Provincial business cycles and fiscal policy in China*

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Abstract

This paper begins by documenting considerable asynchronization in business cycle fluctuations across China's 31 provinces. Given that monetary policy is more or less centralized, this asynchronization points to potential benefits from provinces being able to exercise a degree of fiscal autonomy. The extent to which provinces have this autonomy in practice is discussed. Provincial fiscal policy is then analysed to assess whether it has had the effect of smoothing provincial business cycles. A key finding is that, if anything, provincial fiscal policy has amplified provincial business cycles, not smoothed them.

JEL codes – E32, E62, R12.

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1. Introduction

By any measure, China is a large country. It has the world's largest population, consisting of 1.3 billion people. It has the world's second largest economy, with a GDP in excess of $US5 trillion and that continues to grow by around 10% each year. It is also geographically vast. With a land mass of 9.5 million km^2, this sees it ranking as the world's third (or fourth) largest country in terms of area. As of 2008, this land mass was divided into 31 provinces (including municipalities and autonomous regions), 333 prefectures, 2859 counties and 40,828 townships (CSY, 2009). Dealing with the challenges posed by this spatial dimension has historically proven difficult for the central government in Beijing, with the old Chinese proverb, *shan gao, huangdi yuan* (the mountains are high and the emperor is far away), hinting at some of these challenges.

This paper considers the challenges this spatial dimension poses for macroeconomic policy. China's vast geography means that it cannot be taken for granted that business cycle fluctuations at the sub-national level will be highly synchronized. For example, owing to significantly greater exposure to international trade and investment, the business cycles of coastal provinces might be far more dependent on the international business cycle than their inland counterparts. China's transition to a market economy has also meant that comparative advantage now plays a greater role in determining the structure of production. However, owing to variation in the location of factor endowments across the country, the comparative advantage of one province need not be the same as another. This means that some provinces might be more vulnerable than others to sector specific shocks. If provincial business cycles are not highly synchronized, this implies that the optimal macroeconomic policy stance (expansionary or contractionary) at the national level may not be optimal at the provincial level.

The stance of monetary policy in China is more or less determined centrally. Indeed, in 1998, China central bank, the People's Bank of China (PBC), adopted a supra-regional structure with the explicit aim of removing provincial influence over matters related to the financial system and monetary policy. Provinces do not, for example, have the flexibility to adjust monetary policy tools and operational instruments such

as interest rates and bank reserve requirements. Such centralization, however, does not necessarily apply to fiscal policy and it is fiscal policy that is the focus of this paper. Section 2 begins by providing an assessment of the extent to which business cycle fluctuations have been synchronized across China's 31 provinces during the reform period, 1978-2008. Significant asynchronization is found to exist and this points to potential benefits from provinces being able to exercise a degree of fiscal autonomy. Section 3 discusses the extent to which provinces have this autonomy in practice. Of course, the potential to use provincial fiscal policy to smooth provincial business cycle fluctuations does not mean it has had that effect. Section 4 considers whether provincial fiscal policy has been implemented in a manner that is counter-cyclical to provincial business cycles. Section 5 considers whether provincial fiscal policy has had "Keynesian effects" on the growth of real GDP and private consumption. Section 6 summarises the findings.[1]

2. How Synchronized are Provincial Business Cycles?

Assessing the extent to which provincial business cycles are synchronized requires that they first be identified and measured. Three basic metrics are used. The first is the growth rate, or first difference, of provincial real GDP. The second is the provincial real GDP output gap calculated using the Hodrick-Prescott (H-P) filter (Hodrick and Prescott, 1997). The third is the provincial real GDP output gap calculated using the Baxter-King (B-K) band-pass filter (Baxter and King, 1999). Data availability considerations mean that business cycles must be identified and measured in real output series rather than other possible alternatives, such as unemployment series. The purpose of using multiple metrics to identify and measure business cycles in real output series is because the trend in real output is unobservable. Therefore, the derived cyclical fluctuations can be sensitive to the particular trend extraction technique used. For example, while the H-P filter is probably the most commonly used trend extraction technique in empirical studies,[2] it is not without its critics, particularly with respect to its end of sample properties (Cogley and Nason, 1995). In

[1] This study is not the first to discuss business cycles at the provincial level in China, e.g., Poncet (2004), Byström, et al. (2005), Poncet and Barthélemy (2008) and Gerlach-Kristen (2009). To the best of our knowledge however, it is the first to identify and measure provincial business cycles using multiple metrics and consider the effects of provincial fiscal policy on provincial business cycles.

[2] This is certainly true in the case of previous studies that have discussed provincial business cycles in China, e.g., Poncet (2004), Poncet and Barthélemy (2008) and Gerlach-Kristen (2009)

contrast, the B-K filter comes from a different class of filters known as frequency filters and therefore provides a useful robustness check.

The data set consists of annual real GDP observations for China's 31 provinces covering the reform period, 1978-2008.[3] The data are obtained from the 2009 edition of the various provinces' statistical yearbooks.[4]

After provincial business cycle fluctuations have been identified and measured, the extent to which they are synchronized is assessed in several ways. The first is through the calculation of simple, pairwise correlation coefficients. The second follows Gerlach-Kristen (2009) in using factor analysis to extract the first principal factor and considering how much of the variance in the underlying 31 series this factor is able to explain. Thus, the first principal factor is interpreted as an indicator of the "common component" of provincial business cycle fluctuations. Finally, the concordance index of Harding and Pagan (2002) is utilized. In the context of this paper, the concordance index measures the proportion of the sample period that a given province's business cycle is in the same phase as the national business cycle, according to the H-P and B-K output gap series. The metric of a concordance index adds value to the analysis because the appropriate macroeconomic policy stance, be it fiscal or monetary, is regularly couched in terms of whether an economy is operating at above or below trend. The concordance index is constructed as follows:

Let S_{it} be 1 if province i is above trend at time t, and zero otherwise. Analogously, S_{jt} is equal to 1 if "province j" (i.e., the country as a whole) is above trend at time t. Then the simple matching similarity coefficient (standard concordance index) between the two provinces is:

[3] In China, real GDP data at a quarterly frequency are only available at the national level, and even then, only since the late 1990s.

