Online Appendix: Revenue Persistence and Public Service Delivery

Revenue Persistence and Public Services

Traviss Cassidy[1,*]

*Correspondence address: tmcassidy@ua.edu

A Appendix

Contents

A.1 Theoretical Model

This section develops a simple model of public expenditure, building on Obstfeld and Rogoff (1996, pp. 96–98). The goal is to understand how public good provision responds to revenue shocks of differing persistence, and how lumpy investment affects these responses. Suppose the local government provides a nondurable good, C, and a durable good, D. The durable good evolves according to the equation of motion $D_t = (1-\delta)D_{t-1} + I_t$, where I_t is durable-good investment in period t, and $\delta \in (0,1)$ is the depreciation rate. Let p_t denote the (exogenous) price of durable-good investment in units of the nondurable good in period t.

Total public spending in period t is $G_t \equiv C_t + p_t I_t$. The local government has access to a risk-free bond with exogenous rate of return r. Fiscal transfers from the central government, F_t, are the local government's only source of revenue. Net assets, A_t, evolve according to the equation of motion $A_{t+1} = (1+r)A_t + F_t - C_t - p_t I_t$. The local government's intertemporal budget constraint is

$$\sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t (C_t + p_t I_t) = (1+r)A_0 + \sum_{t=0}^{\infty} \left(\frac{1}{1+r}\right)^t F_t.$$

The government discounts citizen utility over time with factor $\beta \in (0,1)$. The government may be impatient, in that its discount rate may be greater than the interest rate ($\beta < 1/(1+r)$). Initially assume that investment is frictionless (non-lumpy). The government has perfect foresight and chooses a sequence $\{C_t, D_t\}_{t=0}^{\infty}$ to maximize

$$\sum_{t=0}^{\infty} \beta^t \left(\gamma \log C_t + (1-\gamma) \log D_t\right),$$

subject to the intertemporal budget constraint and the equation of motion for durables.[1] Let $\gamma \in (0,1)$ so that the citizen wants to consume both goods.

The optimal path of public good provision is characterised by the equations

$$C_{t+1} = \beta(1+r)C_t, \qquad \frac{(1-\gamma)C_t}{\gamma D_t} = p_t - \frac{1-\delta}{1+r} p_{t+1} \equiv \iota_t. \tag{A.1}$$

[1]The model abstracts from private consumption in order to focus attention on the government's optimal expenditure plan. As there is no taxation in the model, adding private consumption would not change any of the results below as long as citizen preferences for private consumption and public consumption were separable.

The first is the usual Euler equation for consumption of nondurables, and the second states that the marginal rate of substitution between nondurables consumption and durables consumption equals the user cost of durables. Define the stock of lifetime resources,

$$R \equiv (1+r)A_0 + (1-\delta)p_0 D_{-1} + \sum_{t=0}^{\infty} \left(\frac{1}{1+r} \right)^t F_t.$$

Combining the optimality conditions with the intertemporal budget constraint yields the optimal levels of public good provision in each period,

$$C_t = \beta^t (1+r)^t \gamma (1-\beta) R, \qquad D_t = \frac{1}{\iota_t} \beta^t (1+r)^t (1-\gamma)(1-\beta) R.$$

Next consider how public good provision responds to revenue shocks. Suppose transfers evolve deterministically according to the difference equation

$$F_t = \rho F_{t-1} + \psi_t,$$

where $\rho \in [0,1]$ measures the persistence of the transfer. The effect of shock ψ_t on transfers j periods later is $\partial F_{t+j}/\partial \psi_t = \rho^j$. In particular, a one-unit increase in ψ_0 causes transfers to increase by one in all periods if $\rho = 1$ (permanent increase), but it causes only period-0 transfers to increase by one if $\rho = 0$ (transitory increase). The effect of a period-0 revenue shock on lifetime resources is $\partial R/\partial \psi_0 = (1+r)/(1+r-\rho)$, so the response of public good provision in period t is

$$\frac{\partial C_t}{\partial \psi_0} = \beta^t (1+r)^t \gamma (1-\beta) \frac{1+r}{1+r-\rho},$$

$$\frac{\partial D_t}{\partial \psi_0} = \frac{1}{\iota_t} \beta^t (1+r)^t (1-\gamma)(1-\beta) \frac{1+r}{1+r-\rho}. \tag{A.2}$$

The above expressions immediately imply the following result.

