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Abstract

Some politicians argue for the splitting and combining of states to increase government productivity, but there is a dearth of empirical evidence on the optimal size of a state. Using data from Indian states, I test a model of the optimal size of the state. I find that size and preference heterogeneity do not significantly affect the productivity of a state government. However, when states are split up, the productivity of the root state's government is negatively affected. This suggests that there may be a readjustment phase after state reorganisation that brings about this negative effect. It is important to consider this effect when redrawing state borders.

Keywords: India, fiscal federalism, government quality, ethnic heterogeneity, state reorganization

JEL codes: H11, H40, H50, H72, H77

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Does Size Matter? The Productivity of Government: Expenditures and the Size of States: Evidence from India

Cornelis W. Haasnoot

Article Outline

1 Introduction

The productivity of public spending is a hotly debated topic in economics. There is a great deal of research on how productive public spending actually is, and also on the question of whether it adds any value in the first place. This paper seeks to take the debate away from the question of how much value it adds and towards the question of under which conditions it adds value. In order to do this, it incorporates a number of insights from a theoretical framework developed by Alesina and Spolaore (1997), which posits a trade-off between the size of a state and the heterogeneity of the preferences of its inhabitants, into the empirical methods pioneered by Aschauer (1989b) and normally used to measure government productivity. It then applies these methods to the case of India, where the insights from the theoretical framework are particularly useful.

In 2000, three (root) states in India – Bihar, Madhya Pradesh, and Uttar Pradesh – were each split into two, creating the offshoots Jharkhand, Chhatisgarh, and Uttarakhand (previously Uttaranchal), respectively. In recent years, some have called for even more states to be created, arguing that reducing the size of states would allow the government apparatus to become more efficient because it could spend its money more productively (Kale and Bhandari 2010). These calls have culminated in the recent creation of the state of Telangana and will potentially bring about further splits. Regionalist parties have also been strengthened by the earlier decisions of the Indian government to allow for the separation of states (Walter 2006). On the other side of the world, in the Netherlands, some politicians argue that the 12 existing provinces should be turned into five, also saying that this would increase the government's efficiency. Similar discussions about the creation of a Nordland state are also taking place in Germany.

Probably, neither Uttar Pradesh's 200 million people nor Flevoland's 350,000 represent the most efficient size for a single state. What, then, is the most efficient size? This paper attempts to answer this question by looking at the general productivity and efficiency of all Indian state governments, with a special eye to the reorganisation of Indian states that took place in 2000. The case of India is used because the country has actually already implemented such a reorganisation, while the discussion in the Netherlands and Germany has so far only been political. This means that it is possible to look at the performance of the Indian states pre- and post-split and to see how the two compare and whether state reorganisation has had a positive or negative effect on state government productivity.

Furthermore, India's federalist system means that the state governments play an important role in the state economies. The latter's plans and spending account for a very large share of public spending in states, and as such are relevant to the state's economy. So does the size of the state matter for the productivity of its government? This is the issue the rest of the paper focuses on.

2 Literature Review

The literature on the optimal size of states is mostly based around the model of Alesina and Spolaore (1997). This model focuses on the trade-off between economies of scale that favour larger states and heterogeneous preferences amongst citizens over smaller states. These economies of scale stem from a number of sources: reduced per capita costs of non-rival public goods (Alesina and Wacziarg 1998; Remmer 2010); higher tax income because more efficient forms of taxation carry higher fixed costs (Easterly and Rebelo 1993); increased market size under imperfectly free trade (Krugman 1979); and less costly exposure to uninsurable shocks (Sachs and Martin 1991). Heterogeneity carries costs because under a single government people with different preferences have to share the same public good; thus, the average utility of consumers decreases as regions become more heterogeneous.

In the Alesina and Spolaore (1997) model, people are presumed to be geographically distributed over space in a regular fashion, so that people live close to other people with similar preferences for public goods provision, in line with the Tiebout (1956) model. This gives them an incentive to create a country together. Government policy is determined by the median voter within the country. Because policy is designed after countries are delineated, compensation agreements between the centre of the country, where the median voter lives, and its periphery, where the people whose preferences differ the most from the median voter live, suffer from time inconsistency and the median voter decides everything.[1] Each voter then weighs the extra fixed overhead costs of setting up a country with like-minded people against the benefits of having a government better aligned to his or her preferences. In equilibrium, there must be no group of voters that wants to establish its own country.

The model suggests that democracy will cause an inefficiently high number of countries, as those people who live close to the borders, preference-wise, will want to secede, since their preferences lie far from those of the median voter who lives in the centre. Only an autocratic social planner, who determines borders on his own, can help maintain the efficient number of countries. Economic integration, however, increases the stable and efficient number of countries. Since a federal state is more strongly integrated economically, this implies a higher number of states when they are unified within a single country than if they were separate.

In the case of India, the government is mostly capable of behaving as a social planner in that it, in the end, determines the borders between states. This makes the above model relevant to the Indian case: if the government were unable to determine borders, as the model usually assumes, there would be no policy available to deal with the inefficient state delineation suggested by the model.

There are a number of alternatives to this model, such as that of Bolton and Roland (1997), who model the separation and unification of nation states, suggesting three influential factors: differences in regional preferences, efficiency related to economies of scale, and income inequality within states. They, too, argue that countries are likely to break apart under the pressure of minorities displeased with the government's public goods provision. Casella and Feinstein (2002) take a different approach. They model traders rather than voters. Each trader receives an initial endowment and then seeks to start a joint venture with another trader. The optimal joint venture is with a trader who is moderately far away:

1 In reality, compensation agreements may be more feasible, but it is unlikely that the periphery would be fully compensated by the centre. Hence, the mechanics of the model still operate.

not so close that there is too much overlap in competencies, nor so far away that communication is impossible.

The government's role in this model is to supply a public good, in this case education, which makes communication easier. There are additional transaction costs involved in trading with markets that are not part of the same country. The trade-off for the optimal size of a country is then between these transaction costs and the costs of having public goods provision at a level farther away from most traders' preferences. Another model is that of Goyal and Staal (2004). They divide the world into two regions rather than a multitude. They argue that when deliberating on unification, the relative size of the two regions is of great importance because the political costs increase linearly in relation to the size of the other region, while the tax advantages increase exponentially.

There are a number of themes that run through these models and the literature in general.[2] The first is that choice leads to an inefficiently large number of countries, so that only an autocratic social planner could implement the most efficient solution. The second is the important assumption that production factors are immobile. For example, the Bolton and Roland model doesn't work in a world with perfect capital and labour mobility since this would lead to the complete equalisation of government policy across the entire world, rendering regionalism completely moot. Because factors are more likely to be mobile across Indian states, the Alesina and Spolaore model better describes the reality and this model is chosen to be the basis of the empirical specification. However, insights from the other models are also used.

Most of the papers on this topic have remained theoretical, choosing to expand on the models described previously rather than testing their hypotheses. Alesina and Wacziarg (1998) found that larger states have smaller governments. This result suggests that there are scale economies in government production and that larger states should therefore be more productive in supplying government services. The Alesina and Wacziarg view was countered by Ram (2009), who used a fixed-effect specification rather than an OLS specification and found that while the OLS specification yields results in line with those of Alesina and Wacziarg, the fixed-effect specification is preferred under statistical tests, so that larger countries have relatively larger governments. In one of the few analyses of the entire Alesina and Spolaore model, Shelton (2007) argues that there are economies of scale in the public sector and that ethnic fractionalisation and larger country size are compensated for via increased government decentralisation.

