Fiscal Incentives, Public Spending and Productivity: County-Level Evidence from China

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Abstract:

This article develops a new empirical approach to analyze the potential link between fiscal decentralization and economic efficiency, based on a stochastic frontier model with spatial error correction. The estimation strategy advances empirical research in two ways. Firstly, fiscal decentralization is not considered to be a source of growth in itself but rather an incentive scheme that impacts local governments’ spending behaviors in response to economic needs. Secondly, the analysis accounts not only for the vertical relationship between a central authority and local agents but also for horizontal linkages between jurisdictions. County-level data on Zhejiang Province in China between 1995 and 2005 suggest that public spending contributes to economic efficiency significantly more when fiscal incentives are strong. The analysis also sheds evidence on spatial patterns of economic development. We find that education expenditures under fiscal decentralization result in a widening regional divide, while infrastructure investments and administrative expenditures benefit rich and poor areas by fostering market integration and promoting business-friendly policies.

Keywords: Fiscal decentralization, economic efficiency, public spending, spatial dependence, China

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1. Introduction

Since the 1980s, fiscal decentralization has become an important tool for governments in developing and transition countries to improve the efficient allocation of public resources and spur economic development (Brueckner 2009). The theoretical literature elaborates two distinct mechanisms that may bring about efficiency gains in a decentralized setting. In a Tiebout-type model, it is argued that bringing budget decision making closer to the people can make public authorities more responsive to local needs and conditions (Tiebout 1956). The devolution of fiscal authority, however, will be advantageous only if local governments are accountable to their constituencies (Bahl and Martinez-Vazquez 2006). Developing and transition countries often do not have formal institutions in place that allow citizens to monitor public agents and punish corrupt behavior (Bardhan 2002). In this context, the literature on market-preserving federalism suggests that the devolution of fiscal authority can serve as an incentive device to align local agents’ self-interests with the aim of supporting economic development (Weingast 2009, Monitola et al. 1995). If capital is free to move, inter-jurisdictional competition will reward political efforts to promote economic growth by filling the local state’s coffers and punish predatory governments when productive resources are flowing out to localities with more favorable conditions.

The structure and degree of fiscal power sharing between central and local governments is, however, a complex issue because there are several caveats that compromise and even pervert the potential efficiency gains from fiscal decentralization. Apart from the classical problem of finding an appropriate power balance between local agents promoting economic growth and central agents preserving stability (Musgrave 1959), the delegation of economic authority can also
provide lower-tier governments with the means to engage in protectionism (Lee 1998) or attract mobile capital by lowering social (Rom et al. 1998) and environmental (Cumberland 1981) standards. Furthermore, if initial conditions among jurisdictions are too asymmetric, the least competitive localities may have fewer incentives to respond to local needs compared with the case of no competition (Cai and Treisman 2005). Finally, providing tax incentives for local governments means simultaneously increasing financial disincentives for the central government to provide central public goods efficiently (Treisman 2006).

The complex interplay of formal and informal institutions suggests that there are various potential links and trade-offs that shape the relationship between the devolution of fiscal authority and economic growth. Empirical studies have come to different conclusions regarding when, if at all, developing and transition countries benefit from the devolution of fiscal power. Examining cross-country evidence, Davoodi and Zou (1998) find no significant effect of decentralization on economic growth for a sample of 46 developed and developing countries over the 1970-1989 period, while Iimi (2005) reports a significant positive effect for a mixed-country sample of 51 states between 1997 and 2001. Rodríguez-Pose and Krøijer (2009) present a significant negative effect for 16 Central and Eastern European countries over the 1990-2004 period, and Devarajan et al. (1996) show a significant positive relationship for 43 developing countries between 1970 and 1990. Enikolopov and Zhuravskaya (2007) examine institutional differences among a sample of 75 developing and transition countries between 1975 and 2000 and conclude that fiscal decentralization has a growth-enhancing effect, given that the political system is strongly centralized.

The empirical literature provides important insights into various technical and institutional aspects that may shape the outcome of decentralization on economic growth. Previous studies have in common that they employ a growth function augmented by a decentralization measure to shed insight into whether or not decentralized regions grow faster. This empirical setup, however, has two limitations. Firstly, a growth-function approach assumes that each administrative unit achieves the maximum output possible, given the inputs at its disposal. In this setting, fiscal decentralization is considered to be a source for technological progress pushing a jurisdiction’s production curve upwards. The theoretical literature, however, argues in favor of market-preserving federalism as a means for developing countries to limit inefficient government intervention. In this context, Weingast (2009, p 282) maintains: “A subnational government that seeks to create monopolies, engage in extensive corruption, or arrange a privileged position for an interest group places firms in its jurisdiction at a disadvantage relative to competing firms from less restrictive jurisdictions.” Firms operating in regions dominated by political predation are, therefore, likely to achieve an output that is below their technical optimum. Thus, even in the absence of innovation, decentralization can have a positive impact on
productivity, when fiscal incentives and inter-jurisdictional competition provide incentives for local governments to pursue business-friendly policies.

Secondly, the augmented growth-function approach establishes a direct link between fiscal decentralization and economic growth, which discards the possibility that tax-sharing contracts may entail a selection bias either towards economically efficient or inefficient regions. Consider, for instance, the case of a multi-ethnic state, where more fiscal autonomy is granted to minority regions due to political rationale. If these sub-regions tend to be economically less developed and more impoverished than jurisdictions populated by the ethnic majority, measures of decentralization will incorporate a negative bias. In contrast, measures of decentralization will be positively biased if the logic of negotiating fiscal contracts is based on the principle of subsidiarity, such that affluent regions enjoy a higher degree of autonomy. Consequently, examining the direct effect of decentralization on efficiency bears the risk of overstating or understating efficiency gains arising from a decentralized form of governance. Accordingly, it becomes evident that empirical research needs to be more explicit about the role of decentralization as an incentive device that shapes local public spending and, in turn, indirectly impacts productivity.