[4] There are only a handful of exceptions. For example, the data for Guizhou over the period 1978-1998 was obtained from NBS (1999) while for 1999-2008 it was obtained from CSY (various years). For a few provinces, such as Yunnan, the 2009 edition of the provincial statistical yearbook was not yet available and hence the 2008 observation was obtained from CSY (2009). It is also worthwhile noting that data in the provincial yearbooks was cross-checked against that found in the national yearbook to ensure consistency. The full data set is available from the authors upon request.

$$(1) \quad I_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left[S_{it}S_{jt} + (1-S_{it})(1-S_{jt})\right] \qquad \text{where } t = 1, \ldots\ldots T$$

Tables 1, 2 and 3 present the average pairwise correlation coefficients for each of China's provinces using the metrics of first differences, the H-P output gap and the B-K output gap, respectively.[5] The full sample is also divided into two sub-samples in an attempt to shed light on whether there have been any obvious changes in synchronization over time.[6] In light of the reduction in inter-provincial trade barriers that have occurred during the reform period (Holz, 2009), an increase in synchronization might be expected as trade provides a channel through which shocks can be transmitted across borders (Frankel and Rose, 1998). On the other hand, increasing trade, both domestic and international, can in turn encourage specialization in production, which might make some provinces more vulnerable to sector specific shocks than others (Imbs, 2004).

Table 1 here

Table 2 here

Table 3 here

In terms of the full sample the following observations appear salient.

1. The extent of synchronization varies considerably depending upon the metric used to identify and measure business cycles. This highlights the dangers of relying on a single metric, such as the H-P output gap. The average pairwise correlation coefficient across all provinces when using the metric of first differences, the H-P output gap and the B-K output gap, is 0.46, 0.71 and 0.53, respectively. Thus, the results based on the H-P output gap are noticeably higher than the others.

[5] The complete pairwise correlation matrices for each of the three metrics are available from the authors upon request.

[6] The precise size of the full sample and the two sub-samples differs slightly depending upon the metric used. In the case of the H-P output gap, the full sample covers 1978-2008 while the first and second sub-samples cover 1978-1993 and 1994-2008, respectively. In the case of first differences, the full sample covers 1979-2008 while the first and second sub-samples cover 1979-1993 and 1994-2008, respectively. In the case of the B-K output gap, which by construction truncates both ends of the sample, the full sample covers 1981-2005 while the first and second sub-samples cover 1981-1993 and 1994-2005, respectively. Thus, particularly in the case of the B-K output gap, the results for the sub-samples need to be interpreted cautiously in light of the limited number of observations.

It is useful to put the above correlation coefficients into a comparative perspective in order to get a better sense of their magnitude. Partridge and Rickman (2005) undertake a similar exercise in the context of U.S. states. They also identify and measure state business cycles using the H-P and B-K filters, although the underlying variable they consider is unemployment, not real GDP.[7] They find that over the period 1969-2000, the average pairwise correlation coefficient across U.S. states using the H-P and B-K filtered unemployment series is 0.66 and 0.73, respectively. Carmignani (2009) reports that the correlation between the real GDP growth series of European Monetary Union member countries over the period 1960-2007 is around 0.5, while the correlation between H-P filtered real GDP series is around 0.6.

2. In accordance with expectations, the extent of business cycle synchronization appears negatively correlated with distance. This is not only in terms of east and west, the direction into which China is typically divided, but also north and south. For example, when using the metric of first differences, the correlation coefficient between China's Heilongjiang province in the north and Zhejiang, Guangdong and Hainan in the south is just 0.13, 0.12, -0.10, respectively. Such values illustrate that the *average* pairwise correlation coefficients in Tables 1, 2 and 3, which are already not particularly high, act to conceal considerable pairwise heterogeneity.

3. Tibet is an obvious outlier. Across all metrics, its business cycle is weakly (or negatively) correlated even with the bordering provinces of Xinjiang, Qinghai and Sichuan. The average pairwise correlation of Hainan is also low but its business cycle is at least closely synchronized with neighboring provinces.

In terms of the two sub-samples the results based on the H-P output gap indicate a sharp increase in synchronization over time. However, such results stand in contrast to those based on the metrics of first differences and the B-K output gap. In the second sub-period, the average pairwise correlation coefficient across all provinces when using the H-P output gap is 0.91. This seems an implausibly high value. Even for

[7] As alluded to in the Introduction, it is not possible to examine provincial business cycle fluctuations in China using unemployment data as official unemployment data are incomplete and notoriously unreliable.

Tibet, the average pairwise correlation jumps from -0.03 in the first sub-sample to 0.88 in the second sub-sample. Such results suggest that the apparently high synchronization found when using the H-P output gap may say more about the technique itself rather than actually being present in the underlying data. The results based on first differences and the B-K output gap tell a more consistent story. In the case of first differences, the average pairwise correlation across all provinces increases from 0.46 to 0.52, while when using the B-K output gap it increases from 0.54 to 0.58. Reflecting this small increase overall, several provinces actually experienced a decrease in synchronization, including economically important ones, such as Beijing and Shanghai. Thus, even if only the more recent period is considered, the conclusion that China's provinces exhibit considerable business cycle asynchronization remains.

We now turn to the results of the factor analysis. Over the full sample, the first principal factor is found to be able to explain 48.3%, 72.7% and 55.0% of the variation in the underlying 31 provincial series when using the metrics of first differences, the H-P output gap and the B-K output gap, respectively. Thus, the result based on the H-P output gap again appears as a relative outlier and the "common component" of provincial business cycle fluctuations only accounts for around one half of the variance in the underlying 31 provincial series. Figure 1 shows the results of the factor analysis when using a rolling 15 year window. In contrast to the results based on the H-P output gap, the results based on first differences and the B-K output gap show no sharp increase in the explanatory power of the first principal factor over time.

Figure 1 here

Finally, we turn to the results of the concordance index analysis. These results are presented in Table 4 and show the proportion of the sample period that a given province's business cycle is in the same phase as the national business cycle, according to the H-P and B-K output gap series. The results show considerable heterogeneity across provinces. For example, Hubei's business cycle displays a high degree of concordance being in the same phase as the national business cycle 97% and 92% of the time, according to the H-P output gap and the B-K output gap,

respectively. In contrast, Hainan's business cycle displays a much lower level of concordance being in the same cycle phase just 68% and 72% of the time. Other provinces, such as Tibet, display a similarly low level of concordance. Such results are striking given that there are only two cycle phases (i.e., above and below trend). Therefore, even if a particular province's business cycle and the national business cycle were driven by completely independent forces we would still expect to find them in the same cycle phase roughly 50% of the time.[8,9]

Table 4 here

The above results are interesting for a couple of reasons.