Regarding heterogeneity rather than size, Alesina and La Ferrara (2005) look at the effect that ethnic diversity has on growth and public goods provision. They find that both ethnic and linguistic fractionalisation have a negative effect on economic growth. This negative effect is alleviated somewhat in richer and more democratic countries, though the choice for

2 A more extensive summary of most of these models can be found in Bolton et al. (1996).

a democratic regime may signal that fractionalisation in that country is less stark in the first place.

La Porta et al. (1999) also look at the effect that ethnolinguistic fractionalisation has on the government. They find that higher fractionalisation leads to a more corrupt and inefficient government and that public goods, such as education and healthcare, tend to be inferior to those provided in less fractionalised countries.

They argue that this is due to the tendency of ethnic groups to provide only for other members of the same group. When they control for the level of per capita income, as poorer countries tend to be more fractionalised, the effect on corruption and general inefficiency disappears, but the quality of public goods remains low. These findings have been confirmed by Alesina et al. (2003), who find that ethnic and linguistic fractionalisation, rather than religious fractionalisation, determine institutional quality. Specifically, they too find that these kinds of fractionalisation lead to a lower quality of public goods and that governments of ethnically fractionalised countries are more corrupt. In general, ethnic fragmentation appears to be negatively correlated to economic performance (Easterly and Levine 1997). Since India has a highly diverse population, these kinds of fractionalisation, especially ethnic and linguistic, could be very relevant, although the Indian state borders were originally delineated specifically to minimise linguistic fractionalisation.

Overall, empirical investigations of the optimal size of states and countries in line with the aforementioned models have focused on the quality of public goods and the functioning of the government, or they have gone the other direction and looked at economic growth in general. There is, however, a great deal of literature on the effect of government spending on economic growth that is not located within the context of these optimal-size models. This work is mostly empirical in nature, but it has its roots in theoretical models as well.

Originally, public spending was omitted from most economic models that sought to explain economic growth or production, such as the Solow model. In such models, the role of government or institutions was usually relegated to explaining the residual. Most models which used Cobb-Douglas production functions also excluded the role of the government, focusing on labour and private capital. This view has changed somewhat over recent decades, especially in the aftermath of works by Ratner (1983), Aschauer (1989a), and Aschauer (1989b), who found that public capital is productive,[3] especially if it takes the shape of investments in infrastructure, and that it is a complement to private capital. This literature is mostly underpinned by Barro's (1990) theoretical model, which posits that government services can be productive, deriving an optimal ratio of government expenditure that is purely dependent on its productivity relative to that of private capital.

A great deal of the literature focuses on the United States. For example, Munnell (1990) finds that public sector capital increases private sector output and employment, while Lynde

3 Productive, in the context of this paper and this literature, means growth-enhancing or income-creating public spending.

and Richmond (1993) argue that a reduction in public capital is what caused a slowdown in productivity growth in the United States. Duffy-Deno and Eberts (1991) look at the largest metropolitan areas in the United States, rather than states, and find that public capital investment has a significant effect on per capita income in those areas.

Aschauer's contribution came under scrutiny by Holtz-Eakin (1994), who argued that the work on US states essentially contained only a single observation, a decrease in productivity parallel to a decrease in public sector capital. Sturm and Haan (1995) found that Aschauer's model does not work well when the first derivative is taken. Settling this argument required data from a different source. Karras (1996) used a country-level sample and found that government services were productive, even though they were overprovided in Africa and underprovided in Asia, while Cazzavillan (1993) looked at European countries and also found that government services were productive. Canning and Fay (1993) specifically looked at government investments in transportation infrastructure, finding that these were highly productive in industrialising countries and not so in underdeveloped countries. Similarly, Fernald (1999) looked at the effect that increased road building had on economic growth within the United States and found that vehicle-intensive industries profited disproportionately from these investments, though road investment did not appear to be very productive at the margin. However, since countries differ in their institutions and the way they arrange their public sectors, a lower level of analysis is preferable to using countries. This means that looking at a federal country, like India, holds a number of advantages.

Several papers have specifically examined this lower level of analysis. Démurger (2001) found that regional disparities within China could be alleviated by intelligent public investment. Transport infrastructure was one of the most important factors in her growth-gap decomposition analysis, so that was the area she argued the government should focus on. Binswanger et al. (1993) looked at agricultural output within Indian districts and found that the provision of public goods had a significantly positive effect on this output. These types of papers are already taking one step away from simply looking at how productive government services are and towards the conditions under which they are productive, though the focus is still on which type of government service is productive. However, this is not all that should be discussed. The Barro (1990) model predicts that rational governments will set their relative share of expenditures at the optimum level. This optimal relative share should be the same in each country, which implies that all countries should have exactly the same relative government size. Cross-country differences can only arise if there are differences in the relative productivity of government expenditure and private expenditure. These differences are exactly what is explored in the next section, which outlines the paper's model and takes the analysis away from how productive specific types of government services are and towards the conditions under which they are productive.

3 Model

The model used in the empirical section stems from Aschauer's contribution, which is designed to measure the productivity of government spending. This requires a standard production function, including labour and capital, and the addition of the government as a third factor of production. These steps make it possible to measure the government's contribution to GDP per capita. Having done that, the next step is to incorporate the insights of the Alesina and Spolaore model. This allows me to compare my results to those found in the literature while testing the suggestions Alesina and Spolaore provided.

As stated above, the model starts with a standard production function, where output Y is dependent on capital input K, labour input L, and government input G:

$$Y = Z \cdot K^{\alpha} \cdot L^{\beta} \cdot G^{\gamma} \tag{1}$$

Equation 1 reflects the functional form of the standard Cobb-Douglas function. Its shape is independent of time and the size of the inputs. Z is a measure of Hicks-neutral technology change. Lower-case α, β, and γ denote the elasticities of output relative to the three input factors. Government expenditure takes the form of rival public goods that help support private production. Think, for example, of road and waterway infrastructure that provides cheap and easy transport but has a limited capacity. Labour, capital and government have constant returns to scale when put together, so that $\alpha + \beta + \gamma = 1$, with decreasing returns to scale for each individual factor, meaning that $1 > \alpha, \beta, \gamma > 0$.

The elasticity of output relative to government spending, γ, is the coefficient of interest. This is what has been measured in previous papers. However, I argue that these papers failed to take into account the effects of the Alesina and Spolaore variables (size and heterogeneity), so I decompose government productivity into a number of different terms. Heterogeneity here refers to heterogeneity of preferences, which is operationalised in different ways in the later sections.

$$\gamma = \zeta + \theta_1 S + \theta_2 H \tag{2}$$

The inherent government productivity is modelled as ζ, while the other terms are the Alesina and Spolaore variables that then affect this productivity. This inherent productivity parameter can be negative, positive, or zero. It measures the direct effect that the production of public goods has on per capita output – for example, through the positive effect that education and infrastructure have on the economy. Size, represented by S, then reflects the scale economies inherent to the production of these public goods, while heterogeneity, represented by H, reflects the diseconomies of scale brought on by heterogeneity. Letting heterogeneity directly affect per capita output may seem out of place: if the diseconomies of heterogeneity work through preferences, they should affect the utility of consumers, not the actual output. However, if heterogeneity does influence per capita output, as in a more fragmented state, the different ethnic groups expend effort vying for public funds. Alesina, Baqir and Easterly (1999) found, for example, that in more racially fragmented cities, there is less spending on "productive" public goods such as education and schooling and more spending on public goods that are akin to fiscal transfers aimed at specific ethnic groups, such as public employment.

