Fiscal Decentralization, Fiscal Equalization, and Economic Growth:

A Comparative Study of China and India

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by

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Abstract

China and India are pursuing a variety of economic reforms which have led to very high economic growth rates. As part of their current reform agendas, both countries are pursuing fiscal decentralization (FD) reforms. Two prominent features of their decentralization strategies are expenditure decentralization and an intergovernmental transfer system designed, at least in part, to moderate disparities in public expenditures among sub-national governments. In this paper, we examine the effects of FD and horizontal fiscal equalization (HFE) on economic growth in China and India. We find that FD has a negative effect on economic growth in both countries. We estimate that a 10 percent increase in FD results in a 3.63 percentage point decrease in growth in China and a 2.48 percentage point decrease in India. In contrast to previous studies, we find that HFE has a positive effect on growth for both China and India.

JEL classification: E61; H77; P21; R11

Keywords: fiscal policy, economic growth, development economics

Introduction

China and India are among the most significant developing countries in the world. The performance of their economies directly affects the well-being of nearly one-third of the world's population and nearly one-half of those living on a dollar a day. Over the past several decades, both countries have pursued market oriented reforms which have led to very high economic growth rates thereby lifting hundreds of millions of people out of poverty. Among these reforms, both countries are pursuing fiscal decentralization (FD) reforms.[1] Two prominent features of their FD reforms are expenditure decentralization and intergovernmental transfers designed to moderate disparities in public expenditures among sub-national governments or horizontal fiscal equalization (HFE).

It is natural to focus on China and India in a study of the effects of FD and HFE on economic growth. Both countries have enacted major FD reforms in recent years, and both countries are continuing to devolve greater autonomy, fiscal resources, and responsibility for service delivery to sub-national governments. In addition to these and other similarities in the two countries, there are interesting contrasts, as well. India's population is ethnically, linguistically, and religiously diverse; China's population is relatively homogeneous. China is governed by one-party rule; India is a well established democracy, with competitive multi-party elections. For these and other reasons, a comparative study of the effects of China and India's FD and HFE policies on economic growth should be interesting to students of fiscal policy and economic development, alike.

To gauge the effects of FD and HFE policies on economic growth, we estimate a simultaneous equations model (SEM), using provincial (state) level data for the period 1985 to

[1] By fiscal decentralization, we mean the devolution of specific government functions by the central government to sub-national governments with sufficient administrative and fiscal autonomy to perform the assigned functions.

2006 for China and for the period 1980 to 2005 for India. Interestingly, our findings for the two countries are very similar. We estimate that a 10 percent increase in FD results in a 3.63 percentage point decrease in China's provincial growth rates and a 2.48 percentage point decrease in India's state growth rates. In our opinion, the fact that our results are so similar makes our findings all the more convincing.

The remainder of this paper is organized as follows. Section 2 provides some background on China and India's intergovernmental fiscal systems. In the third section, we summarize the existing literature on the effect of FD on China's economic performance. The fourth section describes our empirical strategy, samples, and variable construction. In the fifth section, we discuss our empirical results and a variety of specification tests. The final section concludes.

China and India's Intergovernmental Fiscal Systems

Figures 1 and 2 show the evolution of the growth rates in real GDP per capita, the degree of expenditure decentralization, and the coefficient of variation in sub-national expenditures per capita for China and India, respectively.[2] Comparing the trends in these two figures, China's growth rate is nearly twice that of India's. The degree of expenditure decentralization in China increased from approximately 60 percent of central government expenditures to nearly 70 percent. In contrast, India's degree of expenditure decentralization is about 40 percent and much more stable than China's. Finally, as evidenced by the coefficient of variation (CV) in provincial (state) expenditures per capita, China and India exhibit similar levels of fiscal disparities among their sub-national governments. Interestingly, the CV of provincial (state) expenditures of both countries exhibits a rollercoaster pattern over time. We proceed below with a description of the

[2] The degree of fiscal decentralization is the ratio of sub-national expenditures and central government expenditures. The coefficient of variation is the ratio of the standard deviation of provincial (state) expenditures and the mean of provincial (state) expenditures.

main features of China and India's intergovernmental systems.[3]

China's intergovernmental fiscal system

The People's Republic of China has a unitary form of government with five levels of government hierarchically arranged in a pyramid-like fashion with the central government naturally at the apex of the pyramid. China's political system is characterized by single-party rule with separation of the executive, legislative, and judicial branches of government, all of which, however, are under the leadership of communist party committees at every level of government. In China, there is one central government, twenty-two provincial governments, five ethnic minority autonomous regions, four municipalities directly administered by state councils, two special administrative regions (Hong Kong and Macao), and a twenty-third province that is independent of the central government (Taiwan).

The recent evolution in the direction of greater FD in China has been a gradual process. In 1978, fiscal reforms started with the devolution of control over resources and decision-making authority to sub-national governments as well as to state owned enterprises (SOEs). However, uncontrolled decentralization and case-by-case bargaining between the central and sub-national governments led to sharp declines in total national revenues as a share of GDP as well as in the central share of total revenues. The tax sharing system (TSS) reform was initiated in 1994 to re-centralize revenues and increase the revenue-to-GDP ratio. As a result, the central share of revenues increased from 22 percent to almost 56 percent between 1993 and 1994.[4]

The main pillars of China's intergovernmental fiscal system are characterized by highly decentralized expenditures and highly centralized revenues. This vertical imbalance naturally leads to a high degree of transfer dependence among sub-national governments and hidden

[3] For a comparative study of trends in FD in China and India, see Govinda Rao (2003) and Jorge Martinez-Vazquez and Mark Rider (2006).

[4] See Christine Wong (2000) for more details about the 1994 TSS reforms and its outcomes.

sub-national borrowings.[5] Although sub-national governments are prohibited from borrowing without special approval of the central government, almost all sub-national governments are circumventing these restrictions by borrowing "off the books". Baoyun Qiao and Anwar Shah (2006) describe off-budget finance as a fiscal dual track, namely budgetary and extra-budgetary funds that are under the complete authority of sub-national governments. The size of extra-budgetary funds grew rapidly in the 1980s and 1990s, becoming equivalent in size to budgetary funds in 1991.[6] As a result of several policy reforms, extra-budgetary funds began to decline.[7] By 2005, extra-budgetary expenditures were on average about 16 percent of budgetary expenditures. Since off-budget funds are levied on the same tax base as budget funds, off-budget funds, like extra-budgetary revenues, are positively related to own source revenues, which is an important source of interregional disparities in per capita provincial expenditures.[8]

India's intergovernmental fiscal system

The Republic of India is a federal republic comprised of one central government (the Union), twenty-eight states, and seven union territories, including the National Capital Territory of Delhi. India has a parliamentary system of government in which the prime minister, as the head of the union government and the cabinet are chosen by the party or party coalition that wins a majority of the popular vote. Although local bodies long pre-dated India's independence from British rule, as a practical matter in the modern period FD did not go beyond the state level until the enactment of the 73rd Constitutional amendment in 1992 which grants statutory recognition

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5 The four pillars of fiscal decentralization are expenditure assignments, revenue assignments, intergovernmental transfers, and regulation of sub-national borrowing autonomy. See Zhihua Zhang and Jorge Martinez-Vazquez (2003) for a detailed description of the main features of intergovernmental fiscal relations in China after the 1994 TSS reforms.

6 See Christine Wong (1998) for a discussion of the size evolution of off-budget funds.

7 See, for example, State Council Document No. 29 (1996).

8 See, for example, Christine Wong (1998) for a detailed empirical investigation of the effects of extra-budgetary funds.

to rural and urban local self governments.

Before the 1980s, fiscal centralization dominated the national economy. Beginning in the mid-1980s, market oriented reforms and FD were the focus for revitalizing the economy. Driven by the debt crisis of the early 1990s, the Government of India began a process of deregulation, privatization, and liberalization of the economy, together with enlarging the tax bases, compressing expenditures, and strengthening state fiscal discipline through the enactment of the Fiscal Responsibility and Budget Management Bill in 2000. As a result, the combined central and state gross fiscal deficit fell to 6.7 percent of GDP in 2005, although high outstanding liabilities remain. This recent round of fiscal reforms resulted in lower state deficits.