To address these issues, this paper sets forth a new empirical approach based on a stochastic frontier model with spatial error correction. In this setup, the best-performing locality A defines the production frontier. The degree of inefficiency of any other region B is then defined as the gap between the real output achieved in B compared to the potential maximum output that B might achieve for the same amount of input if it were to implement locality A’s best practices. In contrast to previous studies, the effects of decentralization will not be modeled as input factors of the production function but rather as background variables that influence the distance to
the technological frontier over time. A significant negative effect would imply that a locality is reducing the distance to the frontier and thus increasing efficiency, and vice versa. This approach permits explicit modeling of the contribution of public spending behavior to productivity, conditional on the strength of fiscal incentives. In addition, it is possible to control for the role of inter-jurisdictional competition by introducing spatial-lagged variables for public expenditures in neighboring jurisdictions.

In contrast to the majority of previous studies on China, this article will use county-level data. Decentralization effects are expected to be stronger at lower administrative levels because spending assignments concerning the provision of basic public goods in China were handed down to the counties, initiating intensive competition. Oi (1995) therefore argues that counties constitute the “top of a corporate hierarchy,” and county officials assume a direct role in fostering the development of the local economy. However, because China consists of a large territory consisting of regions that are economically, culturally, ethnically and institutionally diverse, incentive structures may induce quite different outcomes. In this vein, Zhang (2006) argues that the large variation in production patterns and revenue structures makes the underlying assumptions of the market-preserving mechanism invalid. The focal point of this study, therefore, will be the experience of a single province, namely, Zhejiang. Zhejiang is an ideal research site because its economic development is mainly based on small-scale, non-state enterprises and was forced from below, with little intervention from above (Liu 1992). Therefore, capital mobility, as a prerequisite for the decentralization mechanism to work, is strong. The analysis focuses on the time after the major tax reform in 1994, which laid the foundation for a significant change in fiscal incentive structures.
The remainder of this paper is structured as follows. Section 2 reviews the theoretical argument and derives the main hypothesis. Section 3 outlines the empirical context. Section 4 presents the data and model. Section 5 discusses the results, and Section 6 concludes.

2. Reviewing the argument

Transferring fiscal responsibilities to lower-tier governments may improve the efficiency of public-goods provisioning. On the one hand, local governments can attain greater allocative or consumer efficiency if they dispose of superior knowledge about local conditions and effective bureaucratic structures to react to local needs. On the other hand, subnational governments may enhance producer efficiency when, given a fixed budget, they have the capacity to yield larger quantities or quality of public goods compared to central authorities (Martinez-Vazquez and McNab 2003). There are two theoretical arguments supporting the claim for fiscal decentralization as a means to improve the provision of public goods.

Allocative efficiency in the tradition of Tiebout sorting is achieved when local jurisdictions compete with each other for consumer-voters (Tiebout 1956). To attract constituencies, each commune offers a combination of public goods. Consumer-voters will then choose the jurisdiction that offers a service package that best fits their individual needs. The model is based on the assumption that there are no spillover effects between jurisdictions, and preferences among consumer-voters are heterogeneous. Oates (1993) maintains that under these conditions, a decentralized solution is always welfare-enhancing, even in the case of complete immobility.
The second strand of literature, influenced by advances in the new theory of the firm, marks the emergence of a second-generation theory of fiscal federalism (Weingast 2009). This vein emphasizes the role of incentives for government officials to provide public goods and preserve markets (Weingast 1995, Qian and Weingast 1997). The central claim is that local governments have an interest in actively supporting regional economic development if they can keep a share of the resulting increase in tax income. Accordingly, decentralization in a federal or quasi-federal system improves the efficient provision of public goods by reducing agency costs. Market-preserving federalism particularly fits the context of developing countries where bureaucratic structures and legal enforcement mechanisms are deficient (Shah 1999) and result in severe principal-agent problems between central and local authorities. Furthermore, preferences for basic public goods are not likely to vary much among constituencies in different communities (Prud’homme 1995), and hence inter-jurisdictional competition may be too weak to facilitate a Tiebout-type sorting mechanism. In fact, under homogenous preferences, local agents may opt for a race to the bottom, similar to a Bertrand price competition, when they try to attract businesses with low environmental standards (Kunce and Shogren 2005) or downsized welfare systems (Dahlberg and Edmark 2008) and encourage market-corroding actions (Cai and Treisman 2004), such as evading central-government taxes or national regulations. The literature on market-preserving federalism, however, posits that inter-jurisdictional competition under homogenous preferences still can function as a yardstick for local governments (Bordignon et al. 2004) when its constituencies use the performance of neighboring communities as a benchmark to evaluate the quality of service provision in their own region.
Both Tiebout-sorting and the market-preserving mechanism are concerned with the question of how fiscal decentralization impacts local policies in general and budget decisions in particular. None of the models establish a direct link between the devolution of fiscal authority and economic growth. However, it can be argued that local public agents impact productivity indirectly, as their actions shape the local institutional environment in which production processes occur. Fiscal contracts or tax-sharing agreements, on the one hand, constitute incentives that motivate the way in which local agents allocate public resources, while public spending, in turn, impacts local production. Accordingly, the first main hypothesis can be derived.

\[ H1: \text{Fiscal decentralization impacts productivity indirectly through public-spending behavior that responds to local economic needs.} \]

On the other hand, it is expected that inter-jurisdictional competition results in the spatial-dependent allocation of public resources, whereby the public goods provided in one locality impact budget decisions in other jurisdictions. This leads to the second main hypothesis.

\[ H1: \text{Fiscal decentralization impacts productivity indirectly through spatial coordination of public investments.} \]

\( H1 \) and \( H2 \) will be tested for three types of basic public-good investments: education, infrastructure, and administrative services. There are other potential indirect effects on long-run economic growth, for example, when public-good provisioning
encourages higher saving rates, improves the health of its constituencies or encourages parents to make bigger investments in the education of their children. These indirect effects are, however, connected to the mobility of individuals rather than production factors. In the empirical study presented herein on China, such effects are negligible due to the household registration, or hukou, system (Chan and Zhang 1999, Wang 2004). Chinese citizens are eligible to receive basic public goods, such as health care or schooling, only in the locality where they are registered, which is in most cases the place of birth. A Chinese citizen will therefore not be able to enjoy better provision of public goods in a locality outside his/her birthplace. Children inherit the hukou of their parents, irrespective of where they are born. Because changing household registration is difficult and expensive, only a small, privileged group is able to do so. Thus, the mobility of consumer-voters constitutes a relatively low priority for local-government spending behavior.

