Does Flattening Government Improve Economic Performance?

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Abstract

In this paper, we examine a causal relationship between flattening of a government hierarchy and economic performance. Exploiting a novel panel dataset on government reorganization in China from 1999 to 2012, we find that delayering has led to increases in revenue and inter-govermental transfers for county governments. However, the associated enlarged span of control of the upper-level governments, has led to a reduction in county governments' total public expediture and pro-growth expenditure. Overall, the flattening of the government hierarchy has a negative effect on economic performance.

Key words: Flattening; Government; Hierarchies; Organization structures; PMC
JEL Codes: H11, O12

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1 Introduction

In an organization, the design of hierarchies deeply influences the information flow, agents' incentives, and ultimately performance. Among all relevant attributes, the organization's depth—the number of vertical layers—and the width—the spans of control are attracting markedly increased attention. Organization structure involves a trade-off between horizontal coordination and vertical control (Mookherjee, 2006). While considerable progress has been made in empirically understanding corporate hierarchies (Rajan and Wulf, 2006), much less is known about hierarchies and performance in public organizations. An important question remains unanswered: whether or not results based on firms can be reliably generalized to public organizations.

In this paper, we provide quantitative evidence on how a government's productivity measured by per capita GDP varies with the number of vertical layers in its hierarchy. Government bureaucracy is a hierarchical organization with official functions and well-established formal rules. It plays an important role in providing public goods and facilitating economic growth (Weber, 1947). This study exploits a quasi-natural experiment—China's province managing county (PMC) reforms since 2003. After the reform, a provincial government could by-pass the prefecture level and directly administer county governments on fiscal matters in the way it manages prefecture-level governments. In the period considered, there were rich spatial variations in the timing of the adoption of the PMC system, constituting a unique laboratory for studying the effect of delayering on the outcomes of interest. To the best of our knowledge, this has been the first attempt to establish empirically a connection between government organization and economic performance.

Our analysis proceeds in three stages. We first investigate the link between the PMC reform and a county's economic performance. Specifically, do PMC counties experience higher or lower per capita GDP over time? Second, we shed light on the mechanism underlying the effects. Do the flattening improve a county's fiscal revenue and inter-govermental transfers—the goals of the reform? How does increased span of control impact the upper level government's ability to monitor expenditure? Third, we examine how the PMC reform affects other economic outcomes such as household income, consumption, and inequality.

The analysis involves constructing a novel data set from a large number of official sources. The data cover 1,809 counties between 1999 and 2012. They contain very detailed information not only about GDP, fiscal revenue, transfers and expenditure, but also about changes in government's organization. Such comprehensive panel data allows for an examination of China's county economies before and after the PMC reform.

The key challenge in identifying the effect of PMC reforms is selecting appropriate control

groups for the treatment group. The validity of the standard difference-in-differences (DD) strategy and the causal interpretation given to the results relies on the assumption that non-PMC counties and counties which adopted PMC later are valid counterfactuals for what would have happened to earlier adopters in the absence of the PMC reform. However, the reformed counties are not randomly selected. To address the identification challenge, we control for differential trends in outcomes between PMC counties and non-PMC counties depending on the key determinants in the selection of PMC counties, a strategy used by Gentzkow (2006). Beyond that, we restrict the sample to the PMC counties, increasing confidence in the comparability of treated and control groups. Finally, we conduct a placebo test by randomly assigning the adoption of PMC reforms to counties.

The analysis yields several main findings. First, the adoption of PMC reforms reduces a county's GDP per capita by an average of 2.6 percent, which translates into a 0.33 percent drop in the annual growth rate.

Second, the counties' fiscal revenue and transfer tend to increase after the elimination of the intermediate layer of city governments in fiscal management. However, the enlarged span of control for the provincial government has weakened its monitoring capacity on the spending side. In particular, both total public expenditure and pro-growth investment in PMC counties have declined after the reform. This, in turn, tends to negatively influence economic performance.

Third, using alternative measures of performance, no significant effects on household income or income inequality are evident. A negative and significant effect on consumption suggests that PMC reform does not generate an increase in social welfare.

This paper fits into a large existing literature on organizational forms. An important line of research has looked at hierarchical organization processes by boundedly-rational members of an administrative staff (Garicano and Van Zandt, 2013). In a horizontal hierarchy, information flows smoothly across vertical layers of administrations, resulting in fast execution (Patacconi, 2009). This, however, calls for intensive information processing, communication and coordination by the top hierarchy (Williamson, 1975). There are limits to communication and to the cognitive abilities of upper level managers. A broad span of control will be demographically heterogeneous and large groups may create coordination and communication problems (Bandiera, Prat, Sadun and Wulf, 2014). While this prior research mainly focuses on theoretical models, the empirical evidence of this paper can help forge links between theory and data. Specifically, our findings confirm the theoretical logic that while flattening is expected to decrease delay, the increased span of control could cause distortions.

There has also been a broad strand of theoretical work that focuses on the role of incentives in hierarchies (Mookherjee, 2013; Besley and Ghatak, 2005). Rajan and Zingales

(2001) develops a theoretical framework to study the incentive problems resulting from different shaped organizations. The main incentive problem in a vertical hierarchy is expropriability from upper-level managers. However, managers have an incentive to specialize due to their positional power. In a horizontal hierarchy, expropriability is dealt with, but this gives managers very little positional power, and therefore little incentive to specialize. The empirical findings of this study linking hierachial change to organizational performance are consistent with that theory, predicting that both expropriability and specialization would decrease after flattening.

This study also complements a number of works on China's government organization. Several studies have conducted economic system analyses comparing China's multi-divisional form structure to the unitary form structure of the Former Soviet Union. Maskin, Qian and Xu (2000) examine how organizational forms affect the quality of incentive schemes that can be offered to managers, and the resulting economic performance. In a similar vein, Gerard, Qian, and Xu (2006) focuses on coordination problems in conducting experiments associated with organizational forms. In contrast, this study exploits possibly exogenous within-country variations to examine delayering and county economies.

Lastly, our paper relates to a set of studies empirically testing the effects of changes in information technology, competition on the product market or openness to trade on the internal structure of firms including Acemoglu et al (2007), Brynjolfsson and Hitt (2000), Bresnahan, Brynjolfssohn and Hitt (2002), Caroli and van Reenen (2001), and Rajan and Wulf (2006). Most of that work examines the causes of organizational changes rather than the consequences, which is the focus of this paper.