PROPOSITION A.1. *The public goods response to a revenue shock is increasing in the persistence of the shock:*

$$\frac{\partial^2 C_t}{\partial \rho \partial \psi_0} > 0, \qquad \frac{\partial^2 D_t}{\partial \rho \partial \psi_0} > 0 \qquad \textit{for all } t.$$

Proposition A.1 holds because more persistent shocks have a larger impact on lifetime resources.

Because D_{t-1} is predetermined in period t, the initial investment response equals the initial durables response, while the investment response in subsequent periods reflects the change in durables net of depreciation,

$$\frac{\partial I_0}{\partial \psi_0} = \frac{\partial D_0}{\partial \psi_0}, \qquad \frac{\partial I_t}{\partial \psi_0} = \frac{\partial D_t}{\partial \psi_0} - (1-\delta) \frac{\partial D_{t-1}}{\partial \psi_0} \qquad \text{for } t \geq 1. \tag{A.3}$$

Absent a steep downward trend in the user cost of durables over time, investment responds more in the current period than in subsequent periods, as does total government expenditure—even when the government's discount rate equals the interest rate.[2] Together, the expressions in (A.2) and (A.3) imply the following result.

PROPOSITION A.2. *For any discount factor $\beta \leq (1+r)^{-1}$, total expenditure "overshoots,"*

$$\frac{\partial G_0}{\partial \psi_0} > \frac{r}{1+r-\rho},$$

initially increasing by more than the increase in permanent income ($rR/(1+r)$) due to the shock.[3] *In particular, if transfers are perfectly persistent ($\rho = 1$), then spending initially increases more than one-for-one with current transfers ($\partial G_0/\partial \psi_0 > 1$). In addition, the spending response is always smaller in subsequent periods,*

$$\frac{\partial G_t}{\partial \psi_0} < \frac{\partial G_0}{\partial \psi_0} \qquad \text{for } t \geq 1,$$

as long as a weak condition holds for the path of investment costs.[4]

To summarize, when investment is non-lumpy, the expenditure response to a shock to fiscal transfers (1) is larger the more persistent are transfers and (2) initially overshoots under mild assumptions, due to upfront investment in durables.

[2] For $t \geq 1$,

$$\frac{\partial I_0}{\partial \psi_0} - \frac{\partial I_t}{\partial \psi_0} = \frac{(1-\gamma)(1-\beta)(1+r)}{1+r-\rho}\left(\frac{1}{\iota_0} - \beta^{t-1}(1+r)^{t-1}\left[\frac{\beta(1+r)}{\iota_t} - \frac{1-\delta}{\iota_{t-1}}\right]\right).$$

[3] To see this, note that

$$\frac{\partial G_0}{\partial \psi_0} = \frac{(1-\beta)(1+r)}{1+r-\rho}\left(\gamma + (1-\gamma)\frac{p_0}{\iota_0}\right),$$

and $p_0 > \iota_0$ as long as the price of investment is always strictly positive.

[4] Because

$$\frac{\partial G_t}{\partial \psi_0} = \beta^t(1+r)^t\frac{(1-\beta)(1+r)}{1+r-\rho}\left(\gamma + (1-\gamma)\left[\frac{p_t}{\iota_t} - \frac{1-\delta}{\beta(1+r)}\frac{p_t}{\iota_{t-1}}\right]\right),$$

a sufficient (but not necessary) condition for the inequality to hold is $p_0/\iota_0 > p_t/\iota_t - (1-\delta)p_t/\iota_{t-1}$.

Now suppose that investment is lumpy due to non-convex adjustment costs. The local government incurs a fixed cost $\xi > 0$ every time it makes a "large" adjustment to the stock of durables. Following Khan and Thomas (2008), the government does not pay this fixed cost if adjustment is sufficiently small relative to the stock of durables—formally, if $I_t \in [aD_{t-1}, bD_{t-1}]$, where $a \leq 0 \leq b$. An example of such an investment is routine maintenance.