The main features of India's intergovernmental fiscal system, like that of China's, are highly decentralized expenditures, highly centralized revenues, a high degree of transfer dependence, and a lack of budget discipline, including the accumulation of potentially unmanageable debts by the states.[9] In contrast to the leader-subordinate relationship in China's intergovernmental framework, the executive of the central government and those of the state governments in India are accountable first to the corresponding legislatures and second to the voters. That is, at least in principle. Nevertheless, a guiding relationship does exist between the Union government and the states of India. This guiding hand is clearly seen in the plethora of conditional grants or centrally sponsored schemes (CSS) distributed by the ministries of the Union government to the corresponding departments of the states and local bodies.[10]

Literature Review

[9] For a more complete description of the four pillars of India's intergovernmental fiscal system, see Roy Bahl, Eunice Heredia-Ortiz, Jorge Martinez-Vazquez, and Mark Rider (2005).
[10] For a discussion of CSS's, see Roy Bahl, Eunice Heredia-Ortiz, Jorge Martinez-Vazquez and Mark Rider (2005).

The current state of knowledge about the effects of FD on a country's economic performance, especially developing countries, is rather limited. For example, Paul Smoke (2003, page 7), a leading authority on FD, points out that much of its promised benefits is not based on careful empirical evidence but is all too often "… based on anecdotal instances of success or enthusiastic rhetoric about its benefits". Furthermore, the existing literature, scant though it may be, provides conflicting evidence on the effect of FD on economic growth in China and India. Finally, there is limited empirical evidence on the effect of fiscal equalization on growth.

The theoretical literature identifies several advantages and disadvantages from FD, which we briefly review below. Friedrich A. Hayek (1945) contends that the aggregation of individual preferences for public goods by the central government involves comparably greater costs than would occur with decentralization of decision-making to local governments. George J. Stigler (1957) asserts that representative democracy works best when government is closer to the people being governed. Finally, Wallace E. Oates (1972) shows that, in the absence of scale economies and inter-jurisdictional spillovers, decentralized provision of local public goods is always superior in terms of economic efficiency to centralized and therefore uniform provision of local public goods.[11] For these reasons, FD may have a positive effect on economic growth.

The literature identifies accompanying risks from FD, as well. Remy Prud'homme (1995) points out that FD may give rise to regional disparities and macroeconomic instability. Vito Tanzi (1996) further cautions that FD may result in economic distortions due to excessive regulation and local corruption. Finally, Govinda Rao and Nirvikar Singh (1999) describe a "race to the

[11] In a seminal paper on local government, Charles M. Tiebout (1956) shows that, under certain conditions, people 'voting with their feet' among many competing local governments results in an efficient allocation of local public goods. Yingyi Qian and Barry R. Weingast (1997) describe the benefits of "market-preserving federalism". Wallace E. Oates (1999) describes "laboratory federalism," in which best-practices can be identified by competing sub-national governments trying novel economic experiments in a decentralized system of governance.

bottom" in which sub-national governments engage in tax competition to attract mobile factors of production, particularly capital, and thus under provide local public goods. For these reasons, FD may have a negative effect on growth.

Remy Prud'homme (1995) and Baoyun Qiao, Jorge Martinez-Vazquez, and Yongsheng Xu (2007) among others contend that FD may give rise to unacceptably high disparities in expenditures per capita among sub-national governments. The reasons given for an increase in such fiscal disparities due to FD include interregional differences in revenue-raising capacities, in local preferences, in the cost of providing services, and in local fiscal policies. China and India, as well as many other countries, use intergovernmental transfers to moderate fiscal disparities among sub-national governments. Despite the widespread use of equalization grants to address concerns about interregional differences in service provision, very little is known about their effect on economic growth. However, estimates of the effect of expenditure decentralization on growth may be biased if the empirical strategy does not account for equalization policies as both policies are often pursued simultaneously. Certainly, this is the case for China and India.

Like fiscal decentralization, HFE has an ambiguous effect on economic growth. On the one hand, the rate of return to marginal increases in expenditures on infrastructure and social services like health and education may be higher in low-income regions of a country than in high-income regions due to diminishing marginal returns. In that case, a policy of transferring fiscal resources from high- to low-income regions may increase a country's aggregate growth rate. Furthermore, equalizing transfers may provide a social safety-net for the poor thereby reducing the potential for civil unrest that may arise from interregional fiscal disparities.[12] Again, equalization may promote economic growth. On the other hand, the taxes used to finance a

[12] See, for example, Jaejoon Woo (2009) for an insightful examination of fiscal policy in polarized countries.

transfer system and the transfer system itself may be distortionary. Furthermore, high-income recipient regions may use fiscal resources more efficiently than low-income donor regions because of differences in the quality of governance. For these reasons, HFE may have a negative effect on economic growth.

In short, the theory regarding the effects of FD and HFE on economic growth is ambiguous. What is more, the empirical evidence is mixed, as well. Tao Zhang and Heng-fu Zou (1998) estimate two specifications of a model of FD and economic growth for China, using data for the period 1980 through 1992 and for the period 1987 through 1993.[13] They find that FD has a negative and statistically significant effect on economic growth. In contrast, Justin Yifu Lin and Zhiqiang Liu (2000) and Ying Ding (2005) also estimate models of FD and growth, using data for the periods 1970-1993 and 1994-2002, respectively. They find that FD has a positive and statistically significant effect on growth. Neither of these empirical studies account for the potential endogeneity of FD on growth or the potential confounding effect of HFE on growth.

Baoyun Qiao et al. (2008) account for the potential endogeneity of FD using instrumental variables. In addition, they also account for the effect of HFE on growth. They use data for the period 1985-1998 to estimate their model. Like Justin Yifu Lin and Zhiqiang Liu (2000) and Ying Ding (2005) and in contrast to Tao Zhang and Heng-fu Zou (1998), they find that FD has a positive effect on growth. More specifically, based on their 2SLS estimates (table 4), the effect of FD on growth is positive for values of their FD index less than 1.0. However, the effect of FD on growth is negative for values of FD greater than 1.0. The mean value of FD in their sample is 0.70 which is approximately 2 standard deviations greater than the growth maximizing value of

[13] Danyang Xie, Heng-fu Zou, and Hamid Davoodi (1999) examine the effect of FD on economic growth in the United States. They find that the degree of FD in the United States is consistent with growth maximization. Using data for the period 1970 through 1994, Tao Zhang and Heng-fu Zou (2001) find fiscal decentralization has a positive effect on India's regional economic growth.

0.50 but is still in the range where FD has a positive effect on growth.

In contrast to China, there are only two empirical studies on the effect of FD on economic growth in the case of India, of which we are aware, and neither of these account for the effect of HFE on growth. Tao Zhang and Heng-fu Zou (2001) find a positive effect of FD on India's regional economic growth rates, using data for the period 1970 through 1994. Kalpana Kochhar, Utsav Kumar, Raghuram Rajan, Arvind Subramanian, and Ioannis Tokatlidis (2006) exploit FD reforms occurring in the mid-1980s to identify the effect of FD on economic growth in India. They find that India's FD reforms have not adversely affected state growth rates.

The following studies are informative about the differing aims of the FD reforms in China and India. Pranab Bardhan (2004) contends that India's FD policies reflect a strategy of welfare service delivery rather than one of fostering local economic development. In contrast, he argues that China's FD strategy encourages micro-finance and marketing channels which promote local economic development. Nirvikar Singh (2008) concludes that political decentralization alone may not be able to change pervasive and inefficient public service delivery in India. He believes that fiscal decentralization in India would rest on a firmer foundation if there was a greater emphasis on own local fiscal capacity building. This would strengthen the nexus between public prices and public service benefits which would presumably promote public sector efficiency. We proceed below with a description of our empirical strategy.

Empirical Strategy

China

To examine the effect of FD and HFE on growth, we estimate growth and equalization equations. For the growth equation, we adopt a production-function-based model that has been widely used in the empirical literature on growth, including the studies by Robert M. Solow (1956), Robert J. Barro (1990), and Hamid Davoodi and Heng-fu Zou (1998) among many others. For the equalization equation, we include variables that economic theory suggests may influence equalization.