The remainder of the paper is organized as follows. Section 2 lays out the PMC reform background. Section 3 describes the identification strategies and data in detail. Section 4 presents our main empirical findings, followed by the mechanism underlying the PMC effects. Section 5 concludes.

2 China's Administrative Structure and PMC Reform

China's administrative structure is among the most remarkable of human institutions. Its record of longevity and adaption to racially changed situations with minor disruption of its basic structure is unmatched by that of any other government system (Fitzgerald, 2002). There have been variations in local administrative hierarchies under different dynasties, but counties have remained as China's most stable administrative units (Lin et al., 2013; Xu, 2011). An important issue in county governance is then which administrative level should lead the counties.

Since 1949, China's hierarchical system of administration has been highly centralized. Provinces have benefited from a central policy of horizontal-area coordination that devolved significant powers to them (Fitzgerald, 2002). And counties were tasked with almost all the functions and responsibilities of the provincial level. "Between these two spheres of real power... there was much administration but little authority" (Shue, 1994).

From the late 1970s, there have been significant changes in the way that China is governed, and these have been most pronounced at the local level. An important reform of China's administrative system since the early 1980s has been reshaping and reorganizing the prefectures, formerly the local organ of the provincial administration, as prefecture-level cities. This has gradually formed an additional formal layer in China's sub-national administration under the nationwide policy of "city managing county" (CPC). With this system, higher-level governments have much discretion in determining the fiscal arrangement of the levels immediately below them. Provincial governments directly deal with city (prefecture) governments; city (prefecture) governments deal with county governments. There is no direct relationship, however, between provincial and county governments (Lou and Wang, 2008). Figure 1 shows the adminstrative structure under the CPC policy. The average number of subordinates (prefectures) under a provincial government is 12, while the average number of subordinates (counties) under a prefecture government is 8.

[Insert Figure 1 Here]

While relaying the mandates from above to their subordinate organizations, governments in each tier also add their own, leading to a cascade effect so that the final burden on the county government can become very onerous (World Bank, 2002). For example, under the CPC system a prefecture-level city commonly tends to favour its city proper at the expense of its subordinate counties (Ma, 2005). The counties in poor regions have been harmed particularly severely because of this built-in bias in development strategy (Lam, 2009).

Since the 2000s, the merits of the "province-managing-county" system have been hotly debated. Under PMC, a provincial government directly (and separately) manages cities (prefectures) and counties. The fiscal relationship between the prefecture and the county has been removed (Lou and Wang, 2008). By flattening the governance hierarchies, this scheme aims to relieve financial strain on county-level governments, improve the administrative efficiency, and stimulate local economic growth. The PMC policies include:

1. A re-classification of fiscal revenue among province-level, prefecture-level and county-level governments. In principle, a prefectural city is no longer entitled to share the revenue of the counties it formerly administered. The reform defines explicitly which

taxes yield provincial exclusive revenues, county-level exclusive revenues, and shared revenues (including the county's sharing rate).

2. A reassignment of expenditure responsibilities among the different levels of government. A prefecture-level government does not bear responsibility for its formerly-administered counties' newly increased expenditure. More importantly, neither can the prefecture level government shift its expenditure responsibilities to counties.

3. An adjustment of the inter-governmental transfer system. The reformed provinces audit three major types of transfers—general purpose transfers, special-purpose transfers and rebates of tax (value-added tax, consumption tax and income tax)—across three layers of governments—provincial-level, prefecture-level and county-level. Based on the audits, the transfers formerly between prefectures and counties have been adjusted to now be between provincial and county governments. After the reform, provincial transfers and grants are allocated directly to counties instead of going through the prefecture-level governments.

4. Direct supervision and administration of counties by the province on fiscal matters. The province manages counties' budget formulation, approval, implementation, audits and fund allocation.

Figure 2 illustrates the new administrative structure under the PMC system. Zhejiang and Hainan were among the first provinces to adopt the PMC scheme province-wide in the 1980s. However, during the 1990s the PMC fiscal reform was halted because rapid economic growth in some locales had allowed many counties to seek urban designations and "upgrades". Originally, promotion in the hierarchy represented a reward mechanism for local governments who achieved economic growth and did not violate national goals (Li, 2011). Later, however, rampant "city fever" engendered masked urbanization and land use planning contrary to the provincial and national policy (Kung et al., 2011). This finally forced the state to dampen the feverish upgrading in the early 2000s.

[Insert Figure 2 Here]

By 2003, on the one hand, there was growing fiscal inequality among China's regions; while some counties suffered from worsening budget problems. In the face of such challenges, the PMC reform regained its momentum. Experiments resumed in Fujian province in 2003, in Anhui, Henan and Hubei provinces in 2004, and in Hebei, Jilin and Jiangxi provinces in 2005. The central government issued policy circular in 2006 which stated that the scheme

should be gradually implemented in all counties except those in ethnic autonomous regions by the end of 2012. This goal was reaffirmed in China's 11th Five Year Plan. By 2012 the average number of subordinates (prefectures and counties) under a provincial government had displayed a remarkable increase to 52, while the average number of subordinates under a prefecture government was 5. Appendix Table A1 shows which counties adopted the PMC system from 2001 to 2012. By 2012 over 1052 counties across 22 provinces had adopted the PMC system. Figures A1 and A2 show the geographic distribution of PMC counties before 2003 and in 2012, respectively.

In addition to the PMC reforms, another noteworthy reform of China's adminstrative system since 2003 has been the county-power-expansion (CPE) reform, which aims to empower some county-level governments. Within the CPC system, CPE involves the devolution and delegation of powers and authority to county government (Liao, Li and Deng, 2013). However, specific CPE policies vary greatly among the reformed provinces. Some counties enjoy broad decentralization of fiscal revenue and expenditure, land use, project approval and so on, while others have expanded their autonomy only within a limited range of regional matters.

This study focuses on the PMC fiscal reforms because the PMC policies are more homogeneous among the reformed counties. All aim at flattening hierarchies in fiscal administration. The standard approaches used in the reforms facilitate studying the underlying mechanisms without involving other confounding factors.

3 Estimation Strategy

3.1 Data

For the empirical analyses, we assemble a dataset describing socioeconomic conditions in each county in the years from 1999 to 2012. Specifically, we collect county-level information from various official statistical publications and publicly-available databases.

