The Credit-Output Nexus in China: Evidence from Provincial Panel Data

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Abstract

The availability of credit has long been viewed by China-economy scholars as a key driver, if not the key driver, of fluctuations in real output per capita. This paper seeks to move beyond descriptive accounts of this relationship and empirically estimate the impact that credit has on output using a provincial-level panel dataset. The results suggest that a 1 per cent increase in newly extended real credit per capita leads to around a 0.1 per cent increase in real GDP per capita. The results also indicate that credit has a more significant impact on output than does government budgetary expenditure. In so doing, these empirical findings serve to confirm and complement existing descriptive accounts of the credit-output nexus in China, and also illuminate the fondness of the Chinese government for using credit as a macroeconomic stimulus measure.

1 Introduction

Since the beginning of the reform period, the availability of credit has been viewed by China-economy scholars as a key driver, if not the key driver, of fluctuations in real output per capita (Yusuf, 1994; Chai, 1997; Brandt and Zhu, 2000). In the Chinese context, the impact of credit on output is thought to take on particular significance for at least three reasons. Firstly, credit extended by the banking system has long overshadowed direct capital markets as a source of external finance for investment by firms. Formal nation-wide equity markets did not exist in China prior to the 1990s. Secondly, the monetary policy stance of the People's Bank of China (PBC) emphasises targeted growth rates of monetary aggregates and domestic credit (Geiger, 2008). For this reason the tools most commonly used by

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the People's Bank of China (PBC) when implementing monetary policy are those that influence the availability of credit, such as changes in bank reserve requirements, as opposed to those favoured by central banks in OECD economies, such as changes in short-term interest rates. Thirdly, credit in China also takes on quasi-fiscal dimensions. For example, facing a dramatic decline in fiscal revenues in the 1980s, the Chinese government switched from directly supporting state-owned enterprises via the budget, to indirectly supporting them through credit extended by state-owned banks (McKinnon, 1994; Brandt and Zhu, 2000). A more contemporary illustration of the quasi-fiscal nature of credit is the Chinese government's macroeconomic stimulus package in response to the recent global financial crisis. It has been estimated that two-thirds of this stimulus was funded via bank credit and local government borrowing (McKissack and Xu, 2011).

Despite the above, to the best of our knowledge the impact of credit on output has yet to move beyond descriptive accounts to a formal econometric investigation. The purpose of this paper is to contribute towards filling this gap in the literature. Specifically, this paper seeks to establish whether newly extended real credit per capita (that is, the change in the outstanding stock of real credit per capita) has a positive and statistically significant impact on real output per capita, and if it does, is this impact also economically significant? Further, how does the impact of credit compare with other potential aggregate output drivers, such as government budgetary expenditure? This secondary question is motivated by the quasi-fiscal nature of credit in China, and also by recent empirical evidence which suggests that government expenditure does indeed have a statistically and economically significant impact on output (Carmignani and Laurenceson, 2013).

The structure of this paper is as follows. Section 2 outlines the methodology adopted to investigate the above research questions. The decision to use provincial-level panel data rather than national-level time series data is discussed, and dynamic panel GMM-in-difference techniques are used to account for potential endogeneity between credit and output. Details of the data set are discussed in Section 3. Section 4 presents the results. To foreshadow the main finding, credit is found to have both a statistically and economically significant positive impact on output. Section 5 concludes.

2 Methodology

In the methodological discussion that follows, the relationship between credit and output is analysed using panel data techniques. This deserves clarification from the outset. While there are obvious benefits associated with using provincial-level panel data instead of national-level time series data in terms of the number of available observations, if there is little variation in the rate at which new credit is extended across provinces, then the econometric value-added associated with these extra observations might be limited. Moreover, if the rate at which new credit is extended at a provincial level is overwhelmingly driven by a centrally determined monetary policy, then the conceptual justification for using provincial-level data might also be lacking. Table 1 shows the correlation coefficients between the provincial series of newly extended real credit per capita for those provinces included in the sample (see section 3). While these series are clearly positively correlated, this correlation is far from perfect. There is some evidence that the degree of correlation is inversely related to distance. For example, while Beijing is quite closely correlated with other coastal provinces in northern China, such as Tianjin (0.72), the extent of correlation falls considerably with respect to coastal provinces in the south, such as Fujian (0.53), and inland provinces, such as Qinghai (0.29). Variation in the rate at which new credit is extended at the provincial level reflects two main factors. Firstly, China's domestic capital market, and domestic economy more generally, is provincially fragmented (Young, 2000; Li, 2010; Lai, et al. 2013). An implication of this fragmentation is that the availability of credit at the provincial level is determined in significant part by local, not central factors. Secondly, the ability of the headquarters of the PBC in Beijing to implement a centralised monetary policy has been eroded by the decentralisation in decision-making authority that has characterised China's political economy during the reform period (Chai, 1997). This decentralisation meant that the lending decisions of local branches of state banks, which account for the majority of bank credit in China, became sensitive to the demands of local government officials.[2]