Following Baoyun Qiao et al. (2008), we estimate the following SEM:

$$\begin{aligned} G_{it} &= \alpha_0 + \alpha_1 E_{it} + \alpha_2 FD_{it} + \alpha_3 FD_{it}^2 + \alpha_4 FD_{it}^3 + \alpha_5 K_{it} + \alpha_6 L_{it} + \alpha_7 F_{it} + \alpha_8 R_{it} + \alpha_9 FDI_{it} \\ &+ \alpha_{10} AGS_{it} + \alpha_{11} TE_{it} + \alpha_{12} TE_{it}^2 + \alpha_{13} CDEV_{it} + \alpha_{14} GOVS_{it} + \alpha_{15} TSS_{it} + \alpha_{16} CATD_{it} \\ &+ \alpha_{17} TIN_{it} + \alpha_{18} ASIAC_{it} + \mu_i + \upsilon_{it} \end{aligned} \quad (1)$$

$$\begin{aligned} E_{it} &= \beta_0 + \beta_1 G_{it} + \beta_2 FD_{it} + \beta_3 FD_{it}^2 + \beta_4 FD_{it}^3 + \beta_5 K_{it} + \beta_6 F_{it} + \beta_7 AGS_{it} \\ &+ \beta_8 TE_{it} + \beta_9 TE_{it}^2 + \beta_{10} CDEV_{it} + \beta_{11} GOVS_{it} + \beta_{12} MWS_{it} + \beta_{13} LNPOP_{it} \\ &+ \beta_{14} XBGT_{it} + \beta_{15} TSS_{it} + \beta_{16} CATD_{it} + \beta_{17} TIN_{it} + \beta_{18} ASIAC_{it} + \delta_i + \varepsilon_{it} \end{aligned} \quad (2)$$

The subscript *i* indicates the province, and the subscript *t* indicates the year. G is the growth rate in real gross regional product (GRP) per capita. Following Tao Zhang and Heng-Fu Zou (1998), the degree of FD is the ratio of provincial expenditures per capita and central government expenditures per capita. For this purpose, provincial (central) government expenditures include both provincial (central) budgetary and extra-budgetary expenditures. To allow for sufficient flexibility in the functional form, we use a cubic specification of FD, which allows the degree of FD to have non-linear effects on the dependent variables.

E is an index of equalization. Following Baoyun Qiao et al. (2008), we compute the deviation between a province's per capita expenditures in year t and the mean of provincial expenditures per capita in year t, for every province and year in our sample. We take the absolute value of these differences in order to convert them into distances from the mean provincial expenditures per capita in year t. Then, we normalize these figures by dividing by the mean provincial expenditures per capita in year t. Finally, we apply a minus sign to these figures in order to give our index of equalization (E) a more intuitive interpretation. As E approaches zero from the left, the province's per capita expenditures become closer to the mean value of provincial per capita expenditures and thus more equal.

The growth equation includes a vector of control variables that are typically used in empirical growth models. Capital (K) is measured by the growth rate of investment in total fixed assets. Labor (L) is measured by the growth rate in employment. According to economic theory, K and L should have positive effects on growth. Openness to international trade (F) is measured by the share of exports plus imports in GRP. Previous studies, like that by Xiaojuan Jiang (2004), find that the degree of openness promotes economic growth. R is the percentage change in the general retail price index. The effect of inflation on growth is ambiguous. Tao Zhang and Heng-fu Zou (1998) contend that a higher inflation rate encourages people to invest more in capital and reduce real balance holdings, which is the Tobin portfolio-shift effect.[14] In this case, inflation would promote economic growth. Alternatively, inflation may create greater uncertainty which may discourage investment and thus have a negative effect on economic growth.

FDI is the natural logarithm of per capita foreign direct investment, which is expected to have a positive effect on growth. In addition, we include the share of agriculture in total GRP (AGRS), which is expected to have a negative effect on economic growth. Provincial tax effort (TE) is the share of provincial revenues in GRP. Provincial revenues include the revenue from all shared taxes that go to sub-national governments, including tax rebates, as well as local taxes, transfers, and non-tax revenues. TE is expected to have a negative effect on growth since taxes distort the economic behavior of consumers and firms. We include the square of TE because of the potential non-linear effects of tax effort on the dependent variable. Infrastructure investment

[14] See James Tobin (1956) for a detailed discussion.

(CDEV) is the share of central government development expenditures in total expenditures. Provincial government size (GOVS) is the share of provincial budgetary and extra-budgetary expenditures in GRP. Economic theory and previous empirical work suggest that these two variables should have a positive effect on economic growth.

TSS is a vector of time dummy variables set equal to "1" in 1994 and beyond to account for the 1994 TSS reforms. Given the goals of these reforms, which are discussed in greater detail above, we expect this variable to have a positive effect on growth. CATD is a set of dummy variables for natural catastrophes. These are expected to have an adverse affect on economic growth. CATD is set equal to "1" for the province and for the year in which the catastrophe occurs and "0" otherwise.[15] TIN is a time dummy variable set equal to "1" in 1989 to account for the Tian'anmen Square incident and "0" otherwise; ASIAC is a time dummy variable set equal to "1" in 1997 -- the year of the Asian financial crisis -- and "0" otherwise. Both variables are included to account for the adverse economic shocks of these two events and are expected to have a negative effect on growth.

In the equalization equation, we include the growth rate (G), degree of fiscal decentralization (FD), FD-squared, and FD-cubed. As previously discussed, the effect of growth on equalization is ambiguous. Since FD is likely to create interregional disparities, it is likely to have a negative effect on equalization. We use a cubic specification of FD to allow it to have a potentially non-linear effect on equalization. Capital (K), openness (F), and share of agriculture (AGS) are expected to have a negative effect on equalization. TE captures the effect of tax effort on equalization. As discussed by Tao Zhang and Heng-fu Zou (1998), tax effort is expected to have a positive effect on equalization (E) because greater tax effort by a province, all other

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[15] Salvador Barrios, Luisito Bertinelli, and Eric Strobl (2010) examine the effect of rainfall anomalies on economic growth in Africa.

things held constant, should result in greater provincial spending per capita. CDEV are equalizing transfers and therefore should have a positive effect on equalization. The formula used to distribute development funds ensures that this variable is exogenous. Government size (GOVS) is expected to have a negative effect on equalization because a larger government crowds-out private investment which impedes economic growth, narrows the tax base, lowers tax revenues, thus having a negative effect on equalization.

We include the share of missing women in the total population (MWS) in the equalization equation. We calculate the number of hypothesized missing women for each province and year in our sample, using the method described in Ansley J. Coale and Judith Banister (1994). MWS is expected to have an adverse effect on equalization. For example, increased pensions are required for elderly men who never marry because of China's adverse sex ratio that results from the cultural preference for a male child which many believe is exacerbated by China's one child only policy.[16] LNPOP is the natural logarithm of the provincial population which is expected to have a positive effect on equalization. There is a widespread belief among students of China's local public finances that extra-budget funds are a main contributor to interregional fiscal disparities in China.[17] Thus XBGT, defined as the ratio of extra-budget expenditures to budgetary expenditures, is included to capture this potential effect. Given the goals of the 1994 TSS reform, we expect TSS to have a positive effect on equalization. The catastrophe dummy variables (CATD), the Tian'anmen Square dummy variable (TIN), and the Asian financial crisis (ASIAC) are expected to have a negative effect on equalization.

The terms μ_i and δ_i in equations (1) and (2), respectively, are unobserved, time-invariant, provincial effects on the dependent variables, and the terms υ_{it} and ε_{it} are idiosyncratic shocks

[16] See, for example, Quanbao Jiang, Marcus W. Feldman and Xiaoyi Jin (2005) for the adverse effects of missing women.
[17] See, for example, World Bank (2000 and 2001).

that are time-varying and represent unobserved factors that change over time and affect the dependent variables. In this SEM, a change in any disturbance term of equation (1) leads to a change in the potentially endogenous variable E that it directly determines. This, in turn, changes the other potential endogenous variable G. Similar logic applies to the effects of a change in any disturbance term in equation (2). As discussed in greater detail below, we estimate two-stage least squares (2SLS) and two-step generalized method of moments (2S-GMM) to account for the simultaneity between these two equations and the potential endogeneity of FD in both equations.

The data used in this study come from the China Data Center of the University of Michigan and cover the period from 1985 through 2006. The data on extra-budgetary revenues, extra-budgetary expenditures, and central transfers come from the Ministry of Finance (retrieved on October 2008 from www.mof.gov.cn). This period covers the main years of previous studies and straddles the 1994 TSS reform.

There may be concern that the Government of China may be manipulating economic data for political reasons. According to Thomas G. Rawski (2001), the intentional falsification of data, in terms of GRP statistics in particular, is common at all levels of government in China. In contrast, Gregory Chow (2006) concludes that China's official statistics are generally reliable and consistent with China's economy, although some data must be used with caution, as with data for any other country. In particular, the extra-budgetary data from the Ministry of Finance is considered to be reliable.