- County-level GDP, retail sales, rural household income and urban wage data are collected from the annual statistical yearbooks of the 25 Chinese provinces, supplemented by city-level statistical yearbooks or a county's statistical communiqué.
- County-level financial information comes from the *National Prefecture and County Finance Statistics 1999–2009.*
- County-level populations are extracted from *China's Sub-counties and Cities Nationwide Demographic Yearbook 1999–2012*, supplemented by *China Population Census*

2000.

- The average county slope and altitude of each county seat are extracted using data from the space shuttle's radar topographic mission 90m digital elevation model.

- Luminosity data come from the US defense meteorological satellite program that reports images of the earth at night captured from 20:30 to 22:00 local time. Specifically, the image dataset is a grid reporting the intensity of lights as a six-bit digital number, for every 30 arc-second output pixel (approximately 0.86 km^2 at the equator). The digital number of pixel value ranges from 0 to 63, where a higher value reflects more use of lights.

- Parcel-level data on land transactions are collected from the official website of China's Ministry of Land and Resources.[1] No data before 2003 are analyzed because China's land-conveyance was reformed in 2003, and the land sales data have been consistently recorded since. There are over 1 million parcel transactions recorded, which are aggregated to the county-level.

To create a comprehensive and more importantly accurate county-level dataset, provincial statistical yearbooks are the main data source, since such data are the most consistent. In cases of data missing in that source, city-level statistical yearbooks or a county's statistical communiqué are used.

To address the county-level administrative changes during the sample period, the statistical consistency is ensured by tracking the records documented on the website of the Ministry of Civil Affairs.[2] Counties with name changes are regarded as the same county if their administrative boundaries remain the same as in 1999. Those re-designated as urban districts from 1999 to 2012 are not included in the dataset.[3]

China experienced inflations with sizable differences in inflation rates among the regions. The technique of Brandt and Holz (2006) is therefore applied to adjust all the variables using provincial price deflators, with Beijing as the base province and 1999 as the base year.

Note that all urban districts and counties governed under the four centrally administrated municipalities (Beijing, Tianjin, Shanghai, and Chongqing) are excluded. As the analyses focus on the PMC reforms in the 2000s, Hainan and Zhejiang provinces are also not included in the dataset, since those two provinces adopted the PMC system in the late 1980s. Counties in Tibet are excluded due to missing data.

[1] See http://landchina.mlr.gov.cn/

[2] See http://www.xzqh.org/html/

[3] During this period only 21 counties in 20 prefectural cities were changed into urban districts for various reasons.

The sample for empirical analysis thus consists of a panel of 1,809 county-level units over the 1999–2012 period. Detailed variable definitions and descriptive statistics are presented in Table 1.

[Insert Table 1 Here]

3.2 Estimation Framework

To identify the effect of the the flattening of hierarchies on economic performance, we use time and regional variations in the PMC reform in the mid-2000s. Specifically, the DD estimation involves comparing the performance of counties before and after the adoption of the PMC system with that of counties which had not yet adopted it during the same period.

Figure 3 illustrates the validity of our identification strategy. It shows the time trends of the logarithm of GDP per capita of the counties which adopted the PMC reform after 2004 and those which did not adopt the PMC reform during the sample period. The treatment group and the control group show similar trends before 2003, a year before the start of the PMC reform. But they diverge significantly after 2003, when the growth in PMC counties lags behind that in non-PMC counties.

[Insert Figure 3 Here]

Our baseline DD estimation has the following specification:

$$y_{ct} = \alpha_c + \beta \cdot PMC_{ct} + \gamma_t + \varepsilon_{ct}, \tag{1}$$

where c and t indicate county and year, respectively; y_{ct} represents a major outcome, such as the logarithm of GDP per capita; PMC_{ct} indicates the county's PMC status with $PMC_{ct} = 1$ if county c conducted the PMC reform in year t, and 0 otherwise; the α_cs are county fixed effects, capturing all the time-invariant characteristics of the counties which might influence the outcome of interest; γ_ts are year fixed effects, controlling for nation-wide shocks in a particular year likely to have affected all counties in a similar manner; and ε_{ct} is the error term. To address the potential serial correlation and heteroskadesticity, we cluster the standard errors at the county level.

3.3 Identifying Assumption and Checks

The identifying assumption underlying the DD estimation is that the PMC counties would have followed the same time trends as the non-PMC counties if they had not adopted the PMC reform. A primary threat to this identifying assumption is that the PMC counties

were not randomly selected; so the divergence in Figure 3 after 2003 may have been caused by some pre-existing differences between the PMC and non-PMC counties. To address this concern and improve the identification, three approaches are applied.

First, we follow an approach used by Gentzkow (2006). Specifically, key determinants in the selection of PMC counties are identified, and then differential trends in outcomes between the PMC and non-PMC counties after the adoption of the PMC reforms caused by such determinants are controlled for. To this end, we look into the criteria the provinces used in selecting the PMC counties. For example, according to the central government's guidelines, those with a heavy financial burden, those with poverty county status, and with a large production of grain and cotton should in general be given priority to become pilot PMC counties. To reduce political and economic risk, in some provinces the PMC experiment was conducted in sparsely-populated and mountainous counties. Table A2 in the appendix lists in details the criteria used. Eight key selection criteria are identified—county-level city, national poor county, major food-producing county, provincial boundary county, altitude, average slope, fiscal gap, and urbanization rate. The detailed definitions are summarized in Table 1. We include interaction terms between these selection variables S yielded and a third-order polynomial function of time in equation (2),

$$y_{ct} = \alpha_c + \beta PMC_{ct} + \theta_1 S \cdot T + \theta_2 S \cdot T^2 + \theta_3 S \cdot T^3 + \gamma_t + \varepsilon_{ct}. \tag{2}$$

This flexibly controls for the evolution of outcome variables differing between PMC and non-PMC counties depending on non-random selection.

Second, the staggered adoption of the PMC system provides rich variations. The entire sample is used in the baseline analysis, which essentially compares early with later adopting counties as well as with non-PMC counties. In a robustness check, we focus on the PMC counties (52% of the full sample), which are assumed to be more homogenous. Hence, the identification relies on comparing early adopting counties with later adopting ones (for another application of the same strategy, see Biderman, Mello, and Schneider, 2010).

