (0.098)	-0.599*** (0.129)					0.34** (0.122)	0.064 (0.106)
SSINDEX								0.002* (0.001)		-0.005* (0.003)
FC	0.042*** (0.011)	-14.08* (7.02)			1.151 (1.436)	-7.77** (4.11)		-10.34* (4.09)	-0.658 (7.27)	
GOVERN										-0.457 (1.077)
CCORI							0.233* (0.114)			
GSD										
GINI			166.50* (79.15)							
GFDI	-0.337** (0.117)				-0.222 (0.023)					
REGDP									0.219 (0.624)	0.158 (0.688)
RFRGDP									0.733** (0.332)	0.164 (0.371)
Adj. R2	0.57	0.83	0.896	0.79	0.60	0.79	0.85	0.82	0.87	0.55
F-Statistic	6.97	23.90	31.38	18.31	6.68	21.89	12.04	10.66	21.16	4.47

Appendix B Empirical Results for Sustainability Analysis

Table 5 Estimated Fiscal Reaction Function for China

(Dependent Variable: General Government Primary Balance to GDP (percentage))

Independent Variables	Specification (1)	Specification (2)
Lagged debt	-0.155* #	-0.065
	(0.098)	(0.089)
Lagged debt square	0.021**	0.015**
	(0.008)	(0.007)
Lagged debt cubic	-0.00046***	-0.00036**
	(0.0002)	(0.00015)
Output gap##	0.0262**	0.027***
	(0.0098)	(0.008)
Government expenditure gap##	-0.091***	-0.097***
	(0.021)	(0.0115)
Inflation		0.0415***
		(0.0144)
Financial crisis dummy		0.565*
		(0.282)
Adj. R-square	0.496	0.632

Source: author estimation

#: standard errors are reported in parentheses; ***, **, and * denote 1%, 5%, and 10% significance, respectively.

The gap was estimated by H-P Filter. Lamda is taken as 100.

Table 6 Debt service costs for households and firms

Period	Household debt to disposable income	Household debt to financial assets	Firm debt to revenue	Lending rate	DSR for households	DSR for non-financial Firms
1985	26.34		60.09	5.76	3.39	21.23
1986	24.79			8.64	3.60	
1987	23.64			8.64	3.43	
1988	21.02			9.00	3.10	
1989	19.44			11.34	3.15	
1990	18.08		81.21	10.08	2.78	29.99
1991	17.48			10.08	2.69	
1992	15.79			8.64	2.29	
1993	13.33			9.36	1.99	
1994	10.25			10.98	1.64	
1995	8.39		98.27	10.98	1.34	36.63
1996	7.29		110.43	10.98	1.16	41.16
1997	6.89		121.29	10.08	1.06	44.79
1998	6.72		139.43	8.64	0.98	50.73
1999	6.47		143.06	6.39	0.86	50.87
2000	6.62		132.34	5.85	0.86	46.80
2001	18.11		122.20	5.85	2.34	43.21
2002	25.72		130.63	5.31	3.25	45.94
2003	32.19		120.62	5.31	4.06	42.42
2004	38.41	15.62	97.02	5.58	4.91	34.21
2005	37.95	15.11	82.86	5.58	4.85	29.22
2006	40.39	15.21	76.39	6.12	5.28	27.09
2007	44.75	15.10	71.48	6.84	6.03	25.53
2008	43.23	16.64	65.13	7.20	5.91	23.35
2009	55.90	19.91	80.55	5.31	7.06	28.33
2010	67.10	22.74	74.76	5.56	8.56	26.36
2011	69.23	23.53	71.35	6.06	9.03	25.28
2012	71.47		74.72	6.31	9.42	26.55
2013	78.43		77.39	6.00	10.20	27.41

Table 7 Sustainable indicators for China's external debt

Period	Total external Debt/GDP	Total External debt/ Exports	Total external debt/ government fiscal revenue	Total external debt/foreign exchange	Short-term external debt/ government fiscal revenue	Short-term external debt/Exports	Short-term debt/ foreign exchange reserves
1985	5.62	62.65	25.28	1916.78			
1986	7.78	73.88	37.68	3858.62			
1987	9.32	76.47	51.11	3845.62			
1988	9.90	84.27	63.16	4415.30			
1989	11.48	99.70	73.18	3513.92			
1990	14.70	91.91	93.43	2473.82	2.30	2.27	60.99
1991	15.11	85.99	104.49	1515.73	3.27	2.69	47.46
1992	14.81	85.26	114.46	2050.69	3.11	2.32	55.75
1993	13.72	91.72	111.45	2286.46	3.11	2.56	63.90
1994	16.26	75.22	150.23	1518.58	2.00	1.00	20.18
1995	14.58	71.20	142.03	1204.60	1.91	0.96	16.19
1996	13.56	76.72	130.25	918.50	1.90	1.12	13.43
1997	13.73	71.52	125.34	775.13	2.10	1.20	12.97
1998	14.32	79.42	122.42	834.06	1.76	1.14	11.96
1999	14.02	77.79	109.84	812.72	1.33	0.94	9.81
2000	12.16	58.46	90.05	728.52	0.98	0.63	7.90
2001	15.35	76.40	102.69	793.11	5.11	3.80	39.48
2002	13.94	62.24	88.73	585.62	4.61	3.23	30.40
2003	13.37	50.03	83.61	450.23	4.73	2.83	25.49
2004	13.61	44.33	82.46	356.87	5.25	2.82	22.74
2005	12.94	38.20	75.61	292.25	5.42	2.74	20.96
2006	12.22	34.07	68.21	247.95	5.14	2.57	18.68
2007	10.70	30.39	55.40	186.04	4.59	2.52	15.42
2008	8.49	26.56	43.48	137.03	3.69	2.25	11.63
2009	8.59	35.68	42.72	122.00	3.78	3.16	10.81
2010	9.05	33.97	43.75	127.69	4.52	3.51	13.19
2011	9.25	35.53	42.15	137.64	4.82	4.06	15.75
2012	8.92	35.81	39.50	139.87	4.61	4.18	16.33
2013	8.91	38.18	40.54	137.09	5.24	4.93	17.71