Our sample spans the years from 1985 to 2006 and includes data on 31 provinces of China, including Tibet, but does not include data for the island governments of Hong Kong, Macau, or Taiwan. In 1997, the municipality of Chongqing separated from Sichuan Province, and in 1988 Hainan Province separated from Guangdong Province. Data for Chongqing and

Hainan Provinces are available for the years after the bifurcations created these two new provinces in 1997 and 1988, respectively. In calculating provincial growth rates in real GRP per capita for 1986, we lose one year of data or 29 observations. In taking one-lagged values to estimate 2SLS FE and 2-step GMM, we lose another year of the data. As a result, our sample should consist of 638 observations: 29 provinces over a 21 year period, Hainan Province for 19 years, and Chongqing Province for 10 years (29 × 22 = 638). However, we lose 8 observations due to missing values, resulting in a sample of 630 observations. Summary statistics for our China sample are provided in table 3.

India

Our empirical model for India is similar to that of China:

$$\begin{aligned} G_{it} = \chi_0 + \chi_1 E_{it} + \chi_2 FD_{it} + \chi_3 FD_{it}^2 + \chi_4 FD_{it}^3 + \chi_5 K_{it} + \chi_6 LNPOP_{it} + \\ \chi_7 CT_{it} + \chi_8 ST_{it} + \chi_9 CATD_{it} + \chi_{10} ER_{it} + \sigma_i + \tau_{it} \end{aligned} \tag{3}$$

$$\begin{aligned} E_{it} = \gamma_0 + \gamma_1 G_{it} + \gamma_2 FD_{it} + \gamma_3 FD_{it}^2 + \gamma_4 FD_{it}^3 + \gamma_5 LNPOP_{it} + \\ \gamma_6 FSR_{it} + \gamma_7 FDR_{it} + \gamma_8 MWS_{it} + \gamma_9 CATD_{it} + \gamma_{10} ER_{it} + \psi_i + \theta_{it} \end{aligned} \tag{4}$$

G is the growth rate in real gross state domestic product (GSDP) per capita. E is an index of equalization. Other control variables in the growth equation include capital (K) measured as the natural logarithm of capital outlays per capita, and labor (L) measured as the natural logarithm of the state population due to the unavailability of actual labor force data. For comparability, all variables for China and India are measured in U.S. dollars.[18]

As previously noted, K and L are expected to have a positive effect on G. In addition, the Union government's average effective tax rate (CT), defined as the ratio of central revenue receipts and GDP, and state average effective tax rate (ST), defined as the ratio of state revenue

[18] We use the INR-U.S. dollar exchange rate, which was 0.0216 on January 28th, 2010 (www.xe.com/ucc/convert.cgi).

receipts and GSDP, are included to control for tax effort. Since these are distortionary taxes, they are expected to have a negative effect on growth.

Jean-Philippe Meloche, Francois Vaillancourt, and Serdar Yilmaz (2004) among others contend that the rate of fiscal self-reliance (FSR) and the rate of transfer dependence (FDR) are very important determinants of HFE among sub-national governments. Therefore, these two variables are included in the equalization equation. FSR is the share of a state's own revenues in state revenue receipts, and FDR is the share of central government grants in total state revenue. Furthermore, we include the share of missing women in the total state population (MWS), which is assumed to have an adverse effect on HFE. We use the same methodology to compute MWS for India as for China. As before, we expect MWS to have a negative effect on equalization.[19]

CATD is a dummy variable set equal to "1" in the state and year in which there was a natural catastrophe that one would expect directly to influence agricultural production and regional fiscal capacity. ER is a time dummy variable set equal to "1" for years in 1992 and beyond and "0" otherwise to account for the economic reforms adopted in that year. Regarding the simultaneity between the two equations and the potential endogeneity of FD, we pursue the same identification strategy described above for China.

The data used in this study are state-wise for the years 1980 through 2005. The main source for India's state fiscal and general national accounts data is the Reserve Bank of India (retrieved on December, 2009 from www.rbi.org.in). All-India data are from the Central Statistical Organization, and population data are from India's Office of the Registrar General. Data on natural catastrophes are from Natural Disaster Management, Ministry of Home Affairs. All real GSDP per capita figures have been adjusted to 1993–1994 base year.

[19] See, for example, Quanbao Jiang, Marcus W. Feldman, and Xiaoyi Jin (2005) for the adverse effects of missing women.

There are a total of 28 state governments and the national capital territory of Delhi. These 29 state governments include the states of Chhattisgarh, Jharkhand, and Uttaranchal which were established through the bifurcation of the states of Andra Pradesh, Bihar, and Uttar Pradesh, respectively, in 2000.[20] Therefore, the data for Chhattisgarh, Uttaranchal, and Jharkhand are available only for the 6 year period from 2000 to 2005. The resulting sample should consist of 694 observations ($26 \times 26 + 3 \times 6 = 694$). In calculating state growth rates in real GSDP per capita and taking one-lagged values, we lose two years of data. Complete data for Mizoram are only available for the period beginning in 2000, and complete data for Arunachal Pradesh and Goa are only available for the period beginning in 1986. Complete data for Nagaland, Sikkim, and Delhi are available beginning in 1994. Finally, there are 38 missing values for different states and years. As a result, there are 524 ($= 694 - 2\times29 - 1\times20 - 2\times6 - 3\times14 - 38$) observations in our sample. Table 3 provides summary statistics for our sample for India.

Empirical Results

This section begins by reporting the estimates from a variety of specifications of our models of economic growth for China and India, including the results of detailed specification tests. We also report the results of an “extreme bounds analysis”. Finally, we report the results of two simulations of the effect of FD on growth.

Tables 2 and 3 provide the main results. We begin by discussing the fixed effects (FE) estimates of the growth and equalization equations for China. This specification of the model does not account for the potential simultaneity between growth and equalization nor does it account for the potential endogeneity of FD. However, we believe that it is useful to report and

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[20] The following union territories are not included in our sample: Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli, Daman and Diu, Lakshadweep, and Pondicherry.

discuss these estimates to provide clear comparisons with results reported in the existing literature.

We begin by discussing the results for China. The FE estimates of the growth and equalization equations are reported in the first columns of the left and right columnar-panels in table 2, which are labeled growth and equalization, respectively.[21] Starting with the growth equation, the estimated coefficient of FD is -2.25 and is nearly four times its standard error (S.E. = 0.61). The estimated coefficient of FD-squared is 0.18 and more than twice its standard error (S.E. = 0.08), and the estimated coefficient of FD-cubed is negative but statistically indistinguishable from zero at conventional levels.[22] The combined effect of FD and its higher moments on growth is negative for all values of FD. The estimated coefficient of equalization is positive but statistically insignificant at conventional levels. In other words, equalization has no effect on growth, according to our estimates. Turning to the equalization equation, the estimated coefficient of FD is positive; the estimated coefficient of FD-squared is negative; and the estimated coefficient of FD-cubed is positive. These estimates are all statistically significant at conventional levels. Evaluated at the sample mean, the joint effect of FD and its higher moments on equalization is positive effect. Finally, the estimated coefficient of growth is positive but statistically insignificant at conventional levels.

[21] A Hausman test rejects a random effects specification of our model in favor of a fixed effects (FE) specification.

[22] To evaluate the cubic specification, we perform a likelihood ratio test of the 3 specifications of our model (e.g., FE, 2SLS, two-step GMM) and the two equations in the system for China. The null hypothesis is that the coefficient of FD-cubed is equal to zero. For China, the chi-squared values are large enough to soundly reject the null hypothesis, with only one exception. Specifically, the null hypothesis is nearly rejected at the 10 percent significant level in the FE specification of the growth equation. Therefore, we feel justified in reporting the cubic specification of our models. However, the results for a quadratic specification are very similar to those for the cubic specification; specifically, the joint effect of FD on growth is negative within the range of our data.

Although these results are certainly suggestive, the FE estimates may be inconsistent because of the potential endogeneity of FD and equalization in the growth equation. To address this issue, we estimate our SEM, using two-stage least squares with fixed effects (2SLS FE).[23]

To implement 2SLS, we require instruments for the potentially endogenous variables. Valid instruments must be correlated with the potentially endogenous variables and uncorrelated with the error term. In the growth equation, the proposed instruments are the share of missing women (MWS), extra-budgetary funds (XBGT), and the natural logarithm of population (LNPOP). The share of missing women (MWS) should influence the demand for equalization but is unlikely to affect provincial growth. Therefore, we conclude that it is a satisfactory instrument in the growth equation for equalization. As Christine Wong (1998) points out, extra-budgetary funds (XBGT) are counter-equalizing, so it should be correlated with equalization (E) but does not belong in the growth equation. Finally, we include the growth rate of employment (L) in the growth equation and exclude it from the equalization equation, and we include the natural logarithm of the population (LPOP) in the equalization equation and exclude it from the growth equation.