3. Empirical Context

The institutional development of the fiscal system in China after 1978 has been shaped by struggles between local and central agents over how to share the state’s income. Economic decentralization during the 1980s encouraged local governments to set up township and village enterprises (TVEs) targeting the huge demand for simple consumer goods that had been neglected by central planners for so long (Naughton 1994, Oi 1995). While many local governments were able to fill their coffers, the Central State saw its traditional income sources, such as profits from State Owned Enterprises (SOEs), diminish in the transition to a market economy. There were several revenue-sharing systems introduced and abandoned during the 1980s, but none of them
brought the increasingly skewed distribution of income between the Central and local governments to a halt (Wong 2000). The latest of these attempts before the tax reform in 1994 was the “fiscal contract system,” which required provinces to transfer a lump sum of their income, adjusted by a growth factor, to the Central administration each year. In turn, provinces became responsible for matching their expenditure requirements with their residual income. This institutional arrangement had major implications for the increasingly unequal distribution of public goods, as it meant a decoupling of income and expenditure assignments, a characteristic of the Chinese fiscal system that has not been reversed in the subsequent tax reform.

The tax reform of 1994 marked a radical change in central-local fiscal relations and moved the country more in line with modern tax systems in industrialized nations. The first important feature of this new institutional arrangement was the introduction of a production-based value-added tax. This income source is to be shared 75:25 between the Central government and the local state, respectively. Overall, there are now 29 types of taxes, of which eight constitute shared taxes, seven are exclusively assigned to the Central Government, and 14 are at the disposal of local governments.² To reduce agency costs, the Central Government established a separate tax office responsible for collecting the Central State’s taxes as well as the shared taxes. In addition, the reform of 1994 incorporated a general-purpose equalization transfer mechanism to mitigate rising regional asymmetries.³

² For a detailed overview, see World Bank (2002).
³ For a detailed discussion of the 1994 tax reform, see, for example, Ahmad (2008).
Figure 1 depicts the stylized facts of central-local fiscal relations since 1978. The decline of the Central States’ income share began in 1984, followed by a drastic expenditure reduction in 1985. The main reason for this development was the abolishment of the so-called “three principles,” which protected SOEs from competition by restricting the production of TVEs to local resources, local production, and local markets (OECD, 2002, 87). Figure 1 also shows that the tax reform in 1994 not only boosted the Central Government’s income share but also kept it stable on a long-term basis. In contrast, the Central Government’s expenditure share demonstrates a long-run trend in the opposite direction, confirming that the decoupling of income and expenditure assignments has not been modified over time.

A further aim of the 1994 reform was to broaden the overall tax base because previous schemes focused mainly on SOE profits, ignoring the rising importance of TVEs and private enterprises for the national economy (Kanamori 2004). From this perspective, the tax reform was not only advantageous for the Central Government but also for the local administrations because both central and local tax-levying capacities, measured as the ratio of budgetary income to GDP, re-gained momentum from 1994 onwards (Figure 2).

Apart from returned taxes, e.g., shared taxes that the central administration is collecting on behalf of local governments, central-local transfer payments consist of general-purpose grants, which aim to equalize public spending across regions, as well as specific-purpose (earmarked) grants, which are allocated on an ad hoc negotiated basis (Dabla-Norris 2005). Returned taxes are rules-based and thus are not at the
discretion of the Central Government. Such non-discretionary payments as a share of total transfers decreased from 75% to about 40% between 1994 and 2005 (Figure 3), while other transfer payments gained relatively more importance. In parallel, local extra-budgetary revenues, e.g., income from locally levied fees that are exclusively at the disposal of the local administrations, have been declining (Figure 3) due to the Central Leaderships’ efforts to reign in the growing financial burdens plaguing, in particular, small business owners and farmers (Lin 2005). Judging from aggregated national statistics, the 1994 tax reform represents a shift in the distribution of fiscal powers from local governments to the Central government. It is, however, important to note that this power shift varies among provinces, depending on the structure of transfer payments. Wealthy provinces such as Zhejiang do not receive general-purpose transfer payments from the Central Government and therefore remain, to a large extent, self-reliant.

The brief discussion of the current tax system in China brings to the fore that incentives for providing public goods and promoting economic growth vary among provinces. Regional asymmetries may therefore be one of the reasons why empirical studies come to different conclusions about the effectiveness of inter-jurisdictional competition in China. Examining the case of a single province can reduce the noise of spatial variation and thus may help to single out institutional factors that shape fiscal dynamics in a decentralized system. In this context, Zhejiang represents a region that comes quite close to the conditions under which Tiebout sorting and market-preserving federalism can be expected to work. There are three main characteristics that
contribute to Zhejiang as an outstanding research site. Firstly, the degree of fiscal autonomy is relatively high. Zhejiang ranks 4\textsuperscript{th} in terms of per capita local government revenues but only 11\textsuperscript{th} in terms of per capita expenditures. Most of the provinces with higher per capita government expenditures are located in the Center and the West. Thus, this discrepancy is owed to the fact that poor regions receive general transfer payments to develop the local economy, subsidize the agricultural sector and provide social relief for the poor, while Zhejiang remains, to a large extent, self-reliant.