Third, a placebo test is also conducted by randomly assigning the adoption of PMC reforms to counties. Table A1 shows that during the sample period, there are nine years in which PMC reforms took place. To preserve that fact while allowing for at least one year before and one year after the PMC adoption (as required by the DD method), eight years between 2000 and 2011 are selected at random and randomly assigned with the number of PMC adoption from the set $\{58, 113, 75, 15, 256, 201, 153, 87\}$ shown in table A1. For each of the chosen years, we randomly designate counties as the treatment group without replacement. Using this false PMC status variable, a placebo DD estimation is conducted. Given the random data generation process, the false PMC variable should have produced

no significant estimate with a magnitude close to zero; otherwise, it would indicate a misspecification of the DD estimation. To increase the identification power of this placebo test, it is repeated 500 times.

4 Empirical Findings

The baseline estimation results are reported in column 1 of Table 2. They show a negative and statistically significant effect of the PMC reform on the logarithm of GDP per capita. This finding implies that the flattening approach has retarded economic development in the affected counties.

[Insert Table 2 Here]

The results in column 2 include the interactions between the eight key selection variables and a third-order polynomial function of time, and treatment-specific linear time trends to control for the estimation bias caused by the non-random selection of PMC counties. The negative and statistically significant effect of the PMC reform persists despite of a significant drop in its estimated magnitude.

Using the estimates in column 2 to calculate the economic magnitude suggests that the adoption of PMC policies reduces GDP per capita by about 2.6 percent on average. Note that the PMC reform started in 2004 and the sample period is from 1999 to 2012. Hence the DD estimate captures the average treatment effect over about eight years. In other words, the 2.6 percent drop in the GDP per capita caused by the adoption of PMC policies can be translated into about a 0.33 percent drop annually.

4.1 Robustness Checks

To address concerns about the identifying assumptions and **to** corroborate the previous finding, we conduct a battery of robustness checks.

Sample of PMC Counties.—Given the staggered nature of the policy reform, we are able to focus only on the PMC counties and estimate the effect of the PMC reforms by comparing early PMC adopters with later adopters. Those estimation results using only PMC counties are reported in column 3. It shows a similar effect in terms of both statistical significance and magnitude.

Randomly Generated PMC Status.—To further check to what extent the results are influenced by some omitted variables, we randomly assign the PMC status to counties and

conduct a regression using the specification in column 2 of Table 2. This random data generation and regression process are repeated 500 times. Figure 4 shows the distribution of estimates from the 500 runs along with the benchmark estimate, -0.026, from column 2 of Table 2. The distribution of estimates from random assignments is clearly centered around zero and the standard deviation of the estimates is 0.010, suggesting that there is no effect with the randomly-constructed PMC reform. Meanwhile, the benchmark estimate is beyond 95 percent of the 500 estimates (only 4 estimates are close to the benchmark). Combined, these observations suggest that the negative and significant effect of the PMC reform on economic performance is not driven by unobserved factors.

[Insert Figure 4 Here]

Other Policy Reforms.—If other policy reforms occurred during the same period, the estimates may mistakenly capture the effects of those confounding factors rather than the effect of the PMC reform. As a matter of fact, another important policy reform—the CPE reform involving the devolution and delegation of powers and authority to county governments—took place gradually over the sample period. To isolate the effect of the PMC reform, a variable indicating whether a county government carried out the CPE reform is inserted as an additional control variable. As shown in column 4 of Table 2, the flattening of government structure still has a significant and negative effect on economic performance.

Misreporting and Luminosity Data.—Any misreporting of GDP figures by local government officials would influence the results. If such reporting errors (or manipulations) changed systematically after the adoption of the PMC system, the estimates may simply reflect new incentives in GDP reporting. To address that possibility, we use the luminosity data obtained from the American defense meteorological satellite program. The estimation results are reported in column 5 of Table 2. Very similar results are obtained with the light per capita as an alternative performance measure.

4.2 Interpretation

Our aforementioned analyses robustly document a negative link between the PMC system and economic performance. Do they imply that China's implementation of the flattening strategy is flawed? Or does flattening government fail to improve economic performance because the increased span of control for the provincial governments leads to communication and coordination difficulties?

To shed lights on the mechanisms underlying our aforementioned findings, in this section

we first investigate whether the PMC reform achieves its first-order goal by improving county governments' fiscal situations. Then, we proceed to examine whether the expanded span of control for upper-level governments after flattening leads to a decrease in local economic development.

Fiscal Situations (transfers and revenue).—The PMC reform essentially transfered the direct administration of county governments on fiscal matters from city governments to provincial governments. After the reform, provincial transfers (including general purpose transfers, special purpose tranfers and tax rebates) go directly from the provinces to the counties, and the provincial governments manage the counties in budget formulation, approval, implementation, audits and funds allocation. While flattening the hierarchies presumably improves the transmission efficiency, it may have greatly increased the need for communication and coordination by the provincial governments. If the provincial governments are unable to act as better administrators than the preferecture governments have been, the reform may indeed have reduced administration efficiency and worsened the county governments' fiscal situations, which may finally have led to a deterioration in economic performance.

To test such hypotheses, we examine each of the inter-government transfers and the county governments' total fiscal revenue. First, the data limitation makes it impossible to separate general purpose transfers from specific purpose transfers, so whether the PMC reform increases or decreases total budgetary transfers received by county governments is examined. The estimation results are reported in column 1 of Table 3. We find a positive and statistically significant effect of the PMC reform on the per capita budgetary transfers. It suggests that flattening the administration improves the efficiency of distributing intergovernmental transfers.

[Insert Table 3 Here]

Whether county governments receive more tax rebates after the PMC reform is also tested. The estimation results are reported in column 2. The positive and statistically significant coefficient of the PMC term suggests that the reform increases the tax rebates received by county governments.

Whether the overall fiscal revenue at the county level improves or not is tested by the estimation results reported in column 3. Consistent with other findings, the reform increases the total fiscal revenue of the PMC counties.

County governments have been increasingly relying on the revenues from land transactions to fill the fiscal gaps, a phenomenon referred to as land financing. Column 4 shows that per capita land revenue decreased after the PMC reform, implying a reduction in land financing.

Taken together, these results indicate that the county governments' fiscal situations improved after the PMC reform. The reform achieved its policy goals. These findings corroborate those of Rajan and Zingales (2001), which find that a vertical hierarchy suffers from organizational diseconomies of scale due to loss of across vertical layers; and of Cremer, Garicano, and Prat, (2007), which show that vertical hierachies increase delay because communication involves more steps. Expropriability and delay on fiscal matters are apparently reduced in the PMC counties after the flattening.

Span of Control (spending).—According to the literature of knowledge hierarchies, team theory and information processing, a comparison between horizontal and vertical hierarchies entails a trade-off of delay and communication and coordination costs (Van Zandt, 2013). When the number of suborindates increases, a horizontal hierarchy results in less precise communication and poorer coordination across units.