To address the potential endogeneity of the higher moments of FD, we use lagged values, higher moments, and interactions of these variables as additional instruments. In the equalization equation, 1-lag of G, 1-, 2- and 3-lags of FD, interacted values, and squared values of these variables are included as instruments. We believe that our identification strategy is justified by economic and econometric theory. To address any remaining concerns about our identification

[23] To identify these two equations, the rank and order conditions of the system must be satisfied. The rank condition requires that at least one of the excluded exogenous variables have a nonzero coefficient in the other equation. The order condition further requires that the number of excluded exogenous variables in a given equation should be equal to or greater than the number of right-hand-side endogenous variables. The rank and order conditions are satisfied for our SEM.

strategy, we also conduct a number of specification tests to check the statistical validity of our assumptions regarding the correlation of the instruments with the potentially endogeneous explanatory variables and the orthogonality of the instruments and the error terms.

The 2SLS FE estimates of the growth equation are reported in the second column of Table 2. The estimated coefficient of FD is -4.87 and is nearly five times its standard error (S.E. = 0.98). The estimated coefficient of FD-squared is 0.44 (S.E. = 0.13) and statistically significant at conventional levels, and the estimated coefficient of FD-cubed is -0.013 and twice its standard error (S.E. = 0.005). The joint effect of FD and its higher moments on growth is negative for all values of FD. As in the case of the FE estimates, the estimated coefficient of equalization is positive but statistically indistinguishable from zero.

We test for the potential endogeneity of FD and its higher moments, equalization (E), and growth (G), using a Hausman (1998) test. We fail to reject the joint null hypothesis that the set of potentially endogenous variables are exogenous in the growth equation.[24] Since endogeneity may go undetected due to weak instruments, James H. Stock and Motohiro Yogo (2005) provide a rule-of-thumb test for weak instruments and critical values for this statistic. We soundly reject the null hypothesis of weak instruments. In other words, the set of instruments are sufficiently, strongly correlated with the potentially endogenous variables that the small sample bias of 2SLS FE is less than the potential bias of FE with an endogenous regressor.

The estimated coefficients of the remaining covariates in the growth equation generally have the expected signs and are statistically significant at conventional levels. More specifically,

[24] We further estimate a Durbin-Wu-Hausman chi-squared test statistic for the null hypothesis that a given potentially endogenous variable is exogenous independently of the other potentially endogenous variables. We fail to reject the exogeneity of these three variables, one independently of the others. However, we reject the null hypothesis that FD is exogenous in the growth equation at the 5 percent significance level. In the equalization equation, we soundly reject the exogeneity of G, FD, and its higher moments.

the estimated coefficients of the growth rate of investment in fixed assets (K), openness to trade (F), the TSS reform dummy variable (TSS), central government development spending (CDEV), government size (GOVS), rate of inflation (R), and the natural logarithm of foreign direct investment (FDI) are positive and statistically significant at conventional levels in the growth equation. However, the estimated coefficient of the share of agriculture in GRP is negative and statistically significant at conventional levels.

Now, we turn to our 2SLS FE estimates of the equalization equation, which are reported in the second column of the right-hand-side columnar-panel. We find that economic growth (G) has a positive effect on equalization (E) and is statistically distinguishable from zero at a 10 percent significance level. The estimated coefficient of FD is negative; the estimated coefficient of FD-squared is positive; and the estimated coefficient of FD-cubed is negative. These estimates are statistically significant at conventional levels. These results differ from those obtained with the FE model. Now, FD has a negative effect on equalization. This change in the joint effect of FD on equalization may reflect the fact that the FE model does not account for the potential endogeneity of FD and the potential simultaneity between the two equations.

Using a Hausman (1998) test, we fail to reject the joint null hypothesis that growth, FD, and it higher moments are exogeneous in the equalization equation. We also estimate a Durbin-Wu-Hausman chi-square test statistic for the null hypothesis that a given potentially endogenous variable is exogenous independently of the other potentially endogenous variables. We soundly reject the exogeneity of growth, FD, and its higher moments. Similarly, we find no evidence of weak instruments; so, our inability to reject exogeneity of these potentially endogenous variables does not appear to be a simple artifact of weak instruments.

The estimated coefficients of the remaining covariates in the equalization equation have the anticipated signs and are statistically significant in many cases. More specifically, openness to trade (F), the TSS reforms (TSS), central government development spending (CDEV), tax effort (TE), and the natural logarithm of population (LNPOP) have a positive effect on equalization. Meanwhile, capital (K), the share of agriculture (AGRS), TE-squared, government size (GOVS), extra-budgetary funds (XBGT), and the share of missing women (MWS) have a negative effect on equalization. Regarding the effect of extra-budgetary funds (XBGT), our findings are consistent with those of Christine Wong (1998) and the World Bank (2000, 2001): extra-budgetary funds increase interregional fiscal disparities. Perhaps the most gratifying finding is that the 1994 TSS reforms have a positive effect on growth and equalization which are major goals of these reforms.

As previously noted, our SEM is over-identified, meaning that the number of instrumental variables is greater than the number of potentially endogenous variables. According to Lars Peter Hansen (1982), GMM permits the number of moment conditions to exceed the number of parameters to be estimated and also accounts for arbitrary autocorrelation and cross-sectional heteroskedasticity. Thus, 2-step GMM is an ideal procedure for estimating our SEM. The estimated coefficients from our 2-step GMM specification of the model are provided in the third columns of the two-columnar panels in Table 2. These results are very similar to the 2SLS FE results.

Based on these findings, we conclude that the degree of FD currently prevailing in China is having a substantial negative effect on economic growth. This is consistent with the findings of Tao Zhang and Heng-Fu Zou (1998), but inconsistent with those of Justin Yifu Lin and Zhiqiang Liu (2000), Ying Ding (2007), and Baoyun Qiao et al. (2008).

Now, we turn to our results for India, which are reported in table 3. For the sake of brevity, we do not discuss the FE estimates, but these results are provided in table 3 for the interested reader. Instead, we focus on our 2SLS FE and 2-step GMM estimates. Beginning with the 2SLS FE estimates, the joint effect of FD and its higher moments on growth (G) is similar to that for China. The estimated coefficient of FD is -401.43 which is about four times its standard error (S.E. = 101.08). The estimated coefficient of FD-squared is 76.85 (S.E. = 20.83) and is statistically significant at conventional levels, and the estimated coefficient of FD-cubed is -3.48, which is more than three times its standard error (S.E. = 1.00).[25,26] The estimated coefficient of equalization in the growth equation and growth in the equalization equation are positive and statistically significant at conventional levels, implying that there is a mutually positive relationship between growth and equalization.

The estimated coefficients of the remaining covariates in the growth equation generally have the expected signs. The natural logarithm of capital outlays per capita (K) is positive and statistically significant at the 1 percent level. The central revenue share in GDP (CT) is positive but is statistically insignificant. In contrast, the state revenue share in GSDP (ST) is negative and statistically significant at the 1 percent level. As expected, the estimated coefficient of the economic reform dummy variable (ER) is positive and statistically significant at conventional levels. The natural logarithm of state population (LNPOP) is negative but statistically insignificant at conventional levels, suggesting perhaps that state population may not be a good

[25] To evaluate the cubic specification, we perform a likelihood ratio test on the six specifications of the model (FE, 2SLS, two-step GMM for each of the two equations in the system), testing the cubic specification against a quadratic specification). The null hypothesis is that the coefficient of FD-cubed is equal to zero. We reject the null hypothesis that FD-cubed does not belong in the model. Therefore, we feel justified in reporting the cubic specification of model for both China and India. However, the results for a quadratic specification of the model are very similar to those for the cubic specification; specifically, the joint effect of FD on growth is negative within the range of our data.

[26] For India, we soundly reject the exogeneity of FD-squared and FD-cubed at the 1 percent level in the growth equation. In the equalization equation, we cannot reject the exogeneity of G, FD, FD-squared and FD-cubed at conventional significance levels.

proxy for the size of the labor force.

As for the remaining covariates in the equalization equation, missing women (MWS) has the anticipated negative sign and is statistically significant at conventional levels. The natural logarithm of population (LNPOP) has a positive effect on equalization and is statistically significant at conventional levels. Meanwhile, the rate of transfer dependence (FDR) is positive but statistically insignificant at conventional levels. The rate of fiscal self-reliance (FSR) is negative and statistically significant at conventional levels. As expected, the economic reform dummy variable (ER) is positive and statistically distinguishable from zero at the 1 percent significance level. This is also gratifying, as it indicates that the economic reforms undertaken in India in the early 1990s are positively contributing to economic growth and HFE.