In this case, θ_1 1 and θ_2 are the coefficients of S and H, respectively, where $\theta_1 > 0$ and $\theta_2 < 0$ are expected, so that $\frac{\partial Y}{\partial S} > 0$ and $\frac{\partial Y}{\partial H} < 0$. These terms reflect the economies and diseconomies associated with government spending. The way the model is set up implies that the exact returns to scale of government expenditure are dependent on the trade-off between size and heterogeneity. This trade-off has so far been ignored in the literature. In the empirical section of this paper, a key test is to determine whether $\gamma = \zeta$. If this is the case, size and heterogeneity may still be relevant, but they will, on average, cancel each other out. The coefficients for γ found in the previous literature are then likely to still reflect the actual productivity of government spending. The constraint $\alpha + \beta + \gamma = 1$ remains in place, though the change in the formula means that most states will not have constant returns to scale over all factors. This then yields the following functional form:

$$Y = Z \cdot K^{\alpha} \cdot L^{\beta} \cdot G^{\zeta + \theta_1 S + \theta_2 H} \tag{3}$$

The government uses taxation to finance its expenditures, but this is a costless process and no money is lost due to transaction costs or spent on overhead. Size and heterogeneity are represented as exponents of G because their effects are related to public spending and public spending only.[4] The alternative, a log-linear function, would have the problem of size and heterogeneity directly affecting output rather than affecting output through their effect on government productivity. Equation 4 shows the derivative of output with respect to government spending.

$$\frac{dY}{dG} = Z \cdot K^{\alpha} \cdot L^{\beta} \cdot (\zeta + \theta_1 S + \theta_2 H) G^{\zeta + \theta_1 S + \theta_2 H - 1} \tag{4}$$

Since $\theta_2 < 0$, this means that it is possible for government spending to be destructive at the margin, if $|\theta_2 H| > \zeta + \theta_1 S$. This is, however, also possible within the Alesina and Spolaore framework, since increased public spending could potentially decrease the utility of consumers who would prefer a lower level of government spending, especially since the spending, in their model, is financed through taxation.

$$\frac{dY}{(dG)^2} = Z \cdot K^{\alpha} \cdot L^{\beta} \cdot (\zeta + \theta_1 S + \theta_2 H)(\zeta + \theta_1 S + \theta_2 H - 1) G^{\zeta + \theta_1 S + \theta_2 H - 2} \tag{5}$$

Equation 5 shows the second derivative of Y with respect to G. Together with equation 4, it can describe all the potential ways in which an increase in G affects Y, dependent only on $\zeta + \theta_1 S \lesseqgtr |\theta_2 H|$ and $\zeta + \theta_1 S \lesseqgtr |\theta_2 H| + 1$, since they determine whether the first and second derivatives are negative or positive. It should be noted, however, that as the conditions show,

4 Heterogeneity could also affect the productivity of private capital due to its effect on institutions. However, this is not the main focus of the paper, and should only have a secondary influence on capital productivity. The main effect should run through public spending. Therefore, S and H are only introduced as exponents of G.

the exact shape of this relationship is dependent on the actual size and heterogeneity of a state. For example, when $\zeta + \theta_1 S > |\theta_2 H|$ and $\zeta + \theta_1 S > |\theta_2 H| + 1$, government spending is increasingly productive as the size of the public sector increases. However, this does not mean that this always holds: if the population composition of the state changes or if the state is split up and reduced in size, these increasing economies of scale may be lost. If $\zeta + \theta_1 S = |\theta_2 H|$ and $\zeta + \theta_1 S = |\theta_2 H| + 1$, the effect that G has on Y is constant, regardless of the size of the public sector, so that there are constant returns to scale. If $\zeta + \theta_1 S = |\theta_2 H|$ and $\zeta + \theta_1 S = |\theta_2 H| + 1$, the first derivative is positive but less than 1, while the second derivative is negative, implying decreasing returns to scale. Finally, in the event that government spending is destructive, $\zeta + \theta_1 S > |\theta_2 H|$ and $\zeta + \theta_1 S < |\theta_2 H| + 1$ will both hold, so that the first derivative is negative and the second is positive. This means that government spending will become less destructive at the margin as the size of the public sector increases.

As illustrated above, the shape of the relationship between government spending and output is determined for the most part by the relative size and heterogeneity of a state. Government spending in a small but very heterogeneous state is likely to exhibit decreasing returns to scale, or even destructive effects, while in a large and homogeneous state it is likely to exhibit increasing returns to scale. However, these two variables are likely to be related somehow. Increasing the size of a state will very likely also make it a more heterogeneous state. The relationship between size and heterogeneity is expected to be non-linear, so that heterogeneity increases exponentially with size.[5] This means that small states are likely to be quite homogeneous and will have increasing returns to scale on government spending, while large states are likely to be heterogeneous and will have decreasing returns to scale on government spending.

Rearranging the Cobb-Douglas specification and taking the logs makes it possible to measure the effect that government spending has on per capita output. If government spending is a complement to private spending, the effect of per capita government spending on per capita output should be positive. Using $\alpha + \beta + \gamma = 1$ and rearranging the following formula with the matching regression equation follows from 1:[6]

$$y - l = z + \alpha(k - l) + \gamma(g - l) \tag{6a}$$

$$y - l = z + \alpha(k - l) + \gamma(g - l) + \varepsilon \tag{6b}$$

Lower-case letters denote natural logs of the upper-case variables, and e is the error term. This is again similar to what is seen in the rest of the government productivity literature, as in Aschauer (1989b) and Holtz-Eakin (1994). Applying the same method that was used to de-

5 This kind of relationship between size and heterogeneity is similar to that found within the literature on collective action, where heterogeneity is expected to increase exponentially with group size, as each new member may add diversity within multiple dimensions. See, for example, Baland and Platteau (1996) or Poteete and Ostrom (2004).

6 All derivations are included in Appendix A.

rive 6a from 1, 3 can be rewritten to have per capita output on the left-hand side. This yields the following equation, which will also be used as a regression equation.

$$y - l = z + \alpha(k - l) + \theta_1 S(g - l) + \theta_2 S(g - l) + \zeta(g - l) \quad (7a)$$

$$y - l = z + \alpha(k - l) + \theta_1 S(g - l) + \theta_2 S(g - l) + \zeta(g - l) + \varepsilon \quad (7b)$$

However, the effects that size and heterogeneity have on the government productivity parameter are probably not best described by a simple linear relationship. The advantages of a single government apparatus are not linear in size: distributing the same overhead costs over an increasing number of people becomes less and less advantageous as population size increases. For heterogeneity, this may not be so obvious. As discussed above, heterogeneity may actually increase exponentially as the size of the group increases. Part of the empirical section investigates whether these relationships are linear or non-linear. The question is then whether $\theta_1$1 and θ_2 are simple parameters or are themselves functions of S and H.