To simplify the dynamics of the model, assume that the price of investment is constant, $\iota_t = \iota$ for all t. Further assume that the government's discount rate equals the interest rate ($\beta(1+r) = 1$). Under these two assumptions the desired provision of the two public goods is constant over time and equal to

$$C_t = C = \gamma \frac{r}{1+r} R, \qquad D_t = D = \frac{1-\gamma}{\iota} \frac{r}{1+r} R \qquad \text{for all } t.$$

Finally, assume that $b = \delta$ so that the government can maintain a constant stock of durables without incurring the fixed cost. Regardless of whether these three assumptions are imposed, the investment response to a revenue shock will be concentrated in the initial period. The simplifying assumptions make it easier to analyse how non-convex adjustment costs affect this investment response.

For a period-0 shock of size $\mathrm{d}\psi_0$, let $\mathrm{d}R = \mathrm{d}\psi_0(1+r)/(1+r-\rho)$ denote the change in lifetime resources. If the government does not incur the fixed cost, public good provision is

$$C = \gamma \frac{r}{1+r} R + \frac{r}{1+r} \mathrm{d}R, \qquad D = \frac{1-\gamma}{\iota} \frac{r}{1+r} R.$$

The shock leaves the stock of durables unchanged, and all additional resources are devoted to the nondurable good. If the government does incur the fixed cost, the public goods increase proportionally with the increase in lifetime resources, net of the fixed cost:

$$C = \gamma \frac{r}{1+r}(R + \mathrm{d}R - \xi), \qquad D = \frac{1-\gamma}{\iota}\frac{r}{1+r}(R + \mathrm{d}R - \xi).$$

Let $\widetilde{\mathrm{d}R}$ denote the change in lifetime resources for which the government is indifferent between incurring the fixed cost and not incurring the fixed cost. Then $\widetilde{\mathrm{d}R}$ satisfies

$$\begin{aligned}&\gamma \log\left(\gamma \frac{r}{1+r}R + \frac{r}{1+r}\widetilde{\mathrm{d}R}\right) + (1-\gamma)\log\left(\frac{1-\gamma}{\iota}\frac{r}{1+r}R\right) = \\ &\gamma \log\left(\gamma \frac{r}{1+r}(R + \widetilde{\mathrm{d}R} - \xi)\right) + (1-\gamma)\log\left(\frac{1-\gamma}{\iota}\frac{r}{1+r}(R + \widetilde{\mathrm{d}R} - \xi)\right),\end{aligned} \tag{A.4}$$

where clearly $\widetilde{\mathrm{d}R} > \xi$.

Proposition A.3. *Durable good provision increases only in response to large increases in lifetime resources:*

$$\mathrm{d}D = \begin{cases} \frac{1-\gamma}{\iota}\frac{r}{1+r}(\mathrm{d}R - \xi) & \text{if } \mathrm{d}R > \widetilde{\mathrm{d}R} \\ 0 & \text{if } \mathrm{d}R < \widetilde{\mathrm{d}R}, \end{cases}$$

where $\widetilde{\mathrm{d}R}$ *is defined by Equation* (A.4).

To summarize, when there are no fixed costs of adjusting the durable good, the response of the durable good to a revenue shock ($\mathrm{d}\psi_0$) is increasing in the persistence (ρ) of the shock. When there are fixed costs of adjustment, the durable good may not respond *at all* if the shock is sufficiently small or its persistence sufficiently low.

The model makes several simplifying assumptions for the purpose of tractability. The next three subsections discuss how the results might be altered by incorporating supply bottlenecks, liquidity constraints, or uncertainty into the model.

A.1.1 Supply Bottlenecks

First, the local government could face constraints in the supply of non-traded inputs to durables investment. The model assumes that the government can freely purchase any quantity of the investment goods at the fixed price p_t. This would be the case if the investment goods were purchased on world markets. In reality, inputs such as building materials may be non-traded, and their supply may be constrained by the current stock of public goods (van der Ploeg and Venables, 2013). As a consequence, the government may face an upward-sloping supply curve for investment goods. Suppose now that the price of investment is $p_t + \phi I_t/2$, so that the marginal cost of investment is increasing and linear in the level of investment. Then equation (A.1) is modified to become

$$\frac{(1-\gamma)C_t}{\gamma D_t} = \iota_t + \phi \cdot (D_t - (1-\delta)D_{t-1}) - \frac{1-\delta}{1+r}\phi \cdot (D_{t+1} - (1-\delta)D_t), \tag{A.5}$$

where ι_t is the user cost of durables in the absence of supply bottlenecks. The new user cost of durables, given by the right-hand side of (A.5), is increasing in current durables consumption due to supply bottlenecks, and decreasing in planned future durables consumption. The latter is due to the fact that the higher is future durables consumption, the more current consumption lowers the future investment cost by increasing the stock carried over to the next period.