Secondly, capital mobility in Zhejiang is high due to its specific industrial structure. Private enterprises constituted 98.75\% of all registered firms in 2009, generating 93.26\% of GDP. Most of these firms are engaged in light industry, particularly in textiles. As can be observed in Table 4, Zhejiang ranks 4\textsuperscript{th} in total and per capita GDP as well as in industrial output and retail market sales but only 8\textsuperscript{th} in fixed-asset investment, which indicates that domestic firms have relatively low sunk costs and, hence, may be less committed to initial investments in a specific locality compared to heavy industries. Furthermore, in contrast to TVEs and SOEs, mobility of private firms is not restricted due to public ownership and related political intervention. Lastly, Zhejiang displays an unmatched variety of local economic-development trajectories (Parris 1993, Shi and Ganne 2009), a feature that may invoke a Tiebout-type sorting mechanism. In 2008, there were 800 clusters spread over 175 different types of industries (Akoorie and Ding 2009). On average, each town in Zhejiang hosted three clusters, which gives reason to suppose that the variation in industrial structures also translates into heterogeneous economic needs among jurisdictions.

\textit{\{Insert table 1 about here\}}
4. Model and Data

4.1. Model

Suppose that county $i$ produces at time $t$ along the production function $f(X_{it}, \beta, t)$, where $X_{it}$ denotes a vector of input factors, and $\beta$ represents a vector of parameters to be estimated. Without inefficiency or errors, county $i$ would produce

\[ Y_{it} = f(X_{it}, \beta, t). \]

Assuming that resource allocation in county $i$ is subject to a certain degree of inefficiency, the resulting output might be less than the maximum possible outcome, e.g.,

\[ Y_{it} = f(X_{it}, \beta, t)\xi_{it} \]

where $\xi_{it}$ constitutes the level of efficiency for county $i$ at time $t$ with $0 < \xi_{it} \leq 1$. If $\xi_{it} = 1$, then county $i$ achieves the optimal output at time $t$; in the case of $\xi_{it} < 1$, county $i$ is producing below its technological potential. Output is also subject to random shocks $v_{it}$ such that the real output is defined by

\[ Y_{it} = f(X_{it}, \beta, t)\xi_{it} v_{it}. \]

Assuming a translog production function and taking the natural log of both sides yields

\[ \ln(Y_{it}) = \beta_i + \beta \ln(K_{it}) + \sum_j^{m} \beta_j \ln(X_{jit}) + \delta_T T + \frac{1}{2} \beta_{TT} T^2 + \frac{1}{2} \sum_k^m \sum_j \beta_{jk} \ln(X_{jit}) + (v_{it} - u_{it}) \]

where $u_{it} = -\xi_{it}$ and $j, k = 1, 2$ represent indices for two input factors, capital and labor, $T$ and $T^2$ represent linear and exponential time trends, respectively, and $\beta_i$ captures county-fixed effects to account for inter-jurisdictional differences instead of assuming a single-province production frontier. The random effects $v_{it}$ are assumed to be independent and identically distributed.

Following Battese and Coelli (1995), technical inefficiency is specified as
where \( Z_{it} \) represents a vector of explanatory variables, \( \delta \) is the vector of coefficients to be estimated, and \( \omega_{it} \) is a non-negatively truncated, normally distributed random variable.

Based on the theoretical discussion in Section 2, a county government’s responsiveness to local economic needs varies with the level of fiscal incentives. Specifically:

\[
(5) \quad u_{it} = \delta Z_{it} + \omega_{it}
\]

where \( Z_{it} \) represents a vector of explanatory variables, \( \delta \) is the vector of coefficients to be estimated, and \( \omega_{it} \) is a non-negatively truncated, normally distributed random variable.

Equation (5a) models the general idea of Hypothesis 1, whereby public expenditures are allocated efficiently because fiscal incentives align local officials’ self-interests with the aim to promote economic growth. In contrast, the benchmarking or competition effect formulated in Hypothesis 2 identifies the spatially interdependent allocation of public investments as a major source for improving Pareto efficiency.
following estimation strategy. Two general models are considered to reflect the interaction between local jurisdictions. Firstly, we estimate a spatial-lag model where production output $y$ in locality $i$ is impacted by the contemporaneous output $y$ of neighboring jurisdictions $n$ at time $t$. The spatial-lag variable is defined as:

$$y_{nt} = \sum_{j=1}^{N} w_{ij} y_{jt}$$

where $w_{ij}$ describes, based on a contiguity criterion, whether or not $y_j$ is neighbor to $y_i$.

In matrix form, this expression can be rewritten as:

$$y_n = Wy$$

with $W$ representing a row-standardized spatial-weight matrix. The spatial-lag model is then specified as:

$$y_{it} = \rho y_{nt} + \beta x_{it} + \delta_t + \epsilon_{it}$$

Parameter $\rho$ measures the effect of output $y_n$ on $y_i$ at time $t$; $x_{it}$ is a matrix of control variables, and $\beta$ is a vector of related elasticity. In this setting, a positive sign of $\rho$ suggests that economic activity unfolds positive spillover effects, while a negative sign would indicate that technologically more advanced counties attract capital from close-by regions. In any case, capital flows in this model are driven by inter-jurisdictional differences in technological and/or economic development. If we conclude that a spatial-lag model is the most suitable setting for the empirical case presented, it would be necessary to include the spatial-lag variable $y_{nt}$ in the production function to receive unbiased estimates. At the same time, we would reject Hypothesis 2 because spatial dependence is the result of technological spillovers rather than the spatially dependent allocation of public investments.

A second approach to account for spatial dependence is the spatial-error model, which is formulated as:
\[ (9) \quad y = \beta X + \eta \quad \text{with} \quad \eta = \lambda W \eta + \varepsilon \]

where \( \lambda \) is the coefficient of spatially lagged autoregressive errors, \( W \eta \). The error term \( \varepsilon \) is independently distributed. Thus spatial dependence in this setting originates from spatially correlated factors that affect the production process in a jurisdiction. Given that the spatial-error model suits the empirical data best, we cannot reject Hypothesis 2 and need to correct for spatial autocorrelation in the error term. To gain further insights into whether public investments constitute the relevant factors causing spatial autocorrelation in the error term, the next step is to compute spatial-lagged variables for public-goods investments, following the same approach as formulated in Equation (7), and rewrite Equation (5a):

\[ (5b) \quad u_{it} = \delta_0 + \delta_1 fin_{it} + \delta_2 ed_{it} + \delta_3 in_{it} + \delta_4 ad_{it} + \delta_5 edw_{it} + \delta_6 inw_{it} + \delta_7 adw_{it} + \delta_8 fin_{-ed}_{it} + \delta_9 fin_{-in}_{it} + \delta_{10} fin_{-ad}_{it} + \omega_{it} \]

where \( edw, inw \), and \( adw \) represent the spatially lagged public-goods investments with respect to education, infrastructure, and administration.