John D. Sargan (1958) and Lars Peter Hansen (1982) show that when the number of moment conditions exceeds the number of parameters to be estimated, a chi-square test can be used to determine whether the instruments are orthogonal to the error term. The values of the Sargan statistics for the test of over identifying restrictions in the growth (equalization) equations are 30.30 (2.18) and 2.37 (2.04) for China (India), respectively. These values fail to reject the null hypothesis at conventional levels of significance that the instruments are exogenous, i.e., uncorrelated with the error terms.

Following the example of Edward Leamer (1978), Ross Levine and David Renelt (1992), and Tao Zhang and Heng-fu Zou (1998) among others, we conduct an "extreme-bounds analysis" to test the robustness of our results to alternative sets of covariates. In the base scenario, we include the variables of primary interest (I), specifically fiscal decentralization (FD) and horizontal fiscal equalization (E). In addition to the variables of primary interest, we also include the main model variables (M), specifically measures of capital (K), labor (L), openness (F), and inflation (R) in the case of China, and capital (K), labor (L), central revenue share in GDP (CT), and state revenue share in GSDP (ST) in the case of India. The list of other covariates employed in this analysis is provided in table 4.

We proceed by estimating tens of thousands of variations of the base scenario, by adding the remaining covariates or optional variables (O) in sets of one (1) through four (4) in every possible combination. We identify the control sets that give us minimum and maximum values of the estimated coefficients for each of the variables of primary interest and the main variables. We examine the sign and significance of the minimum and maximum values to evaluate the robustness of our results to alternative sets of control variables. The results of this analysis are reported in table 5.

The extreme bounds analysis for China shows that the estimated coefficients of K and L have the expected signs and are statistically significant at conventional levels. All other variables, including fiscal decentralization (FD) and equalization (E), are fragile. For India, only central revenue share in GDP (CT) is robust; all the other variables are fragile. Based on these findings, we are somewhat assured that it is appropriate to include fiscal decentralization, equalization, capital, labor, openness, the rate of inflation, and central revenue share in GDP in the growth equation.

According to 2SLS FE and 2S-GMM results for China and India, in both growth and equalization equations, we find that the estimated coefficients of FD and its higher moments are economically and statistically significantly different from zero at conventional levels. Based our estimates for China, the joint effect of FD on provincial growth rates is negative for all the values of FD greater than zero. For the case of India, the joint effect of FD on state growth rates is negative when FD is less than 9.0. Between 9.0 and 14.0, the effect of FD is positive, and beyond

14, the effect is negative again. Although based on estimates FD could well have a positive effect on state growth rates, the mean value of FD is only 1.66 in our sample which is substantially less than the turning point where a positive effect on economic growth would arise. Another interesting finding is that the magnitude of the negative effect on growth resulting from FD in India is much greater than that in China. However, this analysis does not account for the effect of FD on equalization and, in turn, the effect of equalization on provincial (state) growth rates. We account for these general equilibrium effects below.

Turning to the effect of HFE, an increase of 0.01 in the degree of HFE would bring about an increase of 0.01 percentage points in economic growth at the margin, although the effect is insignificant. The reverse effect of an increase in economic growth of one percentage would have implied an increase of 0.013 in the degree of HFE, which is statistically significant at 10 percent level in 2SLS FE and 5 percent level in 2S-GMM. This weak positive relationship is in contrast with Qiao et al.'s finding of a trade-off. More impressively, this positive relationship between HFE and state growth rates is very strong in the case of India.

To gauge the general equilibrium effects of FD on provincial (state) growth rates, we conduct the following simulations. Using the 2SLS FE estimates for China and India, we increase FD by 10 percent and make corresponding transformations to the higher moments of FD. Then, we obtain the predicted values of G, using the transformed values of FD and the sample values of the other control variables for each observation in our sample. We then use the predicted values of G, the transformed values of FD and its higher moments, and the sample values of the remaining control variables into the equalization equation to obtain predicted values of E for each observation in our sample. Finally, we use the predicted values of E, the transformed values of FD and its higher moments, and the sample values of the remaining control variables to obtain predicted values of G. Based on this general equilibrium simulation, we find that a 10 percent increase in FD results in a 3.63 percentage point average decrease in provincial growth rates in China and a 2.48 percentage point average decrease in India's state growth rates. While these effects are substantial, we believe that they are plausible and within the range obtained in previous studies reporting a negative effect from FD. We also take comfort in the fact that the estimated effects of FD on provincial (state) growth rates for both countries are reasonably close to one another.

Conclusion

We find that FD has a negative effect on economic growth for both China and India. This is consistent with the findings of Tao Zhang and Heng-Fu Zou (1998), but inconsistent with the findings of a positive effect by Justin Yifu Lin and Zhiqiang Liu (2000), Ying Ding (2007) and Baoyun Qiao et al (2008). Based on these results, it would appear that a significant deepening of fiscal decentralization in China and India would not increase the economic growth rate of either country. However, an increase in growth rates may have a positive effect on equalization. Finally, equalization appears to have a positive effect on economic growth.

Table 1: Summary statistics

Variables	China (1985-2006) Mean	China (1985-2006) Standard Deviation	India (1980-2005) Mean	India (1980-2005) Standard Deviation
G (growth rate in real GRP per capita)	9.45	4.11	4.58	13.56
E (horizontal fiscal equalization)	-0.46	0.53	-0.51	0.56
FD (fiscal decentralization)	3.34	2.53	1.66	1.49
FDSQ (FD-squared)	17.60	35.78	4.97	14.83
FDCUB (FD-cubed)	144.16	521.49	28.52	160.33
K (growth rate of fixed asset investment)	20.46	16.70		
L (growth rate of employments)	1.84	3.96		
F (degree of openness)	23.94	32.38		
R (inflation rate)	5.86	7.66		
LNFDI (log of foreign direct investment)	1.75	2.33		
TSS (fiscal regime dummy, "1"for years ≥ 1994, "0"otherwise)	0.63	0.48		
AGRS (agriculture share)	21.35	10.07		
TE (provincial tax effort)	14.03	6.76		
TESQ (TE-squared)	242.36	282.27		
XBGT (extra-budget factor)	0.44	0.30		
CDEV (central government development spending)	45.62	12.11		
GOVS (government size)	0.20	0.10		
MWS (missing women share)	0.04	0.01	0.03	0.01
LNPOP (natural logarithm of population)	17.19	0.90	16.64	1.58
CATD (catastrophe dummy)	0.34	0.47	0.17	0.37
K (log of capital outlays per capita)			1.71	1.27
CT (central tax rate)			0.09	0.006
ST (state tax rate)			0.25	0.24
FSR (fiscal self-reliance rate)			0.50	0.26
FDR (fiscal dependence rate)			0.29	0.24
Number of observations	630		524	

Data sources for China:
1) China Data Center of the University of Michigan and the Ministry of Finance;
2) Estimated coefficients for the catastrophe dummy variables for each year, Tian'anmen Square incident dummy variable, and the Asian financial crisis dummy variable are not reported. China flood data was retrieved on April 2009 from http://www.chinawater.net.cn/flood. Level B and above equal "1", "0" otherwise; other catastrophe data was retrieved on April 2009 from http://zzys.agri.gov.cn.