Supply bottlenecks (i) increase the ratio of nondurables to durables consumption in every period, (ii) increase the steady-state ratio of nondurables to durables consumption (unless $\delta = 0$), and (iii) smooth the adjustment of durables consumption in response to revenue shocks. The stock of durables will not immediately jump to its new level when grant revenue changes. As a result, the total spending response to the permanent grant shock will be less front-loaded than in the baseline case. On the other hand, adding a fixed cost of making large adjustments may limit the degree to which the government can smooth the adjustment of durables.

A.1.2 Liquidity Constraints

Second, district governments may be liquidity constrained. Indeed, since decentralisation was enacted, lending to district governments has been minimal (World Bank, 2007, p. 128). Liquidity constraints would lead to lower government spending in all periods—both when the constraints bind and when they do not. This is because the prospect of liquidity constraints binding in the future lowers current consumption (Zeldes, 1989).

In theory, liquidity constraints could also influence how governments respond to revenue shocks. In a simple model of consumption, liquidity constraints raise the marginal propensity to consume (MPC) and cause the MPC to be higher for small income shocks than for large income shocks. Liquidity constraints also lead to a higher MPC for negative income shocks than for positive income shocks (Christelis *et al.*, 2020). This asymmetric response implies that district governments should react more strongly to the oil and gas grant than to the general grant, biasing the results *away* from the predictions of the model with lumpy investment.

In practice, district governments accumulated substantial reserves in the years immediately following decentralisation, suggesting that liquidity constraints were not a significant issue during most of the sample period. Reserves were especially high for the districts that benefited the most from the general grant and the oil and gas grant, and hence were most exposed to the grant shocks (World Bank, 2007, p. 127). Figure A.8 shows that reserves per capita were much higher in the hydrocarbon-rich provinces of Kalimantan Timur, Riau, and Kepulauan Riau than in other provinces. The provinces of Kalimantan Tengah and Kepulauan Bangka-Belitung also had significant reserves, having benefited from a generous allocation of the general grant. It therefore seems reasonable to assume that liquidity constraints were not binding for the districts that experienced the largest shocks to the two grants.

A.1.3 Uncertainty

Third, districts may face uncertainty about future grant revenue. This would create a demand for precautionary saving, lowering current consumption relative to expected future consumption (Leland, 1968).[5] Whether the precautionary-saving motive influences how the government responds to a grant-revenue shock depends on how the shock affects the overall risk faced by the government. In a model in which the government can tax private income at any rate, Vegh and Vuletin (2015) show that the government's spending response to a permanent positive shock to grant revenue is larger, the weaker is the correlation between grant revenue and private income. The reason is that the shock increases the grant share of total income, which is assumed to be less than one half, diversifying the government's

[5] That is, assuming the utility function has strictly positive third derivatives.

"portfolio."[6] The diversification effect is probably less relevant for Indonesia, where district governments have no control over income taxes and little control over property taxes. The central government sets and administers these taxes and rebates a portion back to the district. On average shared tax revenue accounts for only 11% of the district budget, and own-source revenue from business license fees, hotel and restaurant taxes, and utility fees accounts for 9% of the budget. By contrast, grant revenue accounts for at least 71% of the district budget on average (World Bank, 2007, p. 120). In the Indonesian context a permanent increase in uncertain grant revenue may very well increase the total risk of public revenue, reducing the marginal propensity to spend out of public resources.

A.2 Details on the General Grant

The formula for the general grant is

$$\text{General Grant} = \text{Basic Allocation} + \text{Expenditure Needs} - \text{Fiscal Capacity}.$$

Half of the general grant pool is devoted to the basic allocation. From 2001 to 2005, the basic allocation consisted of a small lump-sum portion and a portion that covered most of the civil service wage bill. Starting in 2006, the lump sum was eliminated and the basic allocation covered the entire civil service wage bill (World Bank, 2007, p. 193), meaning that the grant increases one-for-one with wage costs. Central regulations on recruitment and staffing prevent exorbitant spending on public employees that would otherwise occur due to the structure of the grant (Shah *et al.*, 2012). The remaining half of the general grant pool

[6] The authors do not consider transitory shocks, though they claim that their main results would not change if shocks were assumed to be temporary.

is allocated according to the fiscal gap, defined as the difference between expenditure needs and fiscal capacity.