For the empirical analysis, we use Tim Coelli’s computer program “frontier 4.1”\(^4\), which implements the Battese and Coelli (1995) one-step estimation procedure for stochastic frontier models. This approach allows us to use panel-data and to model inefficiency effects \( u_{it} \) as an explicit function of local government spending and fiscal incentives, as specified in Equation 5. In addition, we use James P. LeSage’s econometrics toolbox for Matlab\(^5\) to estimate the spatial-lag and spatial-error models and Luc Anselin’s spatial data analysis program GeoDa\(^6\) to calculate measures of

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\(^5\) Texas State University - San Marcos, Finance and Economics Department, USA (http://www.business.txstate.edu/users/jl47/).

\(^6\) Center for Geospatial Analysis and Computation, Arizona State University, USA (http://geodacenter.asu.edu/)
spatial dispersion and to generate the spatially lagged variables for local public expenditures.

4.2. Data and Variables

The data for the empirical analysis come from various issues of the Zhejiang Statistical Yearbook as well as prefecture statistical yearbooks for Hangzhou, Huzhou, Jiaxing, Zhoushan, Ningbo, Shaoxing, Quzhou, Jinhua, Taizhou, Wenzhou, and Lishui. All monetary indicators are deflated to 1992 prices based on prefecture consumer price indices. Output in the production function is measured with real per capita GDP ($gdp$) for each county in Zhejiang for 11 years between 1995 and 2005. Input factors include the real per capita capital stock ($cs$), real per capita capital investment ($ci$), per capita employment ($emp$) and time ($t$). The capital stock is calculated as accumulated real fixed-capital investments minus a yearly depreciation rate of 20%. Employment comprises the whole population receiving remuneration for work, and investment refers to all capital expenditures from both domestic and foreign investors.

The inefficiency equation is based on real per capita education expenditure ($edu$), real per capita infrastructure expenditure ($in$), real per capita administration expenditure ($ad$) and two measures of decentralization: the self-reliance ratio ($sel$), and the tax retention rate ($ret$). The two measures of decentralization $sel$ and $ret$ capture two different dimensions of fiscal incentives invoked by the 1994 tax reform. The self-reliance variable measures the extent to which local governments have to rely on local sources to meet expenditure assignments. Because the Chinese budget law from 1994 does not allow local governments to finance their expenditures without authorization of the Central Government, the budget gap between local income and expenditure has
to be met by transfer payments or centrally approved finance instruments. Thus, the smaller the ratio of expenditures to income, the more a county relies on the Central Government to meet its assignments. Interpreted in an optimistic way, the self-reliance ratio refers to spending discipline due to hard budget constraints. However, given that the 1994 tax reform kept revenue and expenditure assignments unbalanced, the self-reliance ratio might also constitute a disincentive, as it measures the degree of budget pressure causing an under-provision of public goods or an increasing privatization of public goods. The retention rate captures central-local fiscal relations. The higher the share of locally generated income that a county government is eligible to keep, the stronger its incentives to employ public resources in a productivity-enhancing manner will be. The public-good expenditures are calculated as three-year moving averages to mitigate the effects of cyclical budget fluctuations.

The indicators used in the inefficiency equations are connected to some inconsistencies and limitations that need some further considerations. Firstly, statistics on local budgetary income are somewhat misleading because they include fixed incomes, e.g. 25% of the value-added tax receipts, but do not account for tax rebates. Tax rebates are, however, not at the discretion of the Central Government, and thus, excluding them understates the local income situation (Wong 2000). Hence, it is necessary to clean the data accordingly and to add to the local budget-respective refunds, e.g. 30% of a county’s annual increase in value-added tax and consumption tax. Secondly, the analysis presented herein is constrained to public-good investments in education, infrastructure and administration because these are the only items that are available for the time period between 1995 and 2005. Unfortunately, the borders between these categories are somewhat blurred because, for instance, investments in school buildings are not categorized as education expenditures but rather as
infrastructure investment, and administrative expenditures include both productive
categories, such as services provided for citizens, and non-productive items, such as
salaries for cadres. Thirdly, an additional limitation of the analysis arises from its focus
on budgetary revenues because there are no statistics on extra-budgetary revenues on
the county level available. The empirical analysis presented herein, therefore, can shed
light on the impact of fiscal incentives on the allocation of budgetary items only and
needs to acknowledge that decentralization may unfold different dynamics in terms of
extra-budgetary income sources.

5. Results

Models 1-3 in Table 2 are baseline models that shed insight into the direct
effects arising from fiscal incentives and public-goods investments. Model 1 uses the
self-reliance ratio, and Model 2 the retention rate, as the main factor for explaining
efficiency differences; all remaining regional differences are captured in the county-
specific intercept $\delta_0$. Both indicators have a positive sign and are significant at
conventional levels, indicating that fiscal decentralization is connected to lower county
productivity. Possibly the decoupling of expenditure and income assignments leads to
non-linear returns from fiscal decentralization. If there is a threshold at which the
marginal costs of decentralization outweigh the marginal returns, then the efficiency
loss in Models 1 and 2 suggest that fiscal decentralization has gone too far with respect
to expenditure assignments or not sufficiently far with respect to income assignments.
Model 3 examines the direct effects of public investments. Here, rising expenditures
for education, infrastructure and administration tend to widen the distance to the
technological frontier. This result indicates that high investment levels do not
necessarily imply a strong commitment to provide public goods. Budgetary spending can be used to nurture clientelist ties by over-staffing public administrations and over-paying local officials. Local governments may also be prone to waste resources, when they produce public goods at high costs, invest in over-scaled prestige projects or finance government consumption. It is in this context that we would expect fiscal incentives to make a difference.