Data sources for India:
1) Directorate of Economics & Statistics of respective State Governments, and for All-India -- Central Statistical Organization;
2) Reserve Bank of India;
3) Estimated coefficients for the catastrophe dummy variables for each year are not reported. Natural disaster data was retrieved on October 2009 from http://www.ndmindia.nic.in

Table 2: Regression results for China (1985-2006 provincial data)

Independent variables	Growth Equation			Equalization Equation		
	Fixed Effects	2SLS FE	2-Step GMM	Fixed Effects	2SLS FE	2-Step GMM
G (growth rate of real GRP per capita)	-	-	-	0.002 (0.002)	0.013* (0.007)	0.013** (0.007)
E (horizontal fiscal equalization)	1.25 (0.99)	1.00 (1.29)	1.00 (1.25)	-	-	-
FD (fiscal decentralization)	-2.25*** (0.61)	-4.87*** (0.98)	-4.87*** (0.95)	0.11*** (0.02)	-0.23* (0.13)	-0.23* (0.13)
FDSQ (FD-squared)	0.18** (0.08)	0.44*** (0.13)	0.44*** (0.12)	-0.02*** (0.003)	0.03 (0.018)	0.03* (0.018)
FDCUB (FD-cubed)	-0.004 (0.003)	-0.013*** (0.005)	-0.013*** (0.005)	0.0005*** (0.0001)	-0.0016** (0.0007)	-0.0016** (0.0007)
K (growth rate of fixed investment)	0.11*** (0.01)	0.11*** (0.01)	0.11*** (0.01)	-0.0002 (0.0004)	-0.002* (0.001)	-0.002* (0.001)
L (growth rate of employment)	0.02 (0.03)	0.03 (0.03)	0.03 (0.03)			
F (openness)	0.007 (0.008)	0.015* (0.01)	0.015* (0.01)	0.0008** (0.0003)	0.0008 (0.0006)	0.0008 (0.0006)
AGRS (share of agriculture in GRP)	-0.24*** (0.04)	-0.31*** (0.05)	-0.31*** (0.05)	-0.003 (0.002)	-0.006* (0.004)	-0.006* (0.004)
TSS (fiscal regime dummy variable)	2.19*** (0.86)	2.80*** (0.90)	2.80*** (0.87)	0.046 (0.04)	0.13** (0.06)	0.13** (0.06)
TE (provincial tax effort)	-0.08 (0.12)	-0.03 (0.13)	-0.03 (0.12)	0.03*** (0.005)	0.055*** (0.01)	0.055*** (0.01)
TESQ (TE-squared)	-0.001 (0.002)	-0.002 (0.002)	-0.002 (0.002)	-0.0007*** (0.0001)	-0.001*** (0.0002)	-0.001*** (0.0002)
CDEV (central government development spending)	0.12*** (0.04)	0.13*** (0.04)	0.13*** (0.04)	0.007*** (0.002)	0.006** (0.003)	0.006** (0.003)
GOVS (government size)	10.26** (4.51)	10.88** (4.91)	10.88** (4.75)	-1.02*** (0.18)	-1.03*** (0.38)	-1.03*** (0.36)
R (inflation rate)	0.09*** (0.03)	0.12*** (0.03)	0.12*** (0.03)			
LNFDI (foreign direct investment)	0.46*** (0.13)	0.62*** (0.14)	0.62*** (0.13)			
XBGT (extra-budget factor)				-0.20*** (0.04)	-0.27*** (0.06)	-0.27*** (0.06)
LNPOP (natural logarithm of population)				0.41*** (0.13)	0.02 (0.23)	0.02 (0.22)
MWS (share of missing women in population)				-2.97** (1.21)	-4.27** (1.93)	-4.27** (1.86)
Constant	8.87*** (2.72)	13.83*** (3.22)		-7.66*** (2.30)	-0.61 (4.11)	
Number of observations	630	630	630	630	630	630
R-squared	0.58	0.50	0.62	0.30	0.46	-0.002
Weak identification (Stock and Yogo 2005)			9.66 Critical values not available			2.70 Critical values not available
Sargan statistic			30.29 p-value=0.11			2.37 p-value=0.88

1) Standard errors are provided in parentheses.
2) *** Statistically significant at 1 percent; ** significant at 5 percent; and * significant at 10 percent.
3) Because of the simultaneity of SEM, 2SLS fixed effects and 2-step GMM are estimated with IVs.
4) The estimated coefficients for each year's catastrophe dummy variables, Tiananmen Square incident dummy variable, and the Asian financial crisis dummy variable are not reported but are available upon request from the authors.

Table 3: Regression results for India (1980-2005 state-wise data)

Independent variables	Growth Equation			Equalization Equation		
	Fixed Effects	**2SLS FE**	**2-Step GMM**	**Fixed Effects**	**2SLS FE**	**2-Step GMM**
G (growth rate of real GSDP per capita)				0.0008** (0.0004)	0.0013* (0.00067)	0.0013* (0.00066)
E (horizontal fiscal equalization)	8.45 (5.23)	80.35** (31.43)	80.35*** (30.53)			
FD (fiscal decentralization)	6.46 (8.19)	-401.43*** (101.08)	-401.43*** (98.18)	0.32*** (0.06)	0.13 (0.13)	0.13 (0.12)
FDSQ (FD-squared)	-0.50 (1.72)	76.85*** (20.83)	76.85*** (20.24)	-0.12*** (0.01)	-0.065** (0.026)	-0.065*** (0.025)
FDCUB (FD-cubed)	0.04 (0.09)	-3.48*** (1.00)	-3.48*** (0.97)	0.006*** (0.0007)	0.0025* (0.0013)	0.002** (0.001)
K (natural logarithm of capital outlays per capita)	4.23*** (1.36)	33.28*** (7.53)	33.28*** (7.32)			
LNPOP (natural logarithm of state population)	-21.04*** (5.09)	-178.57*** (39.85)	-178.57*** (38.71)	0.15*** (0.04)	0.10* (0.06)	0.10* (0.055)
ER (economic reform dummy variable)	-4.53* (2.35)	25.57*** (9.36)	25.57*** (9.09)	0.05*** (0.017)	0.068*** (0.027)	0.068*** (0.026)
CT (central tax rate)	307.71** (131.62)	442.67 (381.97)	442.67 (371.01)			
ST (state tax rate)	-22.59 (14.84)	-277.73*** (94.46)	-277.73*** (91.75)			
MWS (share of missing women in population)				-0.05*** (0.012)	-0.052*** (0.013)	-0.052*** (0.012)
FSR (rate of fiscal self-reliance)				-0.26** (0.12)	-0.28* (0.15)	-0.28* (0.15)
FDR (rate of transfer dependence)				0.01 (0.09)	0.08 (0.10)	0.08 (0.09)
Constant	321.55*** (89.63)	3353.08*** (757.75)		-2.77*** (0.70)	-1.95** (1.00)	
Number of observations	524	524	524	524	524	524
R-squared	0.005	0.002	-5.01	0.73	0.74	0.62
Weak identification (Stock and Yogo 2005)			3.23 Critical values not available			11.16 Critical values not available.
Sargan statistic			2.18 p-value = 0.34			2.04 p-value = 0.56

1) Standard errors are provided in parentheses.
2) *** Statistically significant at 1 percent; ** significant at 5 percent; and * significant at 10 percent.
3) The 2SLS FE and 2-step GMM are estimated with instrumental variables.
4) The estimated coefficients of the catastrophe dummy variables are not reported but are available from the authors upon request.

Table 4: Extreme bounds analysis for China and India

		China (1949-2008) Dependent variable: Growth rate of real GRP per capita				India (1980-2005) Dependent variable: Growth rate of real GSDP per capita			
		Coefficient (S.E.)	t value	Other variables	Robust /Fragile	Coefficient (S.E.)	t value	Other variables	Robust /Fragile
		I-variables:				**I-variables**			
	high	1.63 (0.61)	2.67	LNFISCAP, CT, CHUM, PHUM		15.70 (5.94)	2.64	FSR, GOVS, IPGD, MLTD	
FD	base	-0.49 (0.51)	-0.97		Fragile	6.04 (4.18)	1.45		Fragile
	low	-2.18 (0.49)	-4.46	LNFDI, PDEV, PSSS, CATD		-34.90 (9.78)	-3.57	FSR, RDTR, LEPC, IPGD	
	high	0.29 (0.09)	3.44	LNFDI, PDEV, PSSS, CATD		4.95 (1.79)	2.76	FSR, RDG, LEPC, IPGD	
FD^2	base	0.04 (0.10)	0.45		Fragile	-1.45 (1.04)	-1.39		Fragile
	low	-0.24 (0.11)	-2.22	LNFISCAP, CT, CHUM, PHUM		-3.44 (1.38)	-2.49	PDG, CERE, CETE, MLTD	
	high	-0.002 (0.005)	-0.32			0.18 (0.08)	2.39	PDG, CERE, CETE, MLTD	
FD^3	base	-0.002 (0.005)	-0.32		Fragile	0.08 (0.06)	1.44		Fragile
	low	-0.01 (0.005)	-2.06	PDEV, CADM, AGRS, PSSS		-0.20 (0.09)	-2.20	FSR, RDG, LEPC, IPGD	
	high	1.44 (0.61)	2.36	LNFDI, PDEV, PSSS, CATD		-6.87 (3.49)	-1.97	FSR, CRTR, LRPC, RDTR	
E	base	-0.21(0.61)	-0.33		Fragile	-3.42 (3.46)	-0.99		Fragile
	low	-0.21(0.61)	-0.33			-14.89 (4.38)	-3.40	TA, PDG, LEPC, MLTD	
		M-Variables:				**M-variables**			
	high	0.15 (0.007)	21.67	LNFISCAP, CT, NT, XBGT		N/A	N/A	N/A	
K	base	0.12 (0.01)	21.35		Robust	-0.09 (1.34)	-0.07		Fragile
	low	0.08 (0.006)	14.76	CT, CADM, CDFN, PSSS		N/A	N/A	N/A	
	high	0.31 (0.05)	5.93	PHUM, CHUM, CDEV, CADM		2.47 (1.26)	1.96	LRPC, GDTR, MLTD, GLTD	
L	base	0.23 (0.05)	4.86		Nearly Robust	-0.06 (0.93)	-0.07		Fragile
	low	0.09 (0.04)	1.97	LNFISCAP, NT, PSSS, CATD		-0.06 (0.93)	-0.07		
	high	0.03 (0.01)	3.19	LNFISCAP, PSSS, CATD, PADM					
F	base	0.01 (0.01)	1.39		Fragile				
	low	0.01 (0.01)	1.39						
	high	0.10 (0.02)	4.73	XBGT, CDEV, CHUM, PSSS					
R	base	-0.01 (0.01)	-0.82		Fragile				
	low	-0.01 (0.01)	-0.82						
	high					1457.97 (353.99)	4.12	PDTR, IPGD, GLTD, NT	
CT	base					240.95 (101.14)	2.38		Nearly Robust
	low					196.94 (100.20)	1.97	FSR, RDG. LEPC, KG	
	high					53.68 (20.87)	2.57	CETE, GOVS, MLTD, NT	
ST	base					-7.62 (7.07)	-1.08		Fragile
	low					-61.31 (14.63)	-4.19	FSR, RDG. LEPC, IPGD	