$$\theta_1 = \chi_1 + \psi_1 S \quad (8)$$

$$\theta_2 = \chi_2 + \psi_2 H \quad (9)$$

If size and heterogeneity have a simple linear effect on government spending's Cobb-Douglas parameter, ψ_1 and ψ_2 are equal to zero and the entire effect they have would run through χ_1 and χ_2, which are expected to be positive and negative, respectively. If there are diminishing returns, which is what would be expected in the case of size, ψ_1 would be smaller than zero. As discussed before, because heterogeneity can increase exponentially, there are no decreasing returns expected there. ψ_2 can then be positive, zero, or negative, depending on how heterogeneity actually functions. Filling in 7a with 8 and 9 yields the following formula and matching regression equation:

$$y - 1 = z + \alpha(k - l) + \chi_1 S(g - l) + \psi_1 S^2(g - l) + \chi_2 H(g - l) + \psi_2 H^2(g - l) + \zeta(g - l) \quad (10a)$$

$$y - 1 = z + \alpha(k - l) + \chi_1 S(g - l) + \psi_1 S^2(g - l) + \chi_2 H(g - l) + \psi_2 H^2(g - l) + \zeta(g - l) + \varepsilon \quad (10b)$$

These are the equations that I estimate in the empirical section. They make it possible to measure not only the effect that government expenditure has on private production, but also the effect that government expenditure in itself has on total output and the factors that affect this productivity. The next section describes the data used in the empirical section.

4 Data

Output (Y) is measured by GDP. Data on GDP were gathered from the Reserve Bank of India (RBI). GDP is given in current prices and in crore[7] rupees, and there are some missing values. For Chhattisgarh, Jharkhand, and Sikkim, the data begin with the year 1993/1994. For Mizoram and Uttarakhand it starts even later, with 1999/2000. Due to differences in compilation

7 A crore is 10 million, or 10^7.

methodologies, the GDP data are not perfectly comparable across states, but these differences should not have a significant influence on the results.

For labour (L), using employment figures would be preferable to using population figures. Employment is a more direct measurement of labour than population, but population data are more accurate and are available for more years. The Planning Commission of India supplies data on employment by state. However, these data are only available for the larger states, and only in two years. Employment data are also expected to be less reliable, given India's status as a developing country. For these reasons, I use population data rather than employment data. Robustness checks using employment data yielded results similar to those obtained when using population data. Data on the population size of the various states were taken from the national census. The census is undertaken once every 10 years, so data is available for 1991, 2001, and 2011.

There is no data available on private capital stock (K), so I use electricity consumption as a proxy for capital stock, following Jorgenson and Griliches (1967) and Burnside et al. (1996). Electricity consumption reflects the usage of existing capital stock more than it reflects the stock itself, but as such may reflect capital input in production even better than a basic measure of capital stock. Anxo and Sterner (2008) look at capital operating hours using electricity as a measure, and show that electricity is a good measure of capital usage. There are multiple sources to choose from for these data. The Central Statistics Office produces a yearly Energy Report which cites electricity generation capacity, rather than consumption, by state. These data goes back to 1993. I therefore use the Electric Power Survey (EPS) from the Central Electricity Authority, which does specifically measure consumption. The data from the seventeenth EPS cover the time period from 2004 to 2012 and shows electrical energy requirements at power stations' bus bars in TWh.

It is difficult to measure preference heterogeneity directly, so I use a number of indirect measures. The first of these measures is linguistic fractionalisation. Here, the idea is that different groups of people with different languages will want different things from the government: Anderson and Paskeviciute, (2006) find that linguistic heterogeneity leads to different citizen behaviour, suggesting that different groups speaking the same language also have different preferences. Using data on the 22 major scheduled languages of India, I construct a Herfindahl index of linguistic fractionalisation. These data come from the census, and reflect the mother tongue of each individual. I do not take bilingualism into account. In 2001, 255 million Indians spoke a second language, and 87 million spoke a third, out of a population of approximately 1 billion. This means that the fractionalisation measure, as it is used here, likely overestimates the actual linguistic fractionalisation of the country. As long as there are no cross-state patterns in this bilingualism, however, this does not present a problem. For example, if one state had only one main language and another had two main languages, but everyone in the second state knew both languages, the second state's linguistic fractionalisation would be overestimated. However, because the Indian states were originally created based on shared language within the state, such a situation is unlikely. The data corroborate this: most states have one main language, which is spoken by a majority or large minority of the population, and a number of smaller languages. In order to have heterogeneity increase as the index increases, so that its expected sign is the same as that of the other measures of heterogeneity, the eventual index is constructed as

$$L = 1 - \sum_{i=1}^{N} {s_i}^2 \qquad (11)$$

This way, a completely homogeneous state, with only one mother tongue that is shared by the entire population, gets the lowest score, and an increase in the index means an increase in heterogeneity.

India has not only a large number of languages, but also a large number of different religions. Leege and Kellstedt (1993) show that people from different religious denominations have different policy preferences, not just on deeply moral issues such as abortion, but also on more general government policy. Using data from the census, I create the same index for religions that I created for languages. The seven different options that respondents can select in the census are Hindu, Muslim, Christian, Sikh, Buddhist, Jain, and other. Hinduism is the main religion in every state except for Jammu and Kashmir (Islam), Meghalaya (Christianity), Mizoram (Christianity), Nagaland (Christianity),[8] and Punjab (Sikhism). In terms of religion, India's states range from the very homogeneously Hindu Himachal Pradesh to the very heterogeneous Arunachal Pradesh. As a second robustness check with these religious data, I include the percentage of Muslims in a state. This is because there is a certain antipathy towards Muslims in some parts of Indian society, more so than towards Sikhs or Buddhists. The presence of Muslims would then be more important when determining religious fractionalisation than the presence of people with other religions; in the former case, we would expect to see increased tension and distrust between the various religions.

An alternative measure of heterogeneity is data on the Gini index. This follows the Bolton and Roland (1997) model, which argues that financial fractionalisation, as measured by income inequality, is an important aspect in determining the heterogeneity of a state. In general, poor people are expected to want more public goods than rich people, who have to bear the greater burden of paying for those public goods. As such, income inequality should be a good measure of preference heterogeneity. The Planning Commission of the Indian government provides data on consumption Gini coefficients, which I use as a proxy for financial fractionalisation. These data are available for each state, distinguishing between rural and urban inequality. The data were gathered in 1993/1994, 1999/2000, 2004/2005, and 2009/2010. For the first two time periods, a large number of states are left out, but the sample

8 The reason these states are so Christian is that they are part of the Seven Sisters, the north-eastern states of India. These states have large populations of scheduled tribes, and the Christian missionaries sent to convert them were particularly effective.

is complete for the final two waves. This paper uses the data with a uniform reference period.

The final proxy for heterogeneity is the total area of the state. I argue that for economies of scale, it is not necessarily the area of the state, but the population of the state that matters. This follows directly from the model, where the size of the nation is dependent on the number of people living in it rather than the physical size of the country, and is also grounded in the empirical literature. For example, Bailey and Hickman, (2005) find that electoral competition increases with district size, suggesting that preferences become more diverse with the increased size of political units. People with similar cultures are likely to live together in a single area. Expanding a state or nation then means that people of different cultures and backgrounds are included, while splitting these entities makes their populations more homogeneous. This can be seen directly in India, where all three of the separatist movements in the states that were created in 2000 were based on the assertion of a unique cultural identity different from the root state but shared within the offshoot state. Hence, the reduction in size in this case meant, ostensibly, the homogenisation of each state's population.