Generally, the baseline models in Table 2 indicate that further fiscal decentralization as well as handing down more public spending responsibilities to the county level are likely to worsen economic efficiency. This result is not necessarily a contradiction to the theoretical propositions of Section 2 because neither Tiebout sorting nor market-preserving federalism maintain that decentralization is a source of economic growth in itself but rather that it constitutes a coordination mechanism or incentive system that improves the efficient allocation of public resources. In this sense, the results of the baseline models are not qualified to refute the theoretical propositions but rather highlight that fiscal decentralization and the provision of public goods have many potential links and trade-offs that need to be addressed in a more detailed manner.

The following section of the empirical analysis will shed more light on the question of whether public spending contributes to economic efficiency conditional on the level of fiscal incentives. Based on the estimation strategy of Section 4, we first check whether and in what way it is necessary to account for spatial dependence. To this end, we estimate a spatial-lag model and a spatial-error model based on the same
setting as the stochastic frontier model, e.g., we employ a panel-data approach for the translog production function, as specified in Equation (4) of Section 4 with county-fixed effects to account for unobserved local differences. The results are presented in Table 3. Both coefficients, $\rho$ in the spatial-lag model and $\lambda$ in the spatial-error model, are highly significant and, therefore, confirm that the data are spatially correlated. To decide which model is most suitable, we use Paul Elhorst’s Matlab routine\(^7\) for the robust Lagrange multiplier test, developed by Anselin et al. (1996). The null hypothesis of $\rho=0$ in the spatial-lag model generates a $\chi^2$-distributed statistic of 2.425 with one degree of freedom (p-value = 0.119), and hence the null hypothesis cannot be rejected. In contrast, the test for $\lambda=0$ results in a test statistic value of 29.075 (p-value=0.000), and thus the null hypothesis is rejected. Based on the LM-test, we conclude that the spatial-error model is more suitable and therefore continue to estimate the stochastic frontier model by including spatial-lagged variables for public investments, as formulated in Equation (5b) of Section 4.

\[ \text{Insert table 3 about here} \]

For the case of education investment, the self-reliance model (Model 4) and the retention rate model (Model 5) reveal the same picture: when fiscal incentives are equal to zero, education investments turn out to have a negative impact on productivity, whereas rising fiscal incentives improve the contribution of public spending on economic efficiency significantly. In addition, the spatially lagged variables show that an average of a one-percent increase in education expenditures in neighboring counties reduces the relative speed of catching up to the technological

\(^7\) Department of Economics and Econometrics, University of Groningen, Netherlands (http://www.regroningen.nl/elhorst/)
frontier by around 0.12% to 0.15%. This result highlights that education investments constitute a crucial competition factor shaping a locality’s capacity to absorb existing knowledge and implement best practices. Rich counties are in a much better position to take advantage of this situation. They dispose not only of the means to engage in a race to the top in educational standards but they are also able to drain well-educated personnel from less affluent localities because they offer better social services and employment opportunities for highly skilled personnel. We calculate Moran’s I for education expenditures, a measure for spatial dispersion. The coefficient is significant at the one-percent level and increases from 0.4512 in 1995 to 0.5911 in 2005. This result indicates that education investments became more clustered between 1995 and 2005, which supports the conjecture of a widening education divide.

We turn now to the case of infrastructure investments. Here, the direct effect has a positive sign and is significant at conventional levels in the retention rate model (Model 5). In both model specifications, the interaction between fiscal incentives and infrastructure expenditures demonstrates a significant negative effect on productivity. This result is consistent with previous studies stressing that decentralization in China drives investment hunger of local governments because officials benefit from bonus payments that are based on retained earnings and also because counties rely on additional income sources to finance the communities’ rising responsibilities for social services and public-goods provisioning. Local government policies, therefore, often prioritize developmental goals that, considered in a wider context, lead to inefficient small-scale production as well as investment in over-capacities (Huang 1999).

Accounting for spillover effects from infrastructure investments in neighboring counties, however, offers some additional insights. The spatially lagged variable for infrastructure expenditures has a negative sign in both models (4 and 5) but misses
conventional levels of significance in the retention rate model (Model 5). The self-reliance model (Model 4) indicates that an average one-percent increase in infrastructure investments in a county’s closest neighbors decreases its distance to the technological frontier by 0.19%. Hence, the positive spillover effect in Model 4 overcompensates for the negative investment effect and brings about a positive net marginal speed of catching up. Apparently, counties can benefit from infrastructure investment in an indirect way when respective expenditures serve as a means to integrate into larger markets. The Moran’s I statistic for infrastructure investment supports this conjecture, as it is significant at the one-percent level and shows signs of rising local dispersion, with a coefficient decreasing from 0.5847 in 1995 to 0.4001. Our results, therefore, imply that infrastructure investments played a crucial role in fostering market integration between 1995 and 2005 in Zhejiang’s system of decentralized fiscal governance.

Observing the direct effect of administrative expenditures, we find a negative sign, which is insignificant in the self-reliance ratio model (Model 4) and in the retention rate model (Model 5). In contrast, administrative expenditures conditional on the level of fiscal incentives have a significant positive effect on economic efficiency in both model specifications. Among the three types of public-goods investments, administrative expenditures show the highest return to efficiency. A one-percent increase in the self-reliance ratio reduces technical inefficiency by one percent, and a one-percent increase of the retention rate decreases the distance to the technological frontier by 0.83%. This effect is not surprising, given that county administrations often provide direct support to establish and operate enterprises. Particularly, the wealthy East Coast provinces invested heavily in business-support facilities, such as the establishment of “Enterprise Service Centers” and “Agricultural Service Centers” (Liu
et al. 2006). In contrast to education and infrastructure investments, the spatial-lag variable for administrative services is insignificant at conventional levels in both model specifications. This gives reason to suppose that respective expenditures involve highly localized forms of business support that are only weakly exposed to competition. We find a significant trend of increasing dispersion with a Moran’s I statistic of 0.5160 in 1995 and 0.3349 in 2005, which suggests that providing local business support became a comprehensive strategy for local governments to encourage investments within their jurisdictions.