Notes:

1) Following Levine and Renelt (1992), the regression model is $Y_{it}=\beta_i I_{it} + \beta_m M_{it}+ \beta_z Z_{it} +\mu_i + e_{it}$ where I_{it} are the variables of interest, M_{it} are the main variables, and Z_{it} are the other variables. The base estimates include I-variables and M-variables, which are included in every regression.

2) The robust/fragile designation follows Levine and Renelt (1992). If the high, base, and low estimated coefficients all have the same signs and t values are no less than two, then the variable is said to be robust; otherwise, it is fragile.

3) N/A implies that no bounds are found at conventional 95% confidence intervals.

Variable definitions:

China

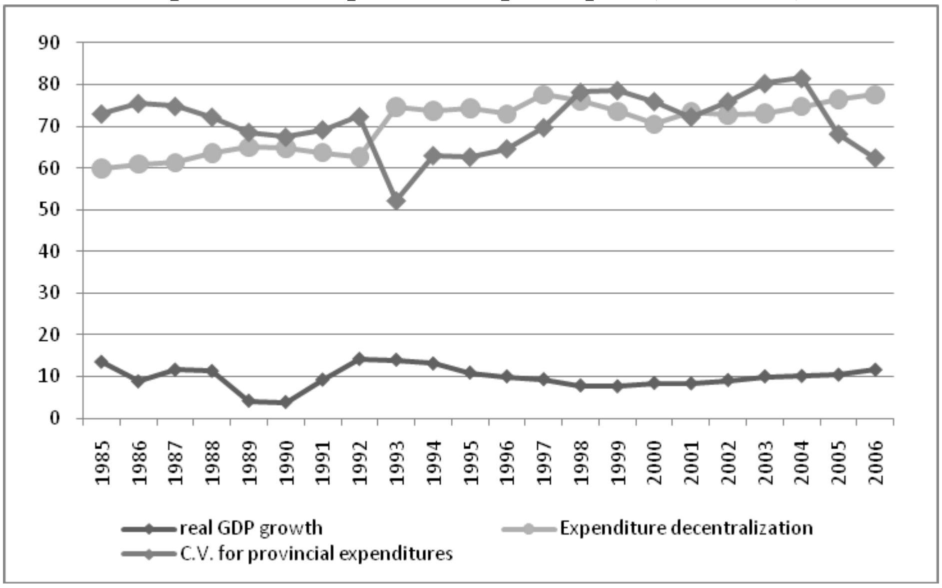
CADM is the share of central government expenditures on administration in total central government expenditures.

CDFN is the share of central government defense expenditures in total central government expenditures.

CHUM is the share of central government expenditures on education and training (human capital) in total central government expenditures.
LNFISCAP is the natural logarithm of a 3-year moving average of real GRP per capita (fiscal capacity).
NT is the national tax rate defined as the share of central government revenues in GDP.
PADM is the share of provincial government expenditures on administration in total provincial government expenditures.
PDEV is the share of provincial government development expenditures in total provincial government expenditures.
PHUM is the share of provincial government education and training (human capital) expenditures in total provincial government expenditures.
PSSS is the share of graduates in primary schools entering secondary schools.

India
CERE is the share of central government capital expenditures in recurrent expenditures.
CETE is the share of capital expenditures in consolidated expenditures.
CRTR is the share of capital receipts in consolidated receipts.
GDTR is the share of gross fiscal deficit in consolidated revenues.
GLTD is the share of net central loans in state outstanding liabilities.
IPGD is the interest payment as a share of gross devolution.
LEPC is the natural logarithm of consolidated expenditures per capita.
LRPC is the natural logarithm of consolidated revenues per capita.
KG is the share of total capital outlays in gross fiscal deficit.
MLTD is the net market loans as a share of state outstanding liabilities.
NT is the national tax rate defined as national revenue receipts as a share of nominal GDP.
PDG is the primary deficit as a share of nominal GSDP.
PDTR is the primary deficit as a share of total revenue receipts.
RDG is the revenue deficit as a share of nominal GSDP.
RDTR is the revenue deficit as a share of total revenue receipts.
TA is the tax autonomy defined as sum of own tax revenues and share in central taxes as a share of total revenue receipts.

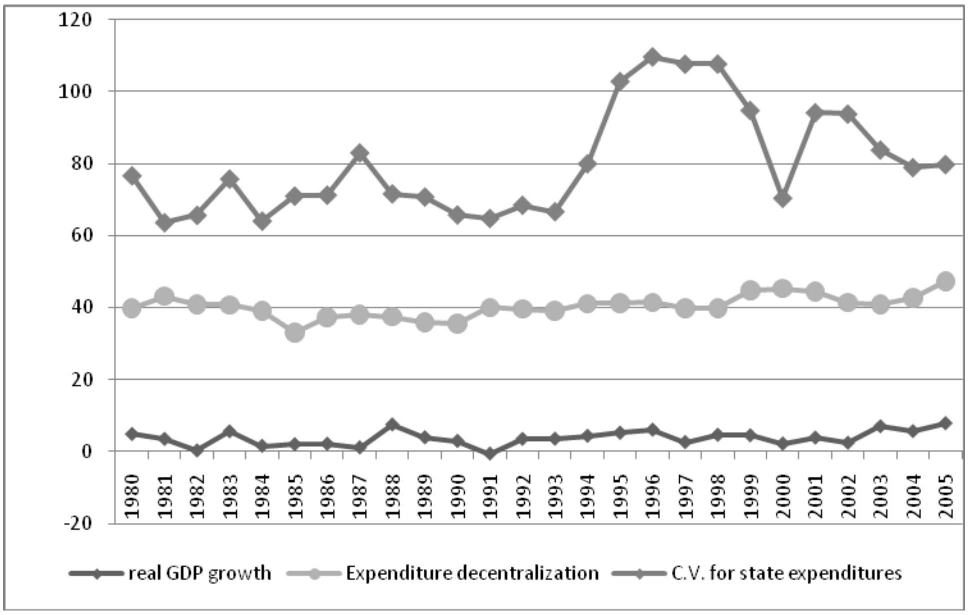
Figure 1: The evolution of China's growth rate in real GDP per capita, expenditure decentralization, and the coefficient of variation in provincial expenditures per capita (1985-2006)



Note: the degree of expenditure decentralization is measured as the share of total sub-national expenditures in total national expenditures.

Data sources:
1) The University of Michigan's China Data Center.
2) China's Ministry of Finance
3) China's National Bureau of Statistics

Figure 2: The evolution of India's growth rate in real GDP per capita, expenditure decentralization, and the coefficient of variation in state expenditures per capita (1980-2005)



Note: the degree of expenditure decentralization is measured as the share of total sub-national expenditures in total national expenditures.

Data sources:
1) Directorate of Economics & Statistics of the respective state governments, and for All-India -- Central Statistical Organization.
2) Reserve Bank of India.

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