Beyond capturing differences in cultures and identities, what area should mainly capture is differences in preferences. While preferences for public goods provision may be tied to cultural groups, they will even more likely be tied to specific areas within the country. For example, all of the regionalist movements that led to the creation of new states in 2000 were specifically linked to perceived inequalities tied to the geographical region and that would not be captured by any of the other heterogeneity measures. For example, the Uttarakhand movement focused on "anger and resistance against the exploitation of hill resources by outsiders" (Chakraborty 1999: 50). The Jharkhand movement focused on a north-south divide within Bihar (Prakash 2001). And, finally, the Chhattisgarh movement focused on the common identity within the state and the relative deprivation of the region compared to the rest of India (Arora 2003). These aspects are not captured by any of the other proxies, as those proxies focus on cultural differences within countries. Alesina and Zhuravskaya (2011), for example, constructed a data set which included religious, ethnic, and linguistic fractionalisation for a large set of countries. For ethnic fractionalisation in India, they used the percentage of Scheduled Castes and Tribes in each of the various states as a measure. However, this measure does not capture any of the three new states' reasons for regionalism: Uttarakhand's hill culture is not captured; Chhattisgarh's cultural differences with Madhya Pradesh are not uniquely tribal, and the two states actually have a very similar percentage of these groups; and Jharkhand is actually more fractionalised than the old unseparated Bihar according to this measure because the percentage of tribes is larger, but they still do not make up the majority in the new state. These measures are probably the best one can do for heterogeneity, but this fractionalisation of cultures does not necessarily measure the heterogeneity of preferences.

Still, this proxy is not perfect: sometimes larger states can still consist of one group simply because this group is much larger. But it is a suitable proxy and in the case of India, perhaps the best possible one. These data are also available from the census.

To measure the size of the state, I use population data. This follows from the theoretical model: the state governments provide public goods from money contributed by individuals. The per capita costs of non-rival goods automatically decrease as the size of the group that pays for them increases.[9] In the Alesina and Spolaore model, the fixed costs of the public sector mean that as the size of the population increases, these fixed costs can be spread out and paid for by more people. In reality, public goods like education carry not only fixed costs but also variable costs. However, as long as there is a fixed component to the costs that does not increase with population size, the reasoning still holds. Hence, population is the best available variable with which to measure the size of the state. The area of the state would be a very poor proxy as all the economies of scale work through population. Adding extra area to the state would not have any benefit in terms of economies of scale as long as there were no people living there.

The RBI publishes data on government budgets (G) for each year. Data on these budgets are available throughout all the years covered in this study. Data on the budgets of the new states are available for 2000/2001 (Chhattisgarh and Uttarakhand) and 2001/2002 (Jharkhand) onwards. The only other missing values are for Delhi, on which there is information for the years 1993/1994 and after. I use total government expenditure as the main relevant variable, as it is an estimate of the total government size. Data for each year are provided in three phases: first, budgetary estimates are released. The next year, these estimates are revised, and the year after that the actual numbers are given. I use actual expenditure where possible, the revised estimates for 2013/2014, and the budget estimates for 2014/2015. The data are in lakh[10] rupees. Government size has a mean of 28.0 per cent of GDP, a minimum of 1.6 per cent of GDP (Delhi in 1993/1994), and a maximum of 201.0 per cent of GDP (Sikkim in 1998/1999). Since all the different expenditure categories in the government budget can be identified, I can analyse them to see where the problems are. On the minimum side, almost all outliers are due to the National Capital Territory of Delhi, which has an extremely small government. Two other small observations are accounted for by Uttarakhand and Chhattisgarh in 2000/2001, when these new states were still in their infancy and had a government size of 7-8 per cent. On the high side, Sikkim's huge government can be explained by an anomaly in the data: the main expenditures there appear to be related to the state lotteries,

9 Because the Indian states are also dependent on the central government for their income, the question is to what extent the inhabitants of each state actually pay the costs of the public goods. According to data from the Planning Commission, approximately 33 per cent of the state budgets is financed by transfers from the central government, so the rest is financed by the states' own tax revenues and non-tax income, which is more dependent on the respective state's population size.

10 A lakh is 100,000, or 10^5.

which amount to a maximum of 131.4 per cent of state GDP. The vast majority of lottery expenditures lie below 1 per cent of GDP, with the mean being approximately 2.5 per cent. Only a few states, such as Goa, Haryana, and Punjab, organise huge lotteries, which can be 100,000 times as large as lotteries in the larger states. For example, in 2006/2007, some large states spent less than 0.01 per cent of GDP on lotteries, whereas Punjab spent 11 per cent and Sikkim 48 per cent of GDP. Since this appears to be an anomaly in the data and state lotteries do not really fit into the government spending of interest, I clean the expenditure data by removing state lottery expenditures.[11] Furthermore, the government budgets are split into developmental and non-developmental expenditure, along the lines that the Indian government itself draws. Developmental expenditure encompass, for example, spending on healthcare, education, infrastructure, agriculture, social welfare, and rural development programmes, while non-developmental expenditures includes overhead and interest costs as well as pensions. As part of a robustness check, both developmental and total expenditures are considered in the empirical section. Development expenditure should have a more positive effect on output than total expenditure, because it excludes factors such as administrative services and pensions, which are less complementary to private expenditure.

A summary of the variables used, their sources, and their availability is provided in Appendix B. In the next section, I use the data discussed here to measure the parameters of the model outlined in the previous section.

5 Results

In this section, I estimate equations 6b, 7b, and 10b. The first goal is to measure g, the production elasticity of government services, and compare this to other results found in the literature. Then, various measures of heterogeneity and size are added to the model to reflect the Alesina model. The estimator of choice is the BE estimator. I divide the dataset into three periods: 1990-1998, 1998-2006, and 2006-2015, so that each period overlaps with one census year, then take each state's average of all the variables for each of those periods. For some variables, this means there is only one observation per time period in the panel, because they are only measured within the census. The first period is initially omitted due to missing data on the capital stock. Taking the time averages may ameliorate measurement error to a point, but there are still some other sources of potential bias that must be addressed.

One of the problems is the possibility of omitted variables. Normally, these would be captured by using state-fixed effects. However, since time-constant characteristics of states, like area, are considered, using fixed effects would make part of the analysis impossible.