A further aspect of our results that needs more attention is the validity of the model specifications. We first check whether a translog form of the production function is the right choice. Tables 2-4 show the results of the log-likelihood test with the null hypothesis of a Cobb-Douglas specification being more suitable than the translog form. In all cases, the null hypothesis is rejected, indicating that the translog form is indeed the more suitable specification. A second issue concerns the definition of the spatial-weight matrix. The general recommendation is to experiment with different matrices to determine which definition of neighborhood exhibits the strongest signs of spatial dependence. We therefore replicate our estimates of Table 3 with different spatial-weight matrices. Our search is based on a heuristic approach, beginning with the broadest possible definition, where county n has N-1 neighbors with N representing all counties in Zhejiang. We then reduce the number of neighbors successively and choose the weight matrix with the highest t-statistic for spatial dependence. The results are presented in Table 5.

(Insert table 5 about here)
6. Conclusions

This paper presents a new empirical approach to analyze the potential link between fiscal decentralization and economic efficiency. The main purpose is to address the present gap between empirical applications measuring the growth-enhancing effects of fiscal decentralization and the theoretical arguments in favor of respective institutional arrangements. Our estimation strategy advances empirical research in two ways. Firstly, fiscal decentralization is not considered to be a source of growth in itself but rather an incentive scheme that impacts local governments’ spending behaviors in response to economic needs. In the case of Zhejiang, we find that the devolution of fiscal authority has had a negative impact on county efficiency since the major tax reform in 1994. However, when we decompose the decentralization effect, both measures, the self-reliance ratio and the retention rate, prove to constitute powerful incentives for the allocation of public-goods investments. The interaction between public expenditures on education and administration, on the one hand, and fiscal incentives, on the other hand, has a significant positive impact on economic efficiency. In contrast, infrastructure investments increase the distance to the technological frontier with rising levels of fiscal decentralization.

Secondly, our analysis accounts not only for the vertical relationship between a central authority and local agents but also for horizontal linkages between jurisdictions. In this context, our sample sheds evidence on the mechanisms that may cause or counter-balance regionally asymmetric economic development. The results indicate that education expenditures in Zhejiang constitute an important means to create a competitive advantage. This effect works in favor of affluent counties and widens the educational divide among different regions. In contrast, infrastructure investments
seem to foster market integration and therefore should be advantageous for both rich and poor areas. In addition, administration expenditures appear to take the form of highly localized business support that is only weakly exposed to inter-jurisdictional competition.

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### Table 1: Zhejiang’s Relative Economic Position in China

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
<th>Rank</th>
<th>Year</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>22,832</td>
<td>4</td>
<td>2009</td>
<td>100 Mio RMB</td>
</tr>
<tr>
<td>pc GDP (pc)</td>
<td>44,335</td>
<td>4</td>
<td>2009</td>
<td>RMB</td>
</tr>
<tr>
<td>pc local gov. income</td>
<td>3,732</td>
<td>4</td>
<td>2008</td>
<td>RMB</td>
</tr>
<tr>
<td>pc local gov. expenditure</td>
<td>4,264</td>
<td>11</td>
<td>2008</td>
<td>RMB</td>
</tr>
<tr>
<td>pc fixed assets investment</td>
<td>20,737</td>
<td>8</td>
<td>2009</td>
<td>RMB</td>
</tr>
<tr>
<td>pc industrial Output</td>
<td>78,826</td>
<td>4</td>
<td>2008</td>
<td>RMB</td>
</tr>
<tr>
<td>pc retail market sales</td>
<td>16,645</td>
<td>4</td>
<td>2009</td>
<td>RMB</td>
</tr>
<tr>
<td>pc FDI</td>
<td>194</td>
<td>7</td>
<td>2008</td>
<td>USD</td>
</tr>
</tbody>
</table>

*Source: Compiled from China Statistical Yearbook 2009 and 2011*
Table 2: Fiscal Decentralization, Public Spending, and Economic Efficiency†