Firstly, they are interesting for what they say about the explanatory power of the theory of endogenous optimal currency areas. The notion that an optimal currency area might be endogenously determined has gained popularity since the seminal work of Frankel and Rose (1998). These authors found that an increase in bilateral trade ties was associated with an increase in business cycle synchronization. Therefore, even if a grouping of countries (or provinces) did not constitute an optimal currency area initially in the sense that their business cycles were highly synchronized, if the formation of the currency area acted to promote trade ties then over time the area might endogenously move towards being optimal. However, thirty years after its economic reform program began, there is only limited evidence to suggest that this is the case in China. One possible reason why China's experience may not lend support to the endogenous optimal currency area hypothesis is that despite liberalization in some parts of the economy, inter-provincial trade barriers have actually increased. This is the position taken by Young (2000) but it has recently been robustly critiqued by Holz (2009).

Secondly, given that monetary policy in China is more or less centralized, the above results point to potential benefits from provinces being able to exercise a degree of fiscal autonomy to smooth their own, somewhat unique, business cycle fluctuations.

[8] This assumes that the output gap series spends an equal number of periods above and below trend and this is indeed the case for most provinces.
[9] We also calculated the pairwise concordance between any two provinces' business cycles. These results are available from the authors upon request.

Whether China's provinces enjoy such fiscal autonomy, and if they do, whether provincial fiscal policy has had the effect of smoothing provincial business cycles are questions to which the following sections turn.

3. Do Provinces Have Fiscal Autonomy?

Prior to the reform period, China operated a centralized system of fiscal revenue and expenditure. This system earned the nickname, *chi da guo fan* (eating from one big pot). He (2008, p.18) notes that, "The system required sub-national governments to collect revenue for the center but to assume no capacity to determine their own expenditures". Thus, under this system provincial governments possessed very limited fiscal autonomy.

The fiscal system began to change with the onset of economy-wide reforms in 1979. Over the period 1980-1993, provincial governments entered into revenue sharing arrangements with the central government. Total revenue was disaggregated into "central revenue", which included items such as profit remittances from central government supervised state-owned enterprises (SOEs), and "local revenue". Jin, et al. (2005) reports that, on average, over this period local revenue accounted for around two-thirds of total government revenue. Local revenue was then divided between the central and provincial authorities based on agreements that varied by province and over time. This system, which earned a contrasting nickname, *fen zao chi fan* (eating from separate pots), had the effect of providing provincial governments with much greater incentives to collect revenue, and in so doing, determine their own level of expenditure. An analysis of this system by Jin, et al. (2005, p.1723) concluded that, "Over time, many provincial governments retained 100% of the total local revenue at the margin, which effectively made them residual claimants over the local revenue". This is reflected in their empirical finding that the correlation between provincial budgetary revenue and expenditure was about four times as large during this period compared with the pre-reform period. Specifically, they found that, on average, a one *yuan* increase in provincial budgetary revenue resulted in about three-quarters *yuan* of provincial budgetary expenditure.

The most recent large-scale fiscal reform took place in 1994. This reform was initiated by the central government in response to two trends. The first was a decline

in the government revenue share of GDP, which had fallen to less than 10% in the early 1990s (Dollar and Hoffman, 2006). The fall was essentially the result of the rapid rise of the non-state sector. China's tax base in the first half of the reform period remained rooted in the retained profits of SOEs. However, with the emerging non-state sector, the importance of SOEs as a proportion of total output declined. Moreover, competition between SOEs and non-SOEs whittled away at the profit margins of the former. Secondly, the share of total government revenue going into central coffers was also falling. Fiscal reform in 1994 designated taxes as being one of three types – central, local or shared. This distinction was supported by a new institutional framework whereby two separate tax administrations were created with one being responsible for collecting central taxes, such as tariff revenue, and the other being responsible for collecting local taxes, such as personal income taxes. Shared taxes, notably a newly introduced value-added tax, were split between central and local authorities in a ratio that was fixed and applied equally to all provinces. The reform had the desired effect of both increasing the tax share of GDP and increasing the central government share of total tax revenue. It did not however, significantly take away from the fiscal autonomy that the provinces had acquired in the first half of the reform period for a variety of reasons.

Firstly, the new system was less than comprehensive in that while it entailed large scale changes on the revenue side of the budget, the status quo was retained on the expenditure side. Government spending responsibilities in China are highly decentralized with local governments responsible for around 70% of total government spending, even on items such as social security that are the responsibility of central government in most other countries (Dollar and Hoffman, 2006). Thus, one of the expected outcomes of the 1994 reforms, which saw the central government take an increased share of total tax revenue, was to increase provincial government budget deficits. The central government increased revenue rebates and transfers to the provinces in compensation. As shown by He (2008), the size of the transfer received by a given province has been significantly correlated with that province's fiscal revenue and revenue contributions to the central government. In other words, rather than the transfer system playing a redistributive role, it instead features a strong churn element whereby revenue remitted from a province to the center gets returned to the province. Secondly, provincial governments retained 25% of the revenue earned from

the shared value-added tax. Thirdly, provincial governments retained 100% of the revenue earned from those taxes defined as local taxes. Fourthly, provincial governments retained 100% of "extra-budgetary" and "off budget" local revenues. Examples of the former are fees and charges levied by the provincial government that are not officially defined as taxes (He, 2008). Fifthly, while the 1994 reform prohibited provincial governments from borrowing of their own accord to fund deficits, since 1999 the central government has provided a facility whereby the proceeds of central government bond sales can be re-lent to the provinces (He, 2008). Local governments can also engage in borrowing indirectly through, for example, business entities under their administrative control.

All of the above factors help to explain another empirical finding of Jin, et al. (2005) that the relationship between provincial expenditure and revenue remained roughly the same after the 1994 reforms as before. On the apparent bias of the 1994 reforms in favour of the central authorities, He (2008, p.22) comments, "In fact, however, great authority and power enjoyed by the central government in fiscal legislation and policy-making does not mean that there is not also great authority and power for sub-national governments to obtain financial resources through various, sometimes implicit, means. In particular, governments and their agencies in China at all levels, have great freedom to conduct business and investment, as well as to impose charges and/or surcharges on the economy and society with or without disguise. This might be simply because there has been no explicit, sufficient legislation and regulation regarding what governments might or might not do in terms of fee-charging and business-making activities. As the central government reserves great authority and power for itself, it also leaves large loopholes for sub-national governments to counterbalance fiscal centralization by exercising similarly heavy authority and power in their individual jurisdiction."