To better tease out the relationship, our formal modelling begins by specifying a simple model that relates newly extended real credit per capita $\Delta credit_{it}$ to real output per capita gdp_{it}, and that also includes fixed effects to account for time invariant unobserved heterogeneity across provinces.[3]

$$gdp_{it} = \alpha + \beta_1 \Delta credit_{it} + \gamma_i + \epsilon_{it} \tag{2.1}$$

where i and t are province and time subscripts, respectively. The coefficient on credit β_1, is the parameter of interest, α is the constant term and γ_i is a fixed

[2]The extent of local government interference became so acute that in 1998 the PBC adopted a supra-provincial organisational structure in a bid to stem this interference.

[3]The decision to use a fixed, rather than random effects model is verified by the results of a Hausman test for systematic differences between the two models. All testing rejected a null of no systematic difference at the 1% level of significant.

effects term included for completeness but is swept out in the estimation by the within transformation.

It is extremely important to note that the theoretical model underpinning equation (1) is one of Keynesian aggregate demand. That is, newly extended credit facilitates aggregate demand, and aggregate demand determines output. In so doing, equation (1) places emphasis on the short run impact of credit and not, for example, the long run impact of credit on output via the marginal productivity of capital. For this reason the left-hand side of equation (1) features real GDP per capita at an annual frequency, in contrast to, say, a five year rolling average. For the same reason, absent from the right-hand side are variables such as the rate of investment (a common proxy for the growth in the capital stock), human capital, trade openness, infrastructure and so on, as the values of these variables do not change significantly in the short run, nor do they have an impact on output over this time horizon according to standard macroeconomic theory.

This basic model is then extended in a number of ways. Firstly, real government budgetary expenditure per capita, $fiscal_{it}$ is added as an explanatory variable. The purpose here is to consider whether the inclusion of government expenditure impacts on the statistical and economic significance of credit and also to gauge their relative magnitudes.

$$gdp_{it} = \alpha + \beta_1 \Delta credit_{it} + \beta_2 fiscal_{it} + \gamma_i + \epsilon_{it} \tag{2.2}$$

A potential problem associated with equations (1) and (2) is that they may suffer from endogeneity. Endogeneity bias can arise from three main causes - 1. measurement error, 2. simultaneity, 3. omitted variables. There is little that can be done about measurement error when working with secondary aggregate data. With respect to simultaneity, a bias in parameter estimates could arise if financial institutions responded to the state of economic activity in their lending decisions. This possibility can be neatly addressed by considering the statistical and economic significance of lagged, rather than contemporaneous, values of credit and government expenditure, as in equation (3) below. Including lagged values of these variables can also be justified on the basis that credit facilitates aggregate demand which determines output, but this link may not be immediate. Essentially, equation (3) reflects the notion that there are outside lags in the monetary transmission channel.

$$gdp_{it} = \alpha + \beta_1 \Delta credit_{it-1} + \beta_2 fiscal_{it-1} + \gamma_i + \epsilon_{it} \tag{2.3}$$

Mitigating the effects of endogeneity caused by omitted variables is more challenging. In short, a problem that any econometric analysis faces with real output per capita as the dependent variable is that there any number of variables that might be considered as potential explanatory variables. Fortunately, the risk of proliferation in right-hand side variables is less acute in the context of equations (1),(2) and (3) because only the short run impact of credit on output is being considered.