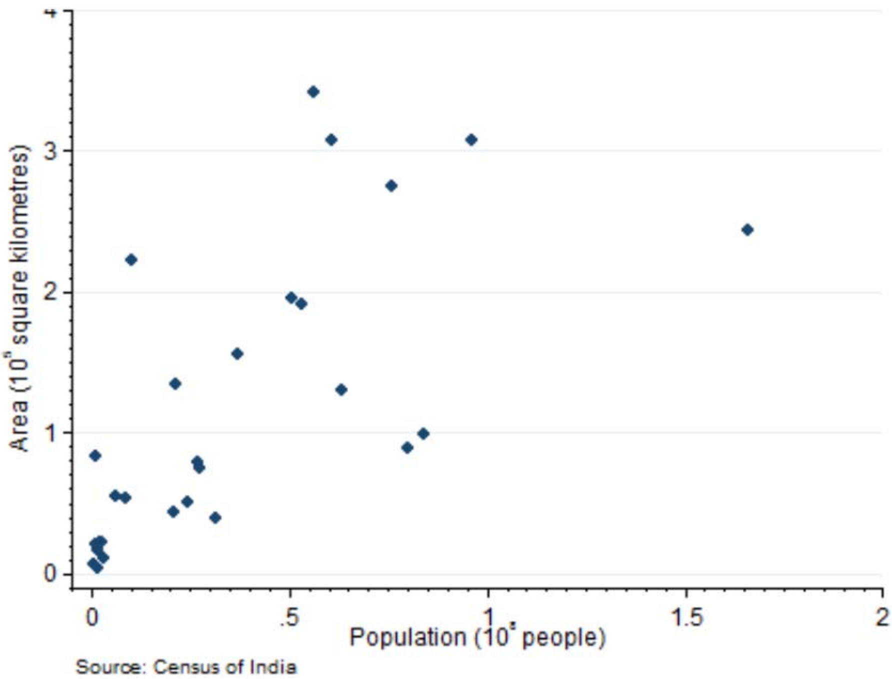
11 There were a few missing values in the lottery expenditure data, with compilation errors meaning that there was no information on Assam, Goa, Jharkhand, Madhya Pradesh, Mizoram, Rajasthan, and West Bengal in 2003/2004, so I used the revised estimates from the year before. For the category "all states," I used the sum of all the individual states, rather than the revised estimates from the year before.

Because state-fixed effects are unlikely to be as much of a problem as country-fixed effects, as institutions and conditions are much more similar between states within a country than between countries, using the between estimator is an acceptable approach.

Another problem is the assumption that government expenditure is chosen exogenously. Governments, if they behave rationally, select their expenditure in such a way as to maximise their productivity. As discussed before, in the Barro model this means that all governments have exactly the same optimal relative size. In the model as I have discussed it here, it means that welfare-maximising governments design their spending to be optimal, so that there is no difference in government productivity between states, and therefore seemingly no impact of size and heterogeneity on government productivity, because the government has already adapted itself to include the productivity effects of these two variables. This issue could also be solved by using data from before and after the split, which is not possible here. The splitting of a state entails a sizeable exogenous shock in terms of size and heterogeneity, to which government expenditure does not respond immediately.

As a baseline, I use population as a proxy for the size of the state, while area reflects the heterogeneity within the state. As Figure 1 attests, population and area do not denote the same thing. The cluster of very small states in the bottom-left corner mostly consists of the north-eastern states. In the rest of the sample, there is a large amount of variation in both population and area, from the extremely densely populated Uttar Pradesh, with its 200 million people over 250,000 square kilometres, to the more sparsely populated but larger Rajasthan, with approximately 70 million people over 350,000 square kilometres.

Figure 1. Size and Heterogeneity



The main findings of the paper are summarised in Table 1. All the specifications discussed in the model section are included here.

Table 1. Government Expenditure, Size, and Heterogeneity: Unrestricted Model

y − l	(1) Aschauer	(2) Alesina	(3) Alesina	(4) Alesina
k − l(α)	0.478* (0.173)	0.594* (0.259)	0.599* (0.254)	0.600* (0.270)
g − l(γ)	0.469* (0.135)			
g − l(ζ)		0.440* (0.107)	0.411* (0.084)	0.430* (0.089)
S*(g − l)(θ1)		0.031 (0.022)	0.048 (0.060)	0.012 (0.050)
H*(g − l)(θ2)		-0.032 (0.019)	-0.105 (0.063)	-0.031 (0.018)
S^2*(g − l)(ψ1)			-0.004 (0.028)	0.011 (0.030)
H^2*(g − l)(ψ2)			0.022 (0.015)	
N	60	56	56	56
R^2	0.441	0.495	0.532	0.496

Clustered standard errors in parentheses.
* p < 0:05

All standard errors are clustered by state. The first column shows the results that are closest to what is normally found in the literature. This column uses the same method 16 as Aschauer, (1989b) and the literature following him. There are a number of papers to draw on to suggest realistic numbers for γ, which is the parameter of interest in that column. Aschauer (1989b) suggested a γ of 0.39, which is considered to be high. Ratner (1983) and Munnell (1990), and Duffy-Deno and Eberts (1991), on the other hand, estimated γ to lie between 0.05 and 0.1. Cazzavillan (1993) and Lynde and Richmond (1993), and Canning and Fay (1993) lie between these two extremes, with a γ around 0.2. The estimates for γ in columns (1) and (2) are on the high side, but within what is considered realistic. A γ of 0.4, in this case, implies that increasing G by 1 means a difference equivalent to that between the 25th percentile state, Jammu and Kashmir, with a GDP per capita of 15,537, and the 50th percentile state, Karnataka, with a GDP per capita of 23,711. Both an increase in G of 1 and an increase in GDP per capita of 0.4 amount to a little less than one standard deviation.

Column (2) shows the results when the Alesina variables are included, splitting g into its various components. The results for government expenditure are similar to those in column

(1), with a high estimate for ζ . The estimate for ζ is not significantly different from γ,[12] which suggests that the Alesina variables, on average, tend to cancel each other out. The size of the state, measured by its population, has a positive but insignificant effect on government productivity, while the heterogeneity of the state, measured by its area, has a negative and insignificant effect on government productivity. Area and population have been resized to be denoted in hundreds of thousands of square kilometres and hundreds of millions of people, respectively. Area varies between below 0.1 for the very small states and 3 for Maharashtra and Madhya Pradesh. Population varies between 0.01 for the small states and goes up to 2 for Uttar Pradesh. The coefficients then imply that size and heterogeneity have a sizeable effect on government productivity: the effects of the individual variables have amount to approximately 10 per cent of the government productivity parameter.

Columns (3) and (4) then show the results for the more elaborate version of the model, which includes the possibility of a non-linear effect of population and area on the government's productivity coefficient. The coefficients for the size and heterogeneity of the state still have the same sign and the same significance. There appear to be no decreasing returns to scale for either size or heterogeneity here.

The analysis, however, is inherently limited by the lack of data on private capital. Still, this is not necessarily a problem. Klenow and Rodríguez-Clare (1997) looked at economic growth over a long period and found that growth due to an increase in physical capital intensity, K/Y, was very small compared to growth due to an increase in technology. This means that in a panel data environment, K/Y can be assumed to be part of the constant, not having a growth effect. With a constant capital-output ratio, the equation to be estimated changes subtly:[13]

$$(y-l)=\frac{z}{1-\alpha}+\frac{\alpha}{1-\alpha}\cdot(k-y)+\frac{\zeta}{1-\alpha}\cdot(g-l)+\frac{\theta_1 S}{1-\alpha}\cdot(g-l)+\frac{\theta_2 H}{1-\alpha}*(g-l) \qquad (12)$$

Since k-y is a constant in a steady-state setting, that term does not feature in the results tables, as it is being incorporated into the constant term. In order to obtain the actual estimate of γ and ζ, the parameter found in the regression must be multiplied by (1-α), for which I use an α of 0.5, which is what Table 1 suggests it should be. Because the capital data are limited, it is not possible to measure α in the larger dataset using equation (12) and then plugging it in afterwards, so the measured a from the smaller dataset needs to be used. When it is no longer necessary to include the capital variable, which was the main gap in the dataset, it becomes possible to use the full extent of the dataset, reaching back to 1990. I then use pooled OLS to estimate the effects, in order to best be able to compare them to the original results from Table 1.