4. Is Provincial Fiscal Policy Counter-Cyclical?

Given that provinces possess a degree of fiscal autonomy, the next question to ask is whether provincial fiscal policy has been used to effectively smooth provincial business cycles? For this to have been the case, two criteria must be satisfied. Firstly, provincial fiscal policy variables, such as provincial government expenditure, must

have moved in a manner that is counter-cyclical to provincial business cycles. Secondly, provincial fiscal policy variables must have had Keynesian effects, that is, they must have had positive and statistically significant effects on the growth of real GDP and private consumption.

In terms of provincial fiscal variables, in this paper we focus solely on provincial government budgetary expenditure. This choice largely reflects data availability considerations. Provincial government budgetary revenue data is also available for most provinces over the reform period but it is "messy". As discussed in the previous section, fiscal reforms during the reform period have focused overwhelmingly on the revenue side of the equation. Thus, while one can find provincial government budgetary revenue data in official sources, data in later years are frequently not comparable with those in earlier years. In any case, if provincial governments have used fiscal policy to offset business cycle fluctuations, this should be clearly evident in the expenditure data.

To consider whether provincial fiscal expenditure has moved in a manner that is counter-cyclical to the business cycle, we first convert the provincial fiscal expenditure series to real terms using the provincial GDP deflators. The cyclical component is then extracted using the H-P and B-K filters. We then calculate the correlation coefficient between the cyclical component of a given province's real fiscal expenditure series and the cyclical component of its real GDP series. A correlation coefficient that is negative (positive) and statistically significant is indicative of provincial fiscal policy being implemented in a counter-cyclical (pro-cyclical) manner. Results are presented in Table 5. Statistical significance at the 1, 5 and 10% levels are denoted by ***, **, *, respectively.

Table 5 here

The correlation coefficients obtained when using the H-P filter are positive and statistically significant at the 1% level across all provinces. The correlation coefficients obtained when using the B-K filter are less extreme in terms of their magnitude but nonetheless also point to provincial fiscal policy generally being implemented in a *pro-cyclical* manner. The correlation coefficients for all provinces

with the exception of Xinjiang are positive. For seven provinces, this positive correlation is significant at the 1% level. For a further 5 provinces, it is significant at the 5% level.

The above findings carry the distinct suggestion that provincial fiscal policy might actually have had the effect of amplifying provincial business cycles rather than smoothing them. Whether this has in fact been the case depends upon whether provincial fiscal policy has had Keynesian effects on the growth of real GDP and private consumption.

5. Does Provincial Fiscal Policy Have Keynesian Effects?

In order to test whether provincial fiscal policy has had Keynesian effects, we begin with the following model estimated on a panel of 31 Chinese provinces over the period 1978-2008:[10]

$$(2) \qquad y_{i,t} - y_{i,t-1} = \beta(g_{i,t-k} - g_{i,t-k-1}) + \mathbf{W}_{it}'\mathbf{b} + \varepsilon_{i,t}$$

where y is the log of per-capita real GDP (or per-capita real private consumption), g is the log of per-capita real fiscal expenditure, **W** is a vector of additional control regressors, such as province fixed effects, ε is an error term, i denotes a generic province and t a generic year. For our purposes, the coefficient of interest is β. A positive and significant β means that, on average, provincial fiscal policy has had Keynesian effects as it implies that a higher per-capita fiscal expenditure growth is associated with a higher per-capita GDP growth.[11] It is worth noting that for k>0, equation (2) allows for a lagged effect of per-capita fiscal expenditure on the pace of economic activity.

[10] Note, however, that data availability means the panel is not perfectly balanced.

[11] It is worth emphasizing that our regression is specified in growth rates, not levels. Thus, the estimated β coefficient can be interpreted as the percentage change in per-capita GDP growth associated with a given percentage change in per-capita fiscal expenditure growth. This is not the same as estimating the effect on the level of per-capita GDP of an increase in the level of per-capita fiscal expenditure by, say, one dollar.

An equation like (2) has been often used in the literature to study the macroeconomic effects of fiscal policy in developed as well as developing countries (see Carmignani, 2008; Carmignani, 2010). Because we are working with a limited number of observations, the specification of **W** will necessarily have to be parsimonious. Our objective is not to include all of the factors that can explain most of variation in per-capita GDP growth across provinces, but simply to examine whether per-capita fiscal expenditure growth affects per-capita GDP growth. As discussed below, we make use of province fixed effects to account for unobserved individual heterogeneity and also introduce a lagged dependent variable to model growth dynamics. When the inclusion of the lagged dependent variable makes our preferred estimator inconsistent, we try to model time effects using year dummies.

5.1 Panel OLS estimates

Table 6 reports OLS estimates of several specifications of equation (2). In column 1, the dependent variable is per-capita GDP growth. In addition to per-capita fiscal expenditure growth, the right hand side of the equation only includes province fixed effects. As can be seen, the coefficient of interest is positive and highly significant suggesting that, on average, provincial fiscal policy has had Keynesian effects. From an economic perspective, however, the effect does not seem to be very large: the point estimate suggests that to increase the growth rate of per-capita GDP by half a percent it is necessary to increase the growth rate of per-capita fiscal expenditure by five percent.[12]

In column 2 we allow for a one year lagged effect of per-capita fiscal expenditure growth. The estimated β is marginally smaller than the one reported in column 1, but is still positive and highly significant.

In columns 3 and 4 we re-estimate the previous two specifications except with real per-capita household consumption growth as the dependent variable. While remaining generally Keynesian, the effect of provincial fiscal policy now appears to be

[12] The R^2 of our regression is relatively low at 0.16. However, as noted, the purpose here is not to explain as much of the variation in per-capita GDP growth as possible. We simply try to estimate the effect of per-capita fiscal expenditure growth after controlling for a reasonable set of right hand side variables.

considerably less strong both economically and statistically, particularly when considering a one-year lagged effect.