This motivates testing whether the enlarged span of control caused by the flattening influences economic performance. To do this, a variable $Span_{ct}$ is defined to quantify the span of control of the county governments' supervising bodies. As an illustration of the variable's construction, consider the following example. Assume that in 2003 county c was under a prefecture city's administration and that the perfecture managed another 4 counties. The province had 15 prefectures. In 2004, assume that 3 counties in the prefecture, including c, adopted the PMC system and that there were 10 counties in the whole province which did so. $Span_{ct}$ is then defined as equal to 5 in 2003; and 10+15 in 200. For non-PMC counties in the prefecture of county c, the span of control variable is equal to 5 in 2003 and 5-3 in 2004.

Regressing $Span_{ct}$ on PMC_{ct} with the same controls as in equation (2) verifies whether the span of control increased in PMC counties after the adoption of the PMC reforms, i.e.,

$$Span_{ct} = \alpha_c + \beta \cdot PMC_{ct} + \theta_1 S \cdot T + \theta_2 S \cdot T^2 + \theta_3 S \cdot T^3 + \gamma_t + \varepsilon_{ct}. \tag{3}$$

The regression results are reported in column 1 of Table 4. We find a positive and statistically significant coefficient for the PMC_{ct} term, supporting the argument that the PMC reform expands the span of control of the county governments' supervising bodies.

[Insert Table 4 Here]

To investigate whether the changes in the span of control significantly influences economic performance, we include $Span_{ct}$ as an additional control in the baseline DD specification (2). If the inclusion of $Span_{ct}$ leads to a substantial decrease in the coefficient of PMC_{ct}, this

would imply that the span of control represents an important channel (for other examples of the same approach see, e.g., Acemoglu, Johnson, and Robinson, 2002; Maccini and Yang, 2009). The regression results are reported in column 2. With $Span_{ct}$ included the coefficient of PMC_{ct} is no longer significant and the magnitude drops from -0.026 to -0.007. This suggests that the PMC reform substantially increases the span of control of the county governments' supervising bodies, which in turn negatively affects the county governments' economic performance.

To further shed light on how the increase in the span of control affects economic performance, we examine the composition in terms of spending components of the county governments. Each county' total public finance investment is decomposed into productive investment—expenditure for capital construction, expenditures supporting rural production and agricultural spending on agriculture, forestry, water managment and meteorology—and other investment.[4] Regression results are reported in columns 3 and 4 of Table 4. After the reform, PMC counties reduce both their total public investment and their pro-growth investment; the magnitudes are economically meaningful albeit marginally insignificant (p-values are around 0.11).

Summary.—These results show that the flattening reform achieves its first-order goal. That is, the counties' revenue improved after the adoption of the PMC policies, due to the elimination of the intermediate city government layer. However, the increase in the span of control involved may have reduced the monitoring of county governments' spending, which had a negative effect on economic performance.

4.3 Other Outcomes

The PMC reform had a negative effect on per capita GDP. But did it affect other aspects of the county economy in a similar manner? In this subsection, we examine its effect on household income, consumption, and inequality.

[Insert Table 5 Here]

Columns 1 and 2 of Table 5 relates the PMC reform with average rural household income and the average urban household wage. Both outcomes are measured in 10,000 Chinese currency and in the log form for ease of the interpretation of the magnitude. PMC status shows no significant effect on either rural household income or urban wage. These results imply

[4] Expenditures on education, public health, social security, government administration and foreign Affairs are considered as other non-productive investment.

that neither rural nor urban residents benefit directly from the flattening of the government hierarchy.

Column 3 intends to study the effect of the PMC reform on household consumption. But due to the lack of household-level data, the logarithm of retailing sales per capita is used as a proxy. The negative and statistically significant coefficient of the PMC_{ct} term suggests that counties adopting PMC policies witness a decline in consumption.

As for income inequality, without longitudinal household-level surveys in the sample period, income inequality can not be quantified directly. Instead, we exploit the luminosity data and calculate the standard deviation of light emission of all cells within a county boundary as a proxy for county income inequality. The regression results are reported in column 4. No statistically significant effect of the PMC reform is evident, indicating that the flattening reform did not influence income inequality significantly.

These alternative ways of measuring performance at the county level give results consistent with the previous findings, which show a negative effect of the PMC reform on per capita GDP. Due to the utilisation pattern of expenditure by the county governments, the increased revenue and transfers do not generate an increase in social welfare.

5 Conclusion

In this paper we exploit a natural experiment to exaimine the effect of government flattening on organizational performance. The results suggest that a more horizontal government organization decreased delay and expropriation in fiscal transfers and revenue. But the increased span of control makes it difficult for the upper level government to monitor local governments' spending. As a result, county economic performance measured by per capita GDP is negatively affected by such reforms.

Our analysis demonstrates the trade-off between a horizontal hierachy and a vertical hierachy. The optimal organizational shape crucially depends on the resulting coordination and control. When the benefits of reducing vertical control losses outweigh the costs of coordination, a horizontal hierachy will outperform a vertical hierachy. By contrast, a vertical hierachy is better if coordination problems are more prevalent.

This study could be a useful first step towards better understanding goverment organizational forms in developing countries. Much remains to be done. A deeper analysis of political economy within organizations is an exciting avenue for future research. Detailed data on the interaction between upper and lower levels of government, such as on the information of time use, would help enrich the micro-foundations of interactions associated with different organizational forms (Bandiera, Prat, Sadun and Wulf, 2014).