12 Due to the clustered standard errors, a Hausman test is impossible here.

13 Derivation is provided in Appendix A.

The results for the fixed-effects model, which reflect the short-term effects more than anything, are reported in Appendix A, but are not dissimilar from pooled OLS. Table 2 shows the results from that analysis.

Table 2. Government Expenditure, Size and Heterogeneity: Restricted Model

	(1) Aschauer	(2) Alesina
$g-l(\gamma)$	0.227* (0.068)	
$g-l(\zeta)$		0.221* (0.067)
$S*(g-l)(\theta 1)$		-0.000 (0.011)
$H*(g-l)(\theta 2)$		-0.004 (0.006)
Observations	85	80
R2	0.288	0.303

Clustered standard errors in parentheses.
* p < 0:05

The reported standard-errors are clustering-robust, to compensate for the panel data structure. In order to obtain the actual coefficients, the regression results need to be multiplied by (1-α). To make the table more digestible, this has already been done. The coefficients for γ and ζ that are found here are lower than before. These estimates are reported in the second row of Table 2. Here, too, the interaction effects for size and heterogeneity show no significant sign.

In the model with diminishing returns, most of the variables are now insignificant, but only marginally so. All in all, the use of a constant K/Y ratio allows the usage of a larger portion of the data set, and yields more realistic results, especially on γ. The estimates of γ and ζ are also not systematically different regardless of the specification here, again suggesting that on average the results from the earlier literature do not under- or overestimate the inherent productivity of government spending.

The next step is to look at alternative measures of heterogeneity. As discussed in the data section, there are a number of possible proxies for heterogeneity. Financial, linguistic, and religious fractionalisation are the ones that I use here. Table 3 shows the results for those variables, using the preferred specification, which excludes non-linear effects but includes a constant K/Y ratio. The first column reproduces the results for area, the preferred proxy for heterogeneity, as a comparison.

Table 3. Government Expenditure, Size, and Alternative Measures of Heterogeneity: Restricted Model

	(1) Alesina	(2) Alesina	(3) Alesina	(4) Alesina	(5) Alesina	(6) Alesina
$g{-}1(\zeta)$	0.221* (0.067)	0.121* (0.031)	0.183* (0.074)	0.290 (0.183)	0.294 (0.196)	0.304 (0.204)
$S{*}(g{-}1)(\theta_1)$	-0.000 (0.011)	-0.029 (0.017)	-0.018 (0.012)	0.002 (0.019)	0.000 (0.018)	0.000 (0.018)
Area (θ_2)	-0.004 (0.006)					
Urban Gini (θ_2)		0.248 (0.144)				
Rural Gini (θ_2)			0.078 (0.085)			
Language (θ_2)				0.019 (0.045)		
Religion (θ_2)					0.006 (0.033)	
Muslim % (θ_2)						0.012 (0.029)
Observations	80	76	76	29	29	29
R^2	0.303	0.375	0.283	0.254	0.248	0.249

Clustered standard errors in parentheses.

* $p < 0.05$

None of the variables that proxy for heterogeneity have a significant effect on the productivity of government spending. The estimates for ζ lie in the range of 0.12–0.31, which are realistic numbers. When the assumption of a constant K/Y ratio is dropped, the results are similar.[14] All in all, the results for these alternative measures of heterogeneity are not as expected; however, financial inequality may not necessarily have a negative effect on government productivity. As discussed in Baland and Platteau (1996), financial inequality means that rich people have a greater incentive to take care of local resources; in the context of government spending, financial inequality would mean that some people have a greater stock in the performance of the government and would be better equipped to perform some monitoring of it.

The final robustness check looks at development spending specifically, rather than total government spending. This is the part of the government's budget that is intended specifically for infrastructure development, energy, social services, agriculture, and mining. The results

14 These results can be found in Appendix A.

for this are summarised in Table 4 and are practically the same as for total expenditure, suggesting that development spending is no more productive than the rest of the Indian state governments' spending. The results for size are found to be robust, however, with significant results in the non-linear model. The results for heterogeneity, on the other hand, are not reproduced here, so that it does not appear to have a significant effect.

Table 4. Development Expenditure, Size, and Heterogeneity: Restricted Model

	(1) Aschauer	(2) Alesina	(3) Alesina	(4) Alesina
$g-1(\gamma)$	0.222* (0.069)			
$g-1(\zeta)$		0.217* (0.071)	0.223* (0.068)	0.222* (0.070)
$S*(g-1)(\theta 1)$		0.003 (0.012)	0.041 (0.037)	0.022 (0.032)
$H*(g-1)(\theta 2)$		-0.005 (0.007)	-0.041 (0.033)	-0.007 (0.007)
$S^{2*}(g-1)(\psi 1)$			-0.020 (0.015)	-0.012 (0.014)
$H^{2*}(g-1)(\psi 2)$			0.010 (0.009)	
N	85	80	80	80
R^2	0.288	0.300	0.335	0.303

Clustered standard errors in parentheses.
* $p < 0.05$

In these empirical results, there is nothing that suggests that the Alesina variables are, in the end, relevant. The differences between the estimates for g and z are minute. This means that, on average, size and heterogeneity do not affect government productivity and that the literature on government productivity has not systematically over- or underestimated this parameter.

6 The Split States

The previous sections looked at India in general. In this section, the focus is on the new states that were formed as part of the reorganisation that took place in 2000. In order to identify the effects of this change, I rerun the regressions with interaction effects for a number of states. These interaction effects show whether a subset of states has an inherently more or less efficient government. The results are outlined in Table 5, which omits the Alesina variables.

Table 5: Government Expenditure, Size, and Heterogeneity: Split States

	(1) Aschauer	(2) Aschauer	(3) Aschauer	(4) Aschauer
[1em] k−l(α)	0.462* (0.181)	0.446* (0.195)		
g−l(γ)	0.430* (0.149)	0.419* (0.157)	0.210* (0.067)	0.199* (0.068)
Split state interaction	-0.027 (0.038)		-0.025 (0.015)	
Root interaction		-0.044 (0.039)		-0.039* (0.008)
Offshoot interaction		-0.014 (0.056)		-0.009 (0.027)
[1em] Model	Unrestricted	Unrestricted	Restricted	Restricted
Observations	60	60	85	85
R^2	0.451	0.455	0.328	0.346

Clustered standard errors in parentheses.
* p < 0:05

The results for a and g are similar to those found in the previous section. I find one statistically significant effect for the interaction dummies: in the restricted model, the states that were subsequently split performed significantly worse than the other states, losing approximately 20 per cent of their productivity. This suggests that splitting the states may have had some negative effects, at least for the root states. The offshoot states, on the other hand, were unaffected. A possible explanation for this is that the root states suffer more from lost synergies than the offshoots. For example, with the split, Bihar lost access to most of its power plants. Another explanation could be that while the offshoot states built their new administration from scratch, the root states had to reorganise the existing administrative structure, which was not designed to govern the root state separately from the offshoot. This would suggest that the government apparatus adapts itself to the size of the state it is supposed to administrate.

A government apparatus can be productive with any size of a state, as long as it is designed with that size in mind. Once the size changes, the apparatus has to adjust to the new size before it can once again be productive. In a way, this result is very similar to the Alesina and Spolaore (1997) model, where peripheral regions that secede do not incorporate the costs that this secession carries for the centre. In Alesina and Spolaore's model, this leads to a suboptimal number of nations. Following the results of this paper, if regions within states can decide to secede, one might observe a suboptimal number of states, as the seceding states do not take into account the loss in government productivity the root states will suffer.