Previous work in OECD economies has raised the possibility that fiscal policy might have non-linear effects (see Giavazzi and Pagano, 1990; Giavazzi and Pagano, 1996; Giavazzi, et al., 2000). In particular, the idea, supported by some empirical evidence, is that fiscal policy effects are generally Keynesian, but they become non-Keynesian in non-normal fiscal times, that is, in times of very large fiscal expansion or contraction. Several subsequent papers have shown that in non-OECD economies the evidence on non-Keynesian effects even in non-normal fiscal times is very limited (see, inter alia, Hemming, et al., 2002; van Aerle and Garretsen, 2003; Schlarek, 2007; Carmignani, 2008). Nonetheless, we account for this possibility by re-estimating the specifications in columns 1 and 2 by adding the squared change in per-capita fiscal expenditure growth on the right hand side. The results are not reported in Table 6 to save space but, in a nutshell, they show that the estimated coefficient on per-capita fiscal expenditure growth is always positive and significant. The coefficient of the squared term is instead negative, in line with the hypothesis that when the change in per-capita fiscal expenditure growth is large enough its effect becomes non-Keynesian, but it is not statistically significant. For this reason, in the rest of the paper we continue working with the linear specification.

In the remaining columns of Table 6 we allow for different dynamics in the per-capita GDP growth process. In columns 5 and 6 we enter the lagged value of per-capita GDP growth as an additional explanatory variable. The coefficients of contemporaneous and lagged per-capita fiscal expenditure growth are again highly significant and indicative of overall Keynesian effects. The autoregressive coefficient of per-capita GDP growth is positive, but smaller than one. The models in columns 5 and 6 are in fact equivalent to a regression of the level of per-capita GDP on its one period and two periods lagged values. In Columns 7 and 8 we therefore re-estimate the more familiar dynamic specification with the lagged level of per-capita GDP as an explanatory variable. This corresponds to a regression of log per-capita GDP on its one period lagged value. Interestingly, the estimated coefficient on the lagged level of per-capita GDP is positive, albeit much smaller, meaning that there is no evidence of mean reversion in per-capita income levels. However, for the purpose of our analysis,

what is really important is that the coefficients of per-capita fiscal expenditure growth are once again positive and significant.[13]

Table 6 here

5.2 Panel instrumental variables estimation

In Table 7 we try to address the issue of potential endogeneity between per-capita GDP growth and per-capita fiscal expenditure growth: if provincial governments set fiscal policy in response to business cycle fluctuations, then per-capita GDP growth might determine per-capita fiscal expenditure growth rather than vice-versa. In this case, OLS estimates of β would be biased. One might argue that reverse causality is unlikely in the case where per-capita fiscal expenditure growth enters on the right hand side with a one period lag. Nonetheless, we would like to present a more systematic treatment of the problem.

We start by estimating a 2SLS version of model (2) that only includes contemporaneous per-capita fiscal expenditure growth and province fixed effects as regressors. These results are presented in column 1 of Table 7. We instrument per-capita fiscal expenditure growth by the lagged value of the level of fiscal expenditure.[14] The results again suggest that fiscal policy has Keynesian effects. Indeed, the point estimate of β is now even larger: an increase in the growth rate of per-capita fiscal expenditure by slightly less than two percent is sufficient to increase the growth rate of per-capita GDP by half a percent. When we also allow for a lagged effect of per-capita GDP growth in column 2, the estimated β decreases somewhat, but the qualitative conclusion regarding the effects of per-capita fiscal expenditure growth does not change. The model specified with one-period lagged per-capita fiscal expenditure growth yields very similar results to those reported in columns 1 and 2 (see columns 3 and 4).

[13] When we estimate the dynamic models using the growth (and level) of per-capita household consumption instead of the growth (and level) of per-capita GDP we find that the contemporaneous growth of per-capita fiscal expenditure always has a positive and significant coefficient while the coefficient of the lagged growth of fiscal expenditure is not different from zero.

[14] We choose to use the two-period lagged level of expenditure because the level of expenditure is likely to be contemporaneously endogenous with the level of per-capita GDP. In this case, the one period lagged value of per-capita fiscal expenditure is no longer a valid instrument for per-capita fiscal expenditure growth. In fact, results obtained using the one-period lagged level of per-capita fiscal expenditure as instruments are not qualitatively different from those reported in Table 6.

One clear weakness in our strategy is that a dynamic model with fixed effects cannot be consistently estimated using 2SLS. We therefore explore two alternative estimation routes. First, we drop the province fixed effects and re-apply 2SLS. A (possibly minor) advantage of not using province fixed effects is that we can introduce a second instrument for the growth of per-capita fiscal expenditure, namely the geographical distance between provinces and Beijing. The intuition here is that more distant provinces enjoy greater "de facto" fiscal autonomy and can therefore afford more expansionary fiscal policies. This hypothesis is indeed confirmed by the results of the first stage regression: the estimated coefficient of physical distance is positive and significant. At the same time, the two excluded instruments (physical distance and the lagged level of per-capita fiscal expenditure) are jointly highly significant in the first stage.[15] The second stage regression results are reported in column 5 (contemporaneous per-capita fiscal expenditure growth) and column 6 (lagged per-capita fiscal expenditure growth). It can be noted that the point estimates of β are now much closer to those reported in Table 6.

The second route is to implement the GMM estimator of Arellano and Bond (1991). To save space, we apply this estimator to the model with contemporaneous per-capita fiscal expenditure growth only. Results are shown in column 7: there is again clear evidence of Keynesian effects. In column 8 we employ the Arellano and Bover (1995) and Blundell and Bond (1998) version of the GMM estimator to get rid of the small sample bias that might affect the Arellano and Bond estimator. Results are not qualitatively different from those shown in the previous column.

Table 7 here

5.3 Differential Effects Across Provinces

The evidence so far indicates that, on average, provincial fiscal policy in China has had Keynesian effects. We now employ an extension of model (2) that allows us to

[15] Because now we have more instruments than endogenous variables, we can also perform the Sargan test. It turns out that the null hypothesis of this test can never be rejected at usual confidence levels, thus suggesting that the overidentifying restrictions implied by our choice of instruments are valid. The results of all these specifications tests are available from the authors upon request.

test whether the effect of fiscal policy differs across provinces. To achieve this, we interact per-capita fiscal expenditure growth with provincial dummies. That is:

$$(3) \qquad y_{i,t} - y_{i,t-1} = \sum_{i=1}^{31} d_i \beta_i \left(g_{i,t-k} - g_{i,t-k-1} \right) + \mathbf{W}_{it}' \mathbf{b} + \varepsilon_{i,t}$$

Results are reported in Table 8. We note that with the inclusion of 31 interactive terms, in addition to province fixed effects, we are asking a lot of our dataset. In a very limited number of cases, such as for the province of Chongqing, the coefficient of the interactive term is estimated using a small number of observations of per-capita fiscal expenditure growth. Therefore, coefficients should be interpreted with some caution.

Columns 1 and 2 of Table 8 present OLS estimates for contemporaneous and one-period lagged per-capita fiscal expenditure growth, respectively. Two interesting findings emerge. First, there is evidence of significant Keynesian effects in several provinces. Keynesian effects appear particularly large in provinces such as Shanxi, Inner Mongolia, Jiangxi, Hunan, Shaanxi, Qinghai and Ningxia. On the other hand, Keynesian effects are not significant in about half of all provinces. Second, there is very little evidence of non-Keynesian effects. In fact, the only province where per-capita fiscal expenditure growth is negatively and significantly associated with per-capita GDP growth is Chongqing and even for this province the estimated coefficient becomes insignificant when lagged per-capita fiscal expenditure growth is used as a regressor.

In columns 3 and 4 we report the 2SLS of the same model. Interactive terms are instrumented by the interaction between lagged levels of per-capita fiscal expenditure and the provincial dummies. Qualitatively these 2SLS estimates are similar to the OLS estimates, although we note an increase in the size of coefficients. Accounting for growth dynamics in a model with 31 interactive terms and 31 provincial dummies is complicated. The inclusion of lagged per-capita GDP growth (or lagged per-capita GDP) as we did in Tables 6 and 7 would make 2SLS heavily inconsistent. We therefore opt for a conservative choice and try to account for possible time effects by

further expanding the model with the addition of a full set of time dummies and by using covariance estimators that are robust to hetoreskedasticity across periods (see Beck and Katz, 1995). The estimates of the model with time effects are reported in columns 5 and 6. The main difference relative to previous estimates is that non-Keynesian effects are now statistically significant in three provinces, Guangdong, Hainan and Xinjiang. Yet, in the large majority of provinces, fiscal policy still either has Keynesian effects or is not statistically significant.

Finally, we conduct a simple experiment to try and understand to what extent the effects of fiscal policy at the provincial level differ from the effects of fiscal policy at the national level. To consider this question we add an additional regressor, per-capita fiscal expenditure growth of the central government, denoted by subscript, *c*. We then estimate the following variation of model (3):

$$(4) \qquad y_{i,t} - y_{i,t-1} = \alpha\left(g_{c,t-k} - g_{c,t-k-1}\right) + \sum_{i=1}^{31} d_i \beta_i \left(g_{i,t-k} - g_{i,t-k-1}\right) + \mathbf{W}_{i,t}'\mathbf{b} + \varepsilon_{i,t}$$

where *i* still denotes a generic province and **W** includes a full set of province and time dummies. In model (4), the effect of per-capita fiscal expenditure growth in generic province *i* is equal to $\beta_i + \alpha$, while the effect of per-capita fiscal expenditure growth at the national level is equal to α. Therefore, β_i represents the differential effect of fiscal policy in each province relative to the national level. Our interest here is not so much on the point estimate of β_i, but rather on its level of statistical significance: a statistically significant β_i means that per-capita fiscal expenditure growth in province *i* has significantly more (or less) Keynesian effects than per-capita fiscal expenditure growth at the national level.

Estimates of β_i and α are reported in columns 7 (contemporaneous change in per-capita fiscal expenditure growth) and 8 (one-year lagged change in per-capita fiscal expenditure growth). The first interesting thing to note is that at national level there is little evidence that fiscal policy has any effects, either Keynesian or non-Keynesian. The estimated α, while being negative, is insignificant. Turning to β_i there is

evidence that in 11 provinces (Tianjiin, Inner Mongolia, Liaoning, Heilongjiang, Shanghai, Jiangxi, Hunan, Guangdong, Tibet, Shaanxi and Qinghai) fiscal policy has significantly more Keynesian effects than at the national level. This number grows to 12 when looking at the effects of one-period lagged per-capita fiscal expenditure growth (the additional province is Jilin). On the contrary, there are only two provinces (Guangdong and Hainan, plus Zhejiang if we refer to one-period lagged per-capita fiscal expenditure growth) where fiscal policy effects are significantly more non-Keynesian than at the national level.

Table 8 here

6. Conclusion

Our key findings are summarized as follows:

Firstly, we found evidence of considerable asychronization in provincial business cycle fluctuations. This implies that the optimal stance of macroeconomic policy (expansionary or contractionary) at the national level may not be optimal at the provincial level. Given that monetary policy is more or less centralized, this finding points to potential benefits from provinces possessing a degree of fiscal autonomy. That is, for provinces to be able to use fiscal policy to smooth their own, somewhat unique, business cycle fluctuations.

Secondly, while provincial business cycle asynchronization pointed to potential benefits from a degree of provincial fiscal autonomy, we found little evidence that provincial fiscal policy has had the effect of smoothing provincial business cycles. There was strong evidence that provincial fiscal policy has often been implemented in a manner that is procyclical to business cycle fluctuations. This finding raised the possibility that provincial fiscal policy might actually have had the effect of amplifying provincial business cycles rather than smoothing them.

Thirdly, whether provincial fiscal policy has amplified provincial business cycles depends upon whether it has had Keynesian effects. The evidence suggested that provincial fiscal policy has, on average, had Keynesian effects, albeit the quantitative magnitude of these effects was limited. When the effect of fiscal policy was permitted

to vary by province, considerable heterogeneity was also apparent. For the bulk of provinces, fiscal policy either had Keynesian effects or insignificant effects. In only a few cases was there evidence of non-Keynesian effects. Central government fiscal policy was found to have had insignificant effects.

Additional research questions remain, such as what drives the heterogeneity in fiscal policy effects across provinces, but we leave these for future research.

One of the implications of the above results is that one should not have great faith in the ability of macroeconomic policy-makers in China to smooth business cycle fluctuations. This is particularly the case in light of other recent research that calls into question the ability of monetary policy to maintain low and stable rates of inflation (Laurenceson and Windsor, 2010). Thus, in countries such as Australia, where economic fortunes are increasingly determined by developments in China, it will be up to policy-makers here to smooth the impact of macroeconomic volatility there.

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Table 1. Average pairwise correlation – GDP Growth

	Average correlation 1979-1993	Average correlation 1994-2008	Average correlation 1979-2008
Beijing	0.49	0.38	0.49
Tianjin	0.55	0.61	0.54
Hebei	0.58	0.52	0.58
Shanxi	0.49	0.45	0.49
Inner Mongolia	0.43	0.53	0.46
Liaoning	0.58	0.58	0.58
Jilin	0.40	0.52	0.43
Heilongjiang	0.35	0.55	0.41
Shanghai	0.62	0.44	0.58
Jiangsu	0.54	0.63	0.53
Zhejiang	0.53	0.46	0.48
Anhui	0.38	0.48	0.40
Fujian	0.43	0.46	0.40
Jiangxi	0.52	0.46	0.49
Shandong	0.60	0.64	0.60
Henan	0.32	0.63	0.38
Hubei	0.52	0.60	0.53
Hunan	0.57	0.61	0.57
Guangdong	0.45	0.49	0.39
Guangxi	0.34	0.62	0.41
Hainan	0.35	0.38	0.26
Chongqing	0.54	0.65	0.57
Sichuan	0.57	0.66	0.58
Guizhou	0.42	0.53	0.42
Yunnan	0.43	0.60	0.44
Tibet	0.14	0.21	0.19
Shaanxi	0.48	0.36	0.48
Gansu	0.39	0.60	0.40
Qinghai	0.48	0.35	0.48
Ningxia	0.46	0.37	0.45
Xinjiang	0.35	0.59	0.28
Average	*0.46*	*0.52*	*0.46*

Table 2. Average pairwise correlation – H-P filter

	Average correlation 1978-93	Average correlation 1994-2008	Average correlation 1978-2008
Beijing	0.71	0.88	0.77
Tianjin	0.53	0.94	0.70
Hebei	0.74	0.93	0.80
Shanxi	0.63	0.89	0.73
Inner Mongolia	0.47	0.94	0.68
Liaoning	0.68	0.94	0.76
Jilin	0.63	0.91	0.73
Heilongjiang	0.54	0.92	0.70
Shanghai	0.63	0.93	0.74
Jiangsu	0.72	0.94	0.79
Zhejiang	0.70	0.91	0.76
Anhui	0.62	0.92	0.68
Fujian	0.57	0.92	0.67
Jiangxi	0.67	0.93	0.77
Shandong	0.73	0.94	0.81
Henan	0.69	0.93	0.78
Hubei	0.71	0.91	0.78
Hunan	0.75	0.92	0.80
Guangdong	0.56	0.90	0.66
Guangxi	0.41	0.92	0.61
Hainan	0.47	0.75	0.53
Chongqing	0.68	0.94	0.77
Sichuan	0.72	0.95	0.80
Guizhou	0.65	0.93	0.74
Yunnan	0.64	0.92	0.73
Tibet	-0.03	0.88	0.19
Shaanxi	0.59	0.90	0.69
Gansu	0.63	0.93	0.69
Qinghai	0.60	0.90	0.71
Ningxia	0.62	0.91	0.71
Xinjiang	0.59	0.92	0.69
Average	*0.61*	*0.91*	*0.71*

Table 3. Average pairwise correlation – B-K filter

	Average correlation 1981-1993	Average correlation 1994-2005	Average correlation 1981-2005
Beijing	0.59	0.27	0.56
Tianjin	0.60	0.62	0.58
Hebei	0.68	0.68	0.66
Shanxi	0.54	0.50	0.53
Inner Mongolia	0.60	0.66	0.51
Liaoning	0.65	0.60	0.66
Jilin	0.46	0.57	0.46
Heilongjiang	0.42	0.58	0.41
Shanghai	0.67	0.60	0.65
Jiangsu	0.62	0.72	0.62
Zhejiang	0.57	0.63	0.56
Anhui	0.49	0.72	0.51
Fujian	0.51	0.65	0.51
Jiangxi	0.64	0.51	0.60
Shandong	0.67	0.70	0.66
Henan	0.46	0.65	0.49
Hubei	0.64	0.66	0.63
Hunan	0.64	0.63	0.62
Guangdong	0.47	0.61	0.47
Guangxi	0.33	0.56	0.36
Hainan	0.37	0.23	0.35
Chongqing	0.64	0.73	0.64
Sichuan	0.63	0.71	0.63
Guizhou	0.55	0.67	0.53
Yunnan	0.50	0.67	0.52
Tibet	0.18	0.25	0.17
Shaanxi	0.55	0.53	0.53
Gansu	0.46	0.62	0.46
Qinghai	0.61	0.49	0.57
Ningxia	0.53	0.45	0.51
Xinjiang	0.35	0.55	0.37
Average	*0.54*	*0.58*	*0.53*

Table 4. Concordance between provincial and national business cycles

	H-P filter	B-K filter
Beijing	0.94	0.76
Tianjin	0.94	0.88
Hebei	0.94	0.80
Shanxi	0.97	0.76
Inner Mongolia	0.87	0.88
Liaoning	0.94	0.84
Jilin	0.90	0.80
Heilongjiang	0.77	0.80
Shanghai	0.84	0.88
Jiangsu	0.97	0.80
Zhejiang	0.87	0.84
Anhui	0.87	0.88
Fujian	0.77	0.84
Jiangxi	0.97	0.84
Shandong	0.90	0.80
Henan	0.90	0.88
Hubei	0.94	0.84
Hunan	0.97	0.92
Guangdong	0.84	0.84
Guangxi	0.81	0.80
Hainan	0.68	0.72
Chongqing	0.90	0.80
Sichuan	0.94	0.88
Guizhou	0.90	0.84
Yunnan	0.84	0.84
Tibet	0.74	0.60
Shaanxi	0.77	0.80
Gansu	0.90	0.84
Qinghai	0.90	0.80
Ningxia	0.87	0.80
Xinjiang	0.81	0.80
Average	*0.88*	*0.82*

Table 5. Correlation between the cyclical component of government expenditure and real GDP

	H-P filter	B-K filter
Beijing	0.84***	0.59***
Tianjin	0.90***	0.44**
Hebei	0.82***	0.45**
Shanxi	0.69***	0.24
Inner Mongolia	0.81***	0.35*
Liaoning	0.90***	0.33*
Jilin	0.81***	0.17
Heilongjiang	0.76***	0.33*
Shanghai	0.87***	0.31
Jiangsu	0.89***	0.56***
Zhejiang	0.61***	0.07
Anhui	0.83***	0.39**
Fujian	0.88***	0.65***
Jiangxi	0.83***	0.34*
Shandong	0.81***	0.38**
Henan	0.86***	0.49***
Hubei	0.81***	0.57***
Hunan	0.87***	0.49***
Guangdong	0.70***	0.14
Guangxi	0.64***	0.35*
Hainan	0.79***	0.62***
Chongqing	n/a	
Sichuan	0.63***	0.37*
Guizhou	0.73***	0.30
Yunnan	0.70***	0.12
Tibet	0.57***	0.28
Shaanxi	0.85***	0.43**
Gansu	0.72***	0.35*
Qinghai	0.67***	0.34*
Ningxia	0.52***	0.23
Xinjiang	0.63***	-0.01

Table 6: Panel least square estimates of equation (2)

	1	2	3	4	5	6	7	8
Fiscal exp. p.c. growth	0.097***		0.041***		0.055***	..	0.0724***	..
Fiscal exp. p.c. growth lagged	..	0.083***	..	0.011	..	0.049***	..	0.056***
Lagged GDP p.c. growth	..	..	..	..	0.329***	0.344***	..	..
Log GDP p.c. lagged	..	..	..	..	..	..	0.009***	0.010***
N. of observations	907	876	854	828	878	876	907	876

Notes: The dependent variable is the per-capita GDP growth in columns, 1,2, 5, 6,7 and 8. In columns 3 and 4 the dependent variable is per-capita household consumption growth. All regressions include province fixed effects. *, **, *** denote statistical significance at the 0.1, 0.05, and 0.01 confidence levels, respectively.

Table 7: 2SLS and dynamic panel estimates of equation (2)

	1	2	3	4	5	6	7	8
Fiscal exp. p.c. growth	0.271***	0.206***	..	..	0.120**		0.060***	0.056***
Fiscal exp. p.c. growth lagged	..	..	0.253***	0.185***	..	0.109**	..	..
Lagged GDP p.c. growth	..	0.207***	..	0.232***	0.333***	0.346***	0.352***	0.397***
N. of observations	876	876	876	876	876	876	847	878

Notes: The dependent variable is per-capita GDP growth in all columns. Estimation is by 2SLS in columns 1, 2, 3, 4, 5 and 6. In this case, per-capita fiscal expenditure growth (contemporaneous and lagged) is instrumented by the two period lagged level of per-capita fiscal expenditure. The regressions reported in columns 1, 2, 3 and 4 also include province fixed effects. Column 7 reports Arellano and Bond (1991) dynamic panel estimates. Column 8 reports Blundell and Bond (1998) dynamic panel estimates.

Table 8: Estimates of equation (3) and (4) with slope coefficients that change by province

	1	2	3	4	5	6	7	8
Fiscal exp. p.c. growth*dummy for: (β_i)								
Beijing	0.019	0.089	0.044	0.031	-0.168	-0.107	-0.122	-0.070
Tianjin	0.050	0.080	0.611*	0.637*	0.411	0.426***	0.458***	0.476***
Hebei	0.179***	0.110	0.188**	0.171	0.055***	0.051	0.103	0.097
Shanxi	0.220***	0.157*	0.292*	0.217*	0.137	0.100	0.185	0.138
In. Mongolia	0.209***	0.126*	0.581***	0.626**	0.447***	0.479***	0.495***	0.534***
Liaoning	0.077	0.050	0.382	0.397	0.180	0.182*	0.228**	0.232**
Jilin	0.079	0.087	0.416	0.451	0.194	0.209	0.241	0.260*
Heilongjiang	0.083*	0.071**	0.425***	0.380***	0.250**	0.228**	0.298**	0.275**
Shanghai	0.119***	0.067	0.589	0.437	0.367**	0.276**	0.412***	0.311***
Jiangsu	0.036	0.059	0.146	0.140	0.003	0.000	0.051	0.047
Zheijang	0.023	0.018	-0.028	-0.021	-0.263	-0.198*	-0.217	-0.163*
Anhui	0.058	-0.019	0.104	0.102	-0.032	-0.030	0.016	0.019
Fujian	-0.001	-0.086	0.054	0.054	-0.145	-0.146	-0.098	-0.098
Jiangxi	0.155***	0.124***	0.299***	0.311**	0.163*	0.166*	0.211**	0.218**
Shandong	0.107*	0.015	0.239	0.184	0.066	0.048	0.114	0.084
Henan	-0.034	0.102*	0.202	0.169	0.043	0.035	0.090	0.077
Hubei	0.066	0.050	0.256	0.216	0.095	0.080	0.143	0.123
Hunan	0.146***	0.092*	0.351***	0.328***	0.201**	0.187**	0.250**	0.234**
Guangdong	0.082	0.128**	-0.218	-0.143	-0.671*	-0.442**	-0.629**	-0.420**
Guangxi	0.094*	0.061	0.407*	0.331*	0.251**	0.209***	0.300**	0.251***
Hainan	0.145	0.146**	-0.280	-0.385	-0.961***	-1.347***	-0.923***	-1.306***
Chongqing	-0.087**	-0.056	-1.388	1.045	-0.112	0.093	-0.067	0.071
Sichuan	-0.001	0.036	0.140	0.282	0.023	0.030	0.071	0.118

Guizhou	0.159**	0.080	0.286**	0.298	0.106	0.108	0.153	0.161
Yunnan	0.016	0.026	0.037	0.049	-0.283	-0.383	-0.239	-0.325
Tibet	0.147*	0.169**	0.357	0.436	0.172	0.202	0.218*	0.258*
Shaanxi	0.229***	0.112**	0.316***	0.302**	0.177*	0.167*	0.225*	0.215*
Gansu	0.210**	0.184*	0.281	0.290*	0.113	0.115	0.161	0.169
Qinghai	0.161***	0.182***	0.431***	0.371***	0.270**	0.235**	0.318**	0.282**
Ningxia	0.108***	0.092**	0.419	0.362	0.149	0.126	0.197	0.177
Xinjiang	0.015	0.026	-0.072	-0.068	-0.240	-0.223*	-0.192	-0.172
Cen. fiscal exp. p.c. growth (α)	..	..	..	..	..	..	-0.049	-0.053
N. Obs	907	876	876	876	876	876	905	905

Notes: the dependent variable is per-capita GDP growth in all columns. Per capita fiscal expenditure growth is lagged by one period in columns 2, 4, 6 and 8. Estimation is by panel least squares in columns 1 and 2. 2SLS are used in the remaining columns. Two period lagged values of the level of per-capita fiscal expenditure are used as instruments. All regressions include province fixed effects. The regressions shown in columns 5, 6, 7 and 8 also include time fixed effects.

Figure 1. First principal factor (rolling 15 year window)