Since 2002, fiscal capacity has been defined as the weighted sum of imputed own-source revenue, shared tax revenue, and shared natural resource revenue:

$$\begin{aligned}\text{Fiscal Capacity} = a \cdot (\text{Imputed Own-Source Revenue}) + b \cdot (\text{Shared Tax Revenue}) \\ + c \cdot (\text{Shared Natural Resource Revenue}).\end{aligned}$$

Imputed own-source revenue is calculated as the predicted values from a regression of actual own-source revenue on regional GDP (World Bank, 2007, p. 193). From 2002 to 2011, a has varied between 0.5 and 1, b has varied between 0.73 and 1, and c has varied between 0.5 and 1 (Shah *et al.*, 2012).

From 2002 to 2005 the expenditure-needs formula was

$$\overline{Exp}_t \cdot (0.4 \cdot PopI_{d,t} + 0.1 \cdot PovGapI_{d,t} + 0.1 \cdot AreaI_{d,t} + 0.4 \cdot CostI_{d,t}),$$

where $\overline{Exp}_t$ is average expenditure of all district governments in year t, $PopI_{d,t}$ is the population index equal to the population of district d divided by average district population in year t, and the poverty gap, land area, and construction cost indices are defined analogously.

Starting in 2006, the expenditure-needs formula was

$$\overline{Exp}_t \cdot (0.3 \cdot PopI_{d,t} + 0.1 \cdot 1/HDI_{d,t} + 0.15 \cdot GDPI_{d,t} + 0.15 \cdot AreaI_{d,t} + 0.3 \cdot CostI_{d,t}),$$

where $HDI_{d,t}$ is the human development index and $GDPI_{d,t}$ is the GDP per capita index. The expenditure-needs formula changed in three ways. First, $\overline{Exp}_t$ increased as a result of the budget expansion. Second, the poverty gap index was replaced by the (inverse of) the human development index and the GDP per capita index.[7] This change had little effect on equalisation (World Bank, 2007). Third, the weights of the population, area, and cost indices changed. In particular, greater weight was giving to less densely populated districts. Rural districts tend to be poorer than urban districts in Indonesia. As a result, in 2006 the general grant increased for most districts, and the increase was much larger for poor, rural districts (World Bank, 2007). Furthermore, the policy change was persistent, as the expenditure-needs formula changed very little from 2006 to 2011 (Shah *et al.*, 2012).[8]

Holding fixed the Basic Allocation and Fiscal Capacity, the change in the per capita general grant allocation to district d from 2005 to 2006 is given by

$$\begin{aligned}
\frac{GenGrant_{d,06}}{Pop_{d,06}} - \frac{GenGrant_{d,05}}{Pop_{d,05}} = & \left(0.3 \cdot \frac{\overline{Exp}_{06}}{\overline{Pop}_{06}} - 0.4 \cdot \frac{\overline{Exp}_{05}}{\overline{Pop}_{05}}\right) \\
& + \left(0.15 \cdot \frac{\overline{Exp}_{06}}{\overline{Area}} \cdot \frac{Area_d}{Pop_{d,06}} - 0.1 \cdot \frac{\overline{Exp}_{05}}{\overline{Area}} \cdot \frac{Area_d}{Pop_{d,05}}\right) \\
& + \left(0.3 \cdot \frac{\overline{Exp}_{06}}{Pop_{d,06}} \cdot \frac{Cost_{d,06}}{\overline{Cost}_{06}} - 0.4 \cdot \frac{\overline{Exp}_{05}}{Pop_{d,05}} \cdot \frac{Cost_{d,05}}{\overline{Cost}_{05}}\right) \\
& + \left(0.1 \cdot \frac{\overline{Exp}_{06}}{Pop_{d,06}} \cdot \frac{1}{HDI_{d,06}} + 0.15 \cdot \frac{\overline{Exp}_{06}}{Pop_{d,06}} \cdot \frac{GDP_{d,06}}{\overline{GDP}_{06}}\right. \\
& \qquad \left. -0.1 \cdot \frac{\overline{Exp}_{05}}{Pop_{d,05}} \cdot \frac{PovGap_{d,05}}{\overline{PovGap}_{05}}\right).
\end{aligned}$$

A useful approximation to the above expression obtains under the assumption of zero district population growth, zero change in the relative cost of construction across districts, and zero

[7]The latter index is district GDP per capita divided by average district GDP per capita.