Nonetheless, there are some other variables that might impact on aggregate demand and output in the short run that reflect domestic (e.g., household consumption) and external (e.g., net inter-provincial trade) factors. We respond to this general challenge by taking motivation from several recent empirical studies that opt for parsimony over a "kitchen sink" approach (e.g., Romer and Romer, 2010; Barro and Redlick, 2011).[4] An obvious remedial measure that accounts for potentially omitted variables that do not vary over time is to include fixed effects. If, on the other hand, potentially omitted variables are time variant, then a dynamic representation of equation (3) is appropriate. That is –

$$gdp_{it} = \alpha + \beta_1 \Delta credit_{it-1} + \beta_2 fiscal_{it-1} + \beta_3 gdp_{it-1} + \gamma_i + \epsilon_{it} \qquad (2.4)$$

The cost associated with equation (4) is that, as initially pointed out by Arellano and Bond (1991), the contemporaneous presence of fixed effects and a lagged dependent variable can lead to inconsistent parameter estimates. There is however a ready solution to this problem in that the fixed effect can be eliminated by first-differencing equation (4) and then applying GMM estimation along the lines of Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). Therefore, our preferred equation of interest is:

$$\Delta gdp_{it} = \beta_1 \Delta^2 credit_{it-1} + \beta_2 \Delta fiscal_{it-1} + \beta_{3,GMM} \Delta gdp_{it-1} + \epsilon_{it} \qquad (2.5)$$

3 Data

The above methodology is implemented using a balanced panel consisting of 16 provinces over 32 years, 1979 to 2010, a total of 512 observations. While China is comprised of 31 provinces, complete data series for 15 of the provinces were unavailable. Nonetheless, a glance at the provinces for which complete data series were available provides some confidence that any empirical results will be reasonably representative of the country as a whole.[5] In particular, provinces that comprise the two main regions into which China is typically divided are included in the sample – Coastal (Beijing, Tiangjin, Jiangsu, Zhejiang, Fujian and Shandong) and Inland (Shanxi, Inner Mongolia, Jilin, Anhui, Henan, Hunan, Guizhou, Tibet, Qinghai and Yunnan).

Data were sourced from the latest edition of the various provincial statistical yearbooks. On occasion data for earlier years were not available from this source and were instead obtained from NBS (1999).

[4] Another problem associated with including all potential drivers of aggregate demand is that statistical significance may result from the accounting identify upon which the national accounts are constructed.

[5] A possible extension to this research is to construct missing data for some provinces. In several cases, only a handful of the 32 annual observations are missing.

All data series were first expressed in log terms. Real GDP per capita was then calculated as real provincial GDP divided by population. Newly extended real credit per capita was calculated by first converting outstanding RMB loans from financial institutions to real terms using the implicit provincial GDP deflator. The real value was then divided by population before the first difference was taken. Real government expenditure per capita was calculated by converting nominal government budgetary expenditure to real values using the implicit provincial GDP deflator, and then dividing by population.

Key descriptive data is presented in Table 2.

Table 1: Descriptive Statistics

	New Credit	Fiscal	GDP
Mean	0.113878	5.34968	7.284108
Median	0.108638	5.233245	7.205206
Maximum	0.551079	8.634478	9.840383
Minimum	-0.250105	3.314186	5.244389
Std. Dev.	0.093266	1.094599	1.006725
Skewness	0.689605	0.369108	0.28737
Kurtosis	5.759824	2.467879	2.274043
Jarque-Bera	203.0688	17.66645	18.28992
Probability	0	0.000146	0.000107
Sum	58.30567	2739.036	3729.463
Sum Sq. Dev.	4.444978	612.2527	517.8962
Observations	512	528	528

1.New Credit, Fiscal and GDP are the log of newly extended real credit per capita, log of real government expenditure per capita and log of real GDP per capita, respectively.

4 Results

We begin by presenting the simple panel and uncorrected dynamic panel estimates as summarised in equations (1)-(4) in Table 3.

1. The dependent variable in all specifications is real GDP per capita. 2. *,**,*** denotes statistical significance at the 10%, 5% and 1% levels, respectively. 3. A constant and fixed effects are included in all specifications.

Table 2: Standard Fixed Effect Panel Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit	0.41	-0.14			0.06***	0.05**		
Fiscal		0.91***				0.03***		
Credit(-1)			0.43	-0.1			0.06***	0.06***
Fiscal(-1)				0.94***				0.01
GDP(-1)					1.01***	0.98***	1.01***	1.01***

Column 1 reports that credit displays a positive but statistically insignificant relationship with output. When government expenditure expenditure is added in column 2, the coefficient to credit becomes negative but remains statistically insignificant. The coefficient to government expenditure appears as positive and significant at the 1 per cent level. When only lagged values of credit and government expenditure are included, as in columns 3 and 4, the results remain similar with the coefficient to credit continuing to be insignificant.