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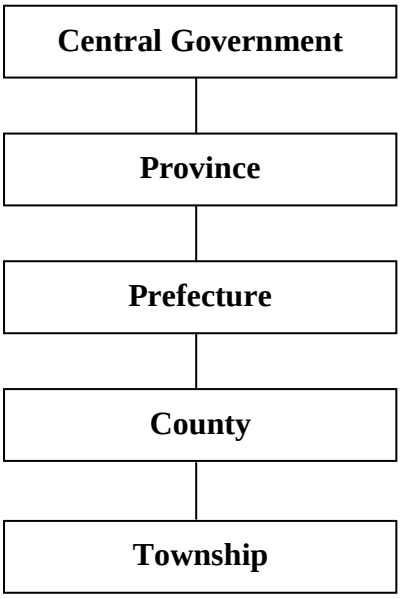
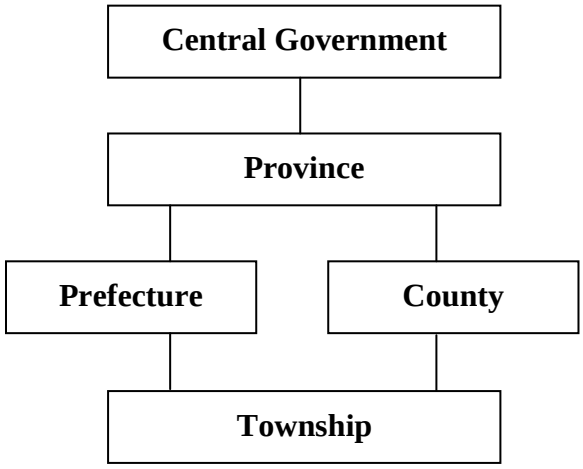
Figure 1. China's Governance Structure before the PMC Reform



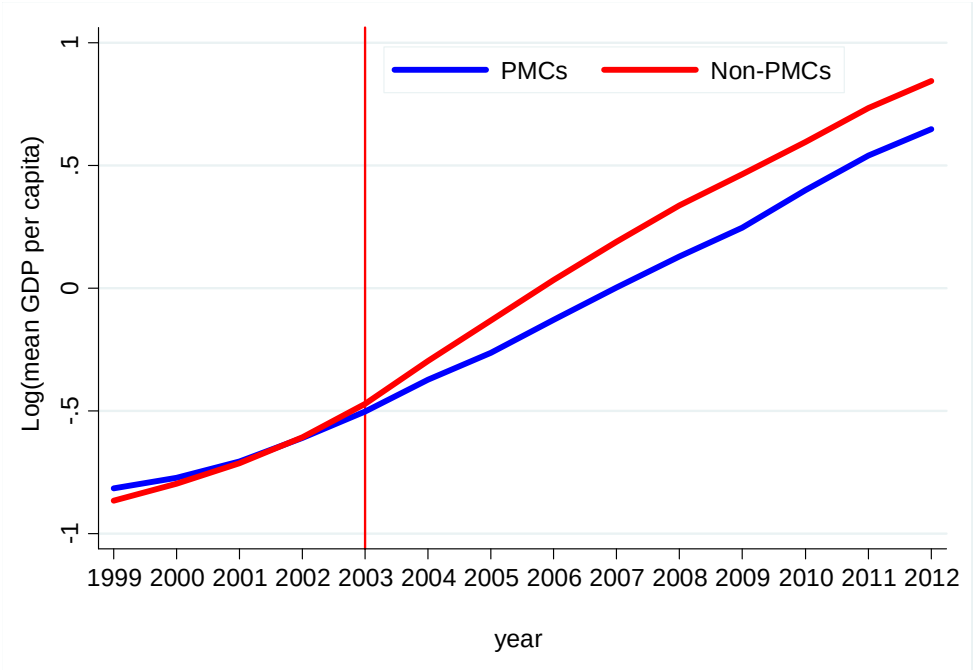
Span of control			
Province		Prefecture	
Mean	SD	Mean	SD
12.33	4.38	8.30	3.90

Figure 2. China's Governance Structure after the PMC Reform



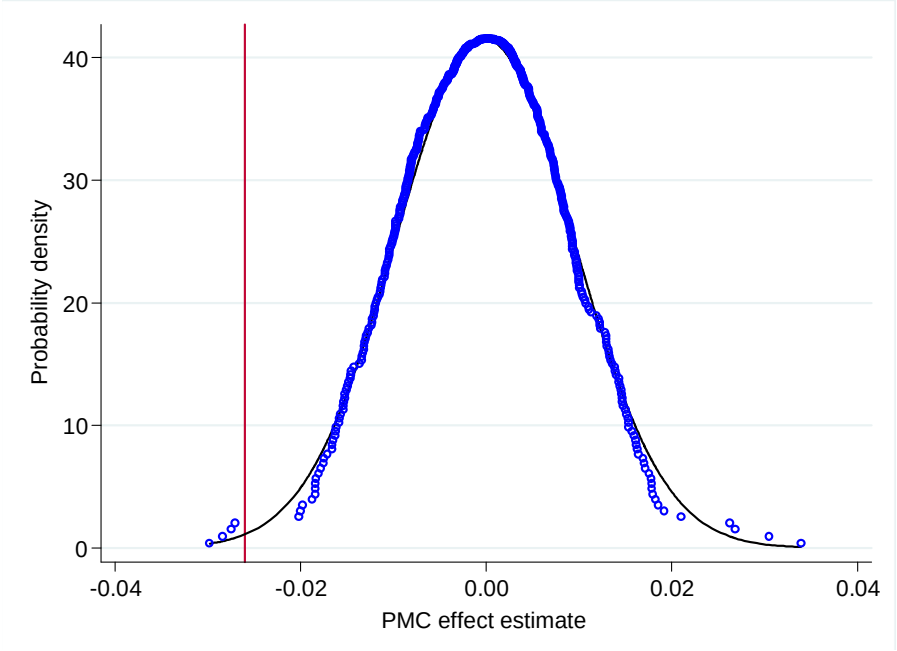
Span of control			
Province		Prefecture	
Mean	SD	Mean	SD
51.82	30.06	5.36	3.79

Figure 3. GDP Per Capita 1999-2012



Note: the figure illustrates the time trends of the natural logarithm of GDP per capita of the counties which adopted the PMC reform since 2004 (PMCs) and counties which did not adopt the PMC reform during the sample period (Non-PMCs).

Figure 4. Distribution of Estimated Coefficients in the Falsification Test



Note: The figure shows the cumulative distribution density of the estimated coefficients from 500 simulations randomly assigning PMC status to counties. The vertical line presents the result of column 2 in Table 2.