[8]In 2010 and 2011 the weight on the area index changed to 0.1325 and 0.135, respectively, and the weights on the inverse human development index and the GDP index increased slightly.

change in the relative poverty gap across districts.[9] Under these assumptions, the change in per capita general grant allocation can be expressed in terms of the total general grant budgets in 2005 and 2006 and district characteristics measured in 2006:

$$\begin{aligned}\frac{GenGrant_{d,06}}{Pop_{d,06}} - \frac{GenGrant_{d,05}}{Pop_{d,05}} \approx\ & \frac{(0.3 \cdot \overline{Exp}_{06} - 0.4 \cdot \overline{Exp}_{05})}{\overline{Pop}_{06}} \\ & + \frac{(0.15 \cdot \overline{Exp}_{06} - 0.1 \cdot \overline{Exp}_{05})}{\overline{Area}} \cdot \frac{Area_d}{Pop_{d,06}} \\ & + \frac{(0.3 \cdot \overline{Exp}_{06} - 0.4 \cdot \overline{Exp}_{05})}{Pop_{d,06}} \cdot \frac{Cost_{d,06}}{\overline{Cost}_{06}} \\ & + \Bigg(0.1 \cdot \frac{\overline{Exp}_{06}}{Pop_{d,06}} \cdot \frac{1}{HDI_{d,06}} + 0.15 \cdot \frac{\overline{Exp}_{06}}{Pop_{d,06}} \cdot \frac{GDP_{d,06}}{\overline{GDP}_{06}} \\ & \quad -0.1 \cdot \frac{\overline{Exp}_{05}}{Pop_{d,06}} \cdot \frac{PovGap_{d,06}}{\overline{PovGap}_{06}}\Bigg).\end{aligned}$$

The second term on the right-hand side accounts for a large fraction of the cross-district variation in the general grant allocation change. The quantity $(0.15 \cdot \overline{Exp}_{06} - 0.1 \cdot \overline{Exp}_{05})$ is large and positive due to the overall general grant budget increase and the increase in the weight assigned to land area. This term is scaled by relative area per capita, $Area_d/(\overline{Area} \cdot Pop_{d,06})$. The change in general grant revenue received by district d from 2005 to 2006 can be approximated as

$$\frac{GenGrant_{d,06}}{Pop_{d,06}} - \frac{GenGrant_{d,05}}{Pop_{d,05}} \approx \theta + \pi \frac{Area_d}{Pop_{d,06}} + Remainder_d.$$

The above expression yields the approximate change in general grant revenue per capita for districts for which the reform to the expenditure-needs formula was binding. The formula

[9]District annual population growth averaged 1.3% over the sample period, and median annual population growth was 1.4%.

dictated that districts rich in natural resources, which had substantial "fiscal capacity" according to the formula, should have experienced a decline in general grant revenue over this period. Instead, a hold-harmless provision froze the general grant amount for such districts over this period.

A.3 Details on the Oil and Gas Grant

For the purpose of natural resource revenue sharing, district territory includes sea territory that extends up to four nautical miles from the coastal shoreline (Law No. 22/1999). Government revenue collected from oil production within a district is divided as follows: 84.5% goes to the central government, 3.1% goes to the provincial government, 6.2 percent goes to the producing district, and the remaining 6.2% is divided equally among the non-producing districts located in the same province as the producing districts. Government revenue collected from gas production within a district is divided as follows: 69.5% goes to the central government, 6.1% goes to the provincial government, 12.2% goes to the producing district, and the remaining 12.2% is divided equally among the non-producing districts located in the same province as the producing districts.

Formally, let $H^O_{d,t}$ and $H^G_{d,t}$ denote oil revenue and gas revenue (royalties and