As noted in the Section 2 however, the problem associated with the equations estimated in columns (1)-(4) is that they do not allow for the possibility of omitted variables that are time variant. Moving to a dynamic model is appropriate in such cases. Columns (5) - (8) reproduce columns (1) - (4), except now also include lagged real GDP per capita as an additional explanatory variable. Moving to a dynamic specification changes the results considerably. In particular, the coefficient to credit becomes positive and highly statistically significant. This is the case whether credit is included contemporaneously (columns 5) and alongside government expenditure (column 6), or instead by their lagged values (columns 7 and 8). The coefficient to government expenditure now becomes much smaller, and in the case of its lagged value, statistically insignificant. This result provides some evidence that earlier empirical studies that reported a positive and statistically significant relationship between government expenditure and output may reflect the fact that the impact of credit was not controlled for. In all specifications the coefficient to real GDP per capita is positive and highly statistically significant, suggesting that the use of a dynamic model is appropriate.

The limitation associated with the results presented in columns (5) - (8) of Table 3 is that a lagged dependent variable is included alongside fixed effects, leading to potentially inconsistent parameter estimates. We therefore move on to presenting dynamic panel GMM-in-difference results as summarised by equation (5) in Table 4. In all columns, real GDP per capita is instrumented by its lagged values (from 2 to 6). 1. The dependent variable in all specifications is the first difference of real GDP per capita. 2. *,**,*** denotes statistical significance at the 10%, 5% and 1% levels, respectively. 3. GDP was instrumented using the 2nd through to 6th lagged

Table 3: Dynamic Fixed Effect Panel Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Credit	0.08***	0.08***			0.08***	0.08***		
Fiscal		-0.01				0.01		
Credit(-1)			0.12***	0.11***			0.06**	0.06**
Fiscal(-1)				-0.02				0.01
GDP(-1)	1.01***	1.02***	1.01***	1.03***	1.45***	1.45***	1.43***	1.43***
GDP(-2)					-0.45***	-0.45***	-0.42***	-0.43***

values. 4. The GMM weighting matrix featured White period standard errors.

The results show that the coefficient to credit remains positive and highly statistically significant. Columns (1) to (4) show that whether the contemporaneous or lagged value of credit is considered, or whether government expenditure is also included as an additional explanatory variable, there is no impact on the statistical significance of the estimated coefficients and only a marginal impact on their magnitude. The reported coefficient values indicate that a 1 per cent increase in newly extended real credit per capita leads to around a 0.1 per cent increase in real GDP per capita. The magnitude is slightly larger when lagged rather than contemporaneous values for credit are considered. The coefficient to government expenditure remains small in magnitude and statistically insignificant when either the contemporaneous or lagged value is considered.

As a final robustness check, we also included an additional lag of the dependent variable. These results are shown in columns (5) - (8). Once again, the coefficient to credit is positive and highly statistically significant, and of a similar order of magnitude. The only difference now is that the magnitude of the coefficients associated with the lagged value of credit are slightly smaller than for the contemporaneous value. The coefficient to government expenditure continues to be small and insignificant.

To summarise, the above results convey two important findings. Firstly, they provide evidence that in China there exists an important nexus between credit and output. Secondly, once the role played by credit has been controlled for, the impact that government expenditure has on output is less robust than previous studies have indicated.

5 Conclusion

This paper sort to move beyond the existing descriptive accounts of the impact that credit has on output in China. The econometric results suggested that the impact of

credit is both statistically and economically significant with a 1 per cent increase in newly extended credit per capita leading to around a 0.1 per cent increase in real GDP per capita. Thus, the empirical findings served to confirm and complement existing descriptive accounts of a credit-output nexus in China.

The results also showed that the impact of credit on output overshadowed that of another possible aggregate demand driver, government expenditure. Once credit was controlled for, government expenditure failed to display a statistically or economically significant impact on output. This finding served to clarify earlier empirical findings that pointed to a more prominent role played by government expenditure, and also to illuminate the fondness of the Chinese government for using credit as a macroeconomic stimulus measure.

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