7 Conclusions

In this paper, I have looked at the productivity of government spending and potential variables that influence this productivity, incorporating the Alesina and Spolaore theory of the optimal size of the state into an empirical model that seeks to measure government productivity. Whereas the previous literature focused on very specific cases of public goods provision, I have taken a broader view to see if these variables also have an effect on GDP per capita through government productivity. The results are mostly in line with those of previous papers. I have found a coefficient for government spending that was on the high side. An increase in capital stock has a similar effect on per capita output as an increase in government spending. When a constant capital-output ratio is used to expand the time dimension in the data set, the findings for the coefficients of government spending become much lower, and more in line with what the literature suggests as a realistic number.

When preference heterogeneity and size were added to the model to look for variables that may affect the productivity of government spending, these coefficients were of the expected sign but insignificant, in both a linear and a non-linear specification of the model. These effects were persistent across both the unrestricted and the restricted version of the model, so that the divergent results for the government productivity parameter should not draw attention away from the main point of the paper.

The results were not in line with the expectation that size and heterogeneity affect government productivity. This does not invalidate Alesina and Spolaore, but it does suggest that their model works at a more subtle level. As shown in previous papers, heterogeneity can affect the performance of the government through channels such as corruption, or at a very local level as in Alesina and La Ferrara (2005). However, this paper casts some doubts as to the effects of heterogeneity on the productivity of the government at a higher level. It also suggests that size does not really matter for the productivity of states. This casts into doubt the idea that splitting or merging states has any effect on the productivity of the state government.

Finally, the paper has looked at the more specific case of India's split states. Here, the main result identified was that the root states experienced a decline in productivity after the split. A possible explanation is that government apparatuses can be productive within any size of state but have problems adjusting once that size changes. Based on the results presented here, I cannot determine whether this effect is temporary or permanent. In order to test whether or not the government's productivity recovers over time, a longer time span is required. If this effect were found to be permanent, it would be empirical evidence supporting Alesina and Spolaore's assertion that selfdetermination leads to a suboptimally high number of states.

The paper opens up interesting new avenues for future research. It provides evidence that government productivity is not dependent on the size or heterogeneity of a state. Instead, it indicates that the reorganisation of a state's administration may lead to that administration having a reduced productivity. For the Indian case, this suggests that when looking to split up states in the future, the national government should take into account the fact that such a split might negatively affect the productivity of the root state’s government apparatus.

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Appendices

Appendix A: Derivations

A.1 Derivation of Equation 6a

$$Y = Z \cdot K^{\propto} \cdot L^{\beta} \cdot G^{\gamma} \tag{A.1}$$

This is the functional form of equation 1 in the main text. The Cobb-Douglas form of the model then implies that $\alpha+\beta+\gamma=1$

$$\frac{Y}{L^{1-\alpha-\gamma}} = Z \cdot K^{\propto} \cdot G^{\gamma} \tag{A.2}$$

$$\frac{Y L^{\alpha} L^{\gamma}}{L} = Z \cdot K^{\propto} \cdot G^{\gamma} \tag{A.3}$$

$$\frac{Y}{L} = Z \cdot \frac{K^{\alpha}}{L^{\alpha}} \cdot \frac{G^{\gamma}}{L^{\gamma}} \tag{A.4}$$

$$y - l = z + \alpha(k - l) + \gamma(g - l) \tag{A.5}$$

This is equation 6a from the main text.

A.2 Derivation of equation 7a

$$Y = Z \cdot K^{\propto} \cdot L^{\beta} \cdot G^{\gamma} \tag{A.6}$$

This is the functional form of equation 1 in the main text. The Cobb-Douglas form of the model then implies that $\alpha+\beta+\gamma=1$. Including size and heterogeneity means decomposing γ into $\gamma=\zeta+\theta_1 S+\theta_2 H$

$$\frac{Y}{L^{\beta}} = Z \cdot K^{\alpha} \cdot G^{\zeta+\theta_1 S+\theta_2 H} \tag{A.7}$$

$$\frac{Y}{L} = Z \cdot \frac{K^{\propto}}{L^{\alpha}} \cdot \frac{G^{\zeta}}{L^{\zeta}} \frac{G^{\theta_1 S}}{L^{\theta_1 S}} \frac{G^{\theta_2 H}}{L^{\theta_2 H}} \tag{A.8}$$

$$y - l = z + \alpha(k - l) + \theta_1 S(g - l) + \theta_2 H(g - l) + \gamma(g - l) \tag{A.9}$$

This is equation 7a in the main text.

A.3 Derivation of equation 12

$$Y = Z \cdot K^{\propto} \cdot L^{\beta} \cdot G^{\gamma} \tag{A.10}$$

This is the functional form of equation 1 in the main text. The Cobb-Douglas form of the model then implies that $\alpha+\beta+\gamma=1$. Including size and heterogeneity means decomposing γ into $\gamma=\zeta+\theta_1 S+\theta_2 H$

$$Y^{\alpha+\beta+\zeta+\theta_1 S+\theta_2 H} = Z \cdot K^{\propto} \cdot L^{\beta} \cdot G^{\zeta+\theta_1 S+\theta_2 H} \tag{A.11}$$

$$\frac{Y^{\beta+\zeta+\theta_1 S+\theta_2 H}}{L^{\beta}} = Z \cdot \frac{K^{\propto}}{Y^{\alpha}} \cdot G^{\zeta+\theta_1 S+\theta_2 H} \tag{A.12}$$

$$\frac{Y^{1-\alpha}}{L^{1-\alpha-\zeta+\theta_1 S+\theta_2 H}} = Z \cdot \frac{K^{\propto}}{Y^{\alpha}} \cdot G^{\zeta+\theta_1 S+\theta_2 H} \tag{A.13}$$

$$\frac{Y^{1-\alpha}}{L^{1-\alpha}} = Z \cdot \frac{K^{\propto}}{Y^{\alpha}} \cdot \frac{G^{\zeta+\theta_1 S+\theta_2 H}}{L^{\zeta+\theta_1 S+\theta_2 H}} \tag{A.14}$$

$$(1-\alpha)\,(y-l) = z + \alpha(k-y) + \zeta(g-l) + \theta_1 S(g-l) + \theta_2 H(g-l) \tag{A.15}$$

$$(y-l) = \frac{z}{1-\alpha} + \frac{\alpha}{1-\alpha}\cdot(k-y) + \frac{\zeta}{1-\alpha}\cdot(g-l) + \frac{\theta_1 S}{1-\alpha}\cdot(g-l) + \frac{\theta_2 H}{1-\alpha} * (g-l) \tag{A.16}$$

This is equation 12 from the main text.

Appendix B: List of Tables

Table A1. Data Sources and Availability

Variable	Source	Measures	Availability
Area	Census of India	S	All years
Electricity	Central Electricity Authority	K	2004–2011
Employment	Planning Commission	L	2004/2005, 2009/2010
Expenditure	Planning Commission	G	All years
Gini index	Planning Commission	H	1993/1994, 1999/2000, 2004/2005, 2009/2010
GDP	Reserve Bank of India	Y	All years
Languages	Census of India	H	2000/2001
Religion	Census of India	H	2000/2001
Population	Census of India	S	1990/1991, 2000/2001, 2010/2011

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