<table>
<thead>
<tr>
<th></th>
<th>Model 1 Self-Reliance (std. err.)</th>
<th>Model 2 Tax Retention (std. err.)</th>
<th>Model 3 Public Spending (std. err.)</th>
<th>Model 4 Self-Reliance (std. err.)</th>
<th>Model 5 Tax Retention (std. err.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta_0$</td>
<td>-15.500*** (2.1500)</td>
<td>-15.008*** (2.0308)</td>
<td>-8.0527*** (2.067)</td>
<td>-8.299*** (1.1350)</td>
<td>-11.585*** (1.2721)</td>
</tr>
<tr>
<td>$s_e$</td>
<td>1.7300*** (0.1700)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_e$</td>
<td>1.7488*** (0.1714)</td>
<td></td>
<td></td>
<td></td>
<td>1.0542*** (0.0405)</td>
</tr>
<tr>
<td>$e_d$</td>
<td>0.0442*** (0.0107)</td>
<td>0.4974*** (0.0275)</td>
<td>0.4556*** (0.0297)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$i_n$</td>
<td>0.4631*** (0.0941)</td>
<td>0.0738</td>
<td>0.1916** (0.0679)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$a_d$</td>
<td>0.0866*** (0.0195)</td>
<td>-0.1125</td>
<td>-0.0873</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$s_e_e_d$</td>
<td></td>
<td>-0.6802*** (0.0959)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$s_e_i_n$</td>
<td></td>
<td>0.1169*** (0.0349)</td>
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<td></td>
</tr>
<tr>
<td>$s_e_a_d$</td>
<td></td>
<td>-0.8898*** (0.1025)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_e_e_d$</td>
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<td></td>
<td></td>
<td>-0.5660*** (0.0870)</td>
<td></td>
</tr>
<tr>
<td>$r_e_i_n$</td>
<td></td>
<td></td>
<td></td>
<td>0.0817** (0.0345)</td>
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<tr>
<td>$r_e_a_d$</td>
<td></td>
<td></td>
<td></td>
<td>-0.7387*** (0.1372)</td>
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</tr>
<tr>
<td>$e_d_w$</td>
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<td>0.1223*** (0.0069)</td>
<td>0.1503*** (0.0107)</td>
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<td></td>
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<tr>
<td>$i_n_w$</td>
<td></td>
<td>-0.1987*** (0.0543)</td>
<td>-0.0645</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$a_d_w$</td>
<td></td>
<td>-0.0144</td>
<td>0.0046</td>
<td></td>
<td></td>
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<tr>
<td>Sigma</td>
<td>4.8500*** (0.7540)</td>
<td>4.7193*** (0.7096)</td>
<td>1.3648*** (0.3132)</td>
<td>2.8893</td>
<td>3.3065</td>
</tr>
<tr>
<td>Gamma</td>
<td>0.9930*** (0.0016)</td>
<td>0.9925*** (0.0015)</td>
<td>0.9584*** (0.0103)</td>
<td>0.9841</td>
<td>0.9858</td>
</tr>
<tr>
<td>N</td>
<td>704</td>
<td>704</td>
<td>704</td>
<td>704</td>
<td>704</td>
</tr>
<tr>
<td>LR Test</td>
<td>187.212*** 978.235*** 1275.738*** 214.798*** 618.397***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

† To save space, we do not present the estimates of the production function. The author provides the respective tables upon request.
Table 3: Spatial Lag and Spatial Error Model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Spatial Lag</th>
<th>Spatial Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>t-statistic</td>
</tr>
<tr>
<td>Capital Stock</td>
<td>0.3194***</td>
<td>9.2113</td>
</tr>
<tr>
<td>Employment</td>
<td>0.2086</td>
<td>0.9399</td>
</tr>
<tr>
<td>Investment</td>
<td>-0.3504***</td>
<td>-3.8035</td>
</tr>
<tr>
<td>Time</td>
<td>0.0281</td>
<td>1.4532</td>
</tr>
<tr>
<td>Emp_Squ.</td>
<td>-0.0083</td>
<td>-0.5053</td>
</tr>
<tr>
<td>Inv_Squ.</td>
<td>0.0226***</td>
<td>3.3926</td>
</tr>
<tr>
<td>Time_Squ.</td>
<td>0.0017***</td>
<td>2.8016</td>
</tr>
<tr>
<td>Emp_Inv</td>
<td>-0.0042</td>
<td>-0.1576</td>
</tr>
<tr>
<td>Emp_Time</td>
<td>0.0021</td>
<td>0.7965</td>
</tr>
<tr>
<td>Inv_Time</td>
<td>-0.0328***</td>
<td>-4.3357</td>
</tr>
<tr>
<td>ρ</td>
<td>0.2720***</td>
<td>6.1731</td>
</tr>
<tr>
<td>λ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R_Squ. (corr.)</td>
<td>0.9179</td>
<td></td>
</tr>
<tr>
<td>N†</td>
<td>781</td>
<td></td>
</tr>
<tr>
<td>LR Test</td>
<td>70.1358***</td>
<td></td>
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</tbody>
</table>

† Spatial lag and error models require balanced panels. We therefore interpolated missing values. As a consequence, the number of observations N in the spatial lag and error models exceeds N in the stochastic frontier model, which is based on an unbalanced panel.
Table 4: Spatial Dependence with Different Contiguity Matrices

<table>
<thead>
<tr>
<th>contiguity criterion</th>
<th>ρ (spatial lag)</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>0.2610</td>
<td>1.7994</td>
<td>0.0720</td>
</tr>
<tr>
<td>35</td>
<td>0.3850</td>
<td>3.9372</td>
<td>0.0001</td>
</tr>
<tr>
<td>10</td>
<td>0.2140</td>
<td>3.1011</td>
<td>0.0019</td>
</tr>
<tr>
<td>5</td>
<td>0.2770</td>
<td>5.7411</td>
<td>0.0000</td>
</tr>
<tr>
<td>4</td>
<td>0.2710</td>
<td>6.1731</td>
<td>0.0000</td>
</tr>
<tr>
<td>3</td>
<td>0.2270</td>
<td>5.6356</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>contiguity criterion</th>
<th>λ (spatial error)</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>0.3690</td>
<td>2.7479</td>
<td>0.0060</td>
</tr>
<tr>
<td>35</td>
<td>0.3840</td>
<td>3.5785</td>
<td>0.0003</td>
</tr>
<tr>
<td>10</td>
<td>0.2010</td>
<td>2.7259</td>
<td>0.0064</td>
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<tr>
<td>5</td>
<td>0.2890</td>
<td>5.7477</td>
<td>0.0000</td>
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<tr>
<td>4</td>
<td>0.2920</td>
<td>6.3822</td>
<td>0.0000</td>
</tr>
<tr>
<td>3</td>
<td>0.2620</td>
<td>6.2794</td>
<td>0.0000</td>
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</table>
Figure 1. Central State income and expenditure share (percent, 1978-2011). Source: China Statistical Yearbook, various issues.
Figure 2. Tax capacity (tax revenue /gdp ratio), (percent, 1978-2011). Source: China Statistical Yearbook, Zhejiang Statistical Yearbook, various issues.
Figure 4. Local budgetary revenue in Zhejiang (quantiles, 1995 and 2005). Source: Zhejiang Statistical Yearbook, various issues.
Figure 5. Industrial base and fiscal decentralization in Zhejiang (1995-2005).

Source: See information on data sample in section 4.2
Figure 6: Distributional graphs (1995-2005). Source: See information on data sample in section 4.2
Figure 7. Total marginal effects of fiscal decentralization