Figure A1. Spatial Distribution of PMC Counties before 2003

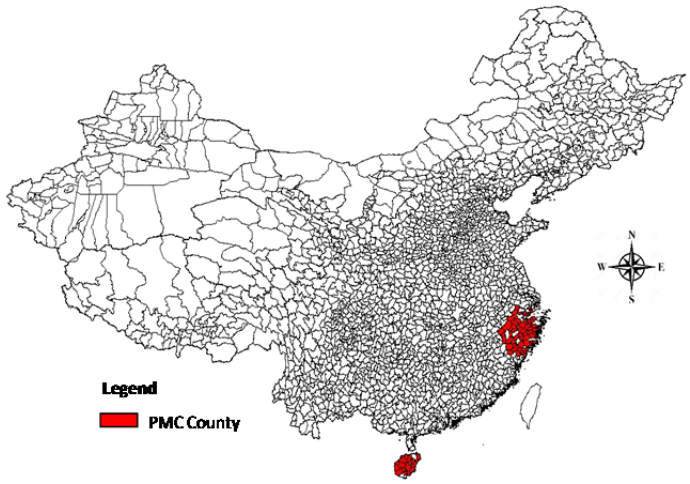


Figure A2. Spatial Distribution of PMC Counties in 2012

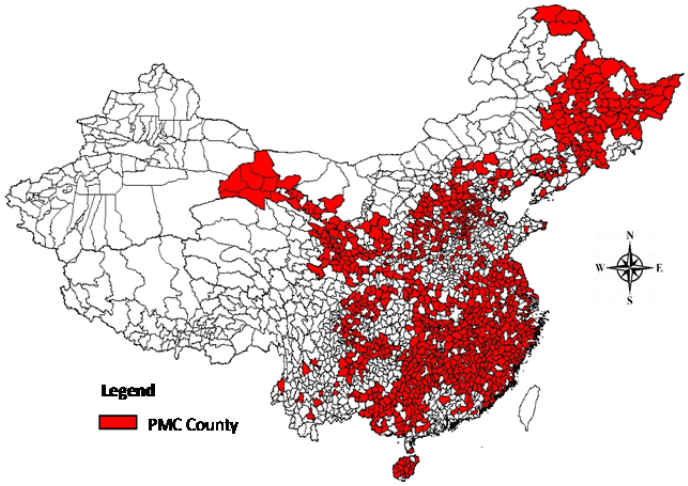


Table 1
Summary Statistics

Variable	Definition	Mean	S.D.	Data Coverage
Organization Form				
PMC	=1 if a county adopted PMC reform in year t and afterwards; =0 otherwise	0.208	0.406	1999-2012
Span	No. of administrative units fiscally governed by the same up-tier government of a county	21.792	25.172	1999-2012
Selection Criteria				
County_City	=1 if a county is a county-level city; =0 otherwise	0.181	0.385	1999
Poor_County	=1 if a county is a national poverty county; =0 otherwise	0.305	0.460	1999
Food_County	=1 if a county is a national food or cotton production county; =0 otherwise	0.281	0.450	1999
ProvBoundary_county	=1 if a county's boundary (at least part of it) is overlapped with its provincial boundary; =0 otherwise	0.376	0.484	1999
Altitude	County seat altitude (km)	0.692	0.839	1999
Slope	Average county slope (degrees)	8.941	6.862	1999
Fiscal_Gap99	Ratio of fiscal expenditure to fiscal revenue in year 1999	2.523	2.510	1999
Urban_Rate00	Percentage of non-agricultural population in total population in year 2000	16.199	11.457	2000
Fiscal Variables				
Transfer_PerCapita	Fiscal transfer per capita (¥×10^4)	0.075	0.096	1999-2009
TaxRebate_PerCapita	Tax rebate per capita (¥×10^4)	0.007	0.010	1999-2009
GovRev_PerCapita	Budgetary government revenue per capita (¥×10^4)	0.036	0.063	1999-2009
LandSale_Percapita	Land sales revenue per capita (¥×10^4)	0.052	0.929	2003-2012
GovExp_PerCapita	Budgetary government expenditure per capita (¥×10^4)	0.157	0.208	1999-2012
ProGrowthInvest_PerCapita	Pro-growth government investment per capita (¥×10^4)	0.011	0.023	1999-2006
Outcomes				
GDP_PerCapita	GDP per capita (¥×10^4)	1.051	1.371	1999-2012
Light_PerCapita	Light emissions at night per capita (original digital number× 100)	1.807	2.466	1999-2012
Retail_PerCapita	Retail sales per capita (¥×10^4)	0.279	0.298	1999-2012
Rural_Income	Rural household income (¥×10^4)	0.307	0.172	1999-2012
Urban_Wage	Urban worker wage (¥×10^4)	1.371	0.696	1999-2012
Light_SD	Standard deviation of light emission of all cells within a county boundary	4.193	3.213	1999-2012
Other Reform				
CPE	=1 if a county adopted county-power-expansion reform in year t and afterwards; =0 otherwise	0.196	0.397	1999-2012

Note: All variables are at the county-level. Definitions, means, standard deviation and time periods covered are reported. All monetary values are deflated using the provincial price deflators of Brandt and Holz (2006) with Beijing as the base province and 1999 as the base year. Data sources are described in full in section 3.1.

Table 2
The Impacts of the PMC Reform on Economic Development

Dependent variable	Log(*GDP_PerCapita*)				Log(*Light_PerCapita*)
	(1)	(2)	(3)	(4)	(5)
PMC	-0.074***	-0.026***	-0.028***	-0.033***	-0.021*
	(0.011)	(0.009)	(0.009)	(0.009)	(0.012)
County fixed effect	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes
Control × T		Yes	Yes	Yes	Yes
Control × ($T+T^2$)		Yes	Yes	Yes	Yes
Control × ($T+T^2+T^3$)		Yes	Yes	Yes	Yes
Treatment trend		Yes	Yes	Yes	Yes
Only PMC counties			Yes		
CPE dummy				Yes	
Adjusted R-squared	0.941	0.944	0.948	0.944	0.923
No. of clusters	1,809	1,809	978	1,809	1,809
No. of Observations	25,323	25,323	13,691	25,323	25,280

Note: *** denotes significance at 1%, ** at 5%, and * at 10%. All observations are at the county-year level. The standard errors are reported in parentheses, clustered by county. The PMC dummy variable is equal to one if an observation is after the PMC reform starts and zero otherwise. The dependent variable in columns $1-4$ is the natural log of GDP per capita. The dependent variable in column 5 is the natural log of light emissions at night per capita. Column 1 only additionally controls for county and year fixed effects. In column 2 onwards, the following control variables are controlled for: the interactions between the eight key selection variables and a third-order polynomial function of time, and treatment-specific linear time trends. In column 3 the sample is based on PMC counties (52% of the full sample) excluding non-PMC counties. Column 4 additionally controls for the CPE

Table 3
The Impact of the PMC Reform on Transfer and Revenue

	Log(*Transfer_PerCapita*)	Log(*TaxRebate_PerCapita*)	Log(*GovRev_PerCapita*)	Log(*LandSale_Percapita*)
	(1)	(2)	(2)	(3)
PMC	0.020**	0.055***	0.039*	-0.459***
	(0.011)	(0.019)	(0.020)	(0.140)
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Control × T	Yes	Yes	Yes	Yes
Control × ($T+T^2$)	Yes	Yes	Yes	Yes
Control × ($T+T^2+T^3$)	Yes	Yes	Yes	Yes
Treatment trend	Yes	Yes	Yes	Yes
Adjusted R-squared	0.955	0.904	0.877	0.742
Year coverage	1999-2009	1999-2009	1999-2009	2003-2012
No. of clusters	1,809	1,809	1,809	1,809
No. of Observations	19,892	19,819	19,899	16,281

Note: *** denotes significance at 1%, ** at 5%, and * at 10%. All observations are at the county-year level. The standard errors are reported in parentheses, clustered by county. The PMC dummy variable is equal to one if an observation is after the PMC reform starts and zero otherwise. The dependent variables in columns 1–4 are the natural log of the measure of per capita fiscal transfer, tax rebates, fiscal revenue and land sales. All specifications control for county and year fixed effects, the interactions between the eight key selection variables and a third-order polynomial function of time, and treatment-specific linear time trends.

Table 4
The Mechanism of PMC: the Span of Control and Expenditure

	Log(*Span*)	Log(*GDP_PerCapita*)	Log(*GovExp_PerCapita*)	Log(*ProGrowthInvest_PerCapita*)
	(1)	(2)	(3)	(4)
PMC	1.907***	-0.007	-0.014	-0.046
	(0.024)	(0.025)	(0.009)	(0.029)
Log(*Span*)		-0.010		
		(0.012)		
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Control × T	Yes	Yes	Yes	Yes
Control × ($T+T^2$)	Yes	Yes	Yes	Yes
Control × ($T+T^2+T^3$)	Yes	Yes	Yes	Yes
Treatment trend	Yes	Yes	Yes	Yes
Adjusted R-squared	0.920	0.944	0.959	0.864
Year coverage	1999–2012	1999–2012	1999–2012	1999–2006
No. of clusters	1,809	1,809	1,809	1,809
No. of Observations	25,326	25,323	25,322	14,472

Note: *** denotes significance at 1%, ** at 5%, and * at 10%. All observations are at the county-year level. The standard errors are reported in parentheses, clustered by county. The PMC dummy variable is equal to one if an observation is after the PMC reform starts and zero otherwise. The dependent variables in columns 1-4 are the natural log of the span of control, per capita GDP, fiscal expenditure and pro-growth investment. Pro-growth investment is a subset of fiscal expenditure and includes expenditure for capital construction, expenditures supporting rural production and agricultural spending on agriculture, forestry, water managment and meteorology. All specifications control for county and year fixed effects, the interactions between the eight key selection variables and a third-order polynomial function of time, and treatment-specific linear time trends.

Table 5
The Impacts of the PMC Reform on Social Welfare Outcomes

	(1)	(2)	(3)	(4)
Log(*Rural_Income*)	0.004			
	(0.007)			
Log(*Urban_Wage*)		-0.003		
		(0.006)		
Log(*Retail_PerCapita*)			-0.027***	
			(0.009)	
Log(*Light_SD*)				-0.010
				(0.008)
County fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Control × T	Yes	Yes	Yes	Yes
Control × ($T+T^2$)	Yes	Yes	Yes	Yes
Control × ($T+T^2+T^3$)	Yes	Yes	Yes	Yes
Treatment trend	Yes	Yes	Yes	Yes
Adjusted R-squared	0.923	0.933	0.938	0.946
No. of clusters	1,804	1,809	1,809	1,809
No. of Observations	25,248	25,267	25,324	25,280

Note : *** denotes significance at 1%, ** at 5%, and * at 10%. All observations are at the county-year level. The standard errors are reported in parentheses, clustered by county. The dependent variables in columns 1–4 are the natural log of rural income, urban wage, retail sales per capita and standard deviation of light emissions at night of all cells within a county boundary. All specifications control for county and year fixed effects, the interactions between the eight key selection variables and a third-order polynomial function of time, and treatment-specific linear time trends.

Table A1

Number of counties adopting PMC and CPE reforms.

Year	PMC	CPE
Before 2001	74	31
2001	0	0
2002	0	0
2003	58	30
2004	113	168
2005	75	68
2006	15	161
2007	254	90
2008	0	64
2009	201	183
2010	153	12
2011	87	68
2012	22	65
Total	1052	940

Note: By the end of 2012, the PMC reform had been implemented across 22 provinces in China and the CPE reform had been implemented across 21 provinces.

Table A2
Province-Managing-County Criteria

Province	Implementation Phase			Simultaneous Implementation
	The First Wave	The Second Wave	The Third Wave	
Hebei	Economic strength, Development potential, Regional planning, Urbanization levels	Major grain-producing county	No criteria listed	
Shanxi	National Poor Counties	Major grain producing county, Major cotton producing county, Major oil producing county, Major pig-supplying county	No criteria listed	
Liaoning	No criteria listed	Location advantage, Natural resources, Development potential		
Jilin				Yes*
Heilongjiang				Yes
Jiangsu				Yes
Anhui	No criteria listed			
Fujian				Yes
Jiangxi	National poor counties	No criteria listed	No criteria listed	
Shandong	No criteria listed			
Henan	Regional planning, Aggregate economy, Fiscal status, Industrial development, Urbanization levels, Development potential	Location advantage	No criteria listed	
Hubei				Yes*
Guangdong	No criteria listed			
Guangxi	No criteria listed	the rest of the counties		
Sichuan	Aggregate Economy, Fiscal Status, Industrial Development, Sectoral Structure, Urbanization Levels, Development Potential	Major grain producing county, major oil producing counties and major pig-supplying counties; Aggregate Economy, Fiscal Status, Urbanization Levels, Development Potential		
Guizhou	Major grain producing counties, major oil producing counties and major pig-supplying counties, ecological preserving counties			
Yunnan	Aggregate Economy, Development Potential	No criteria listed		
Shaanxi	Ecological preservation, Fiscal status	Ecological preservation, Fiscal status		
Gansu	No criteria listed	No criteria listed	No criteria listed	
Qinghai	No criteria listed			
Ningxia	No criteria listed			

Note : * Excluding autonomous prefectures. *Source* : Provincial government decrees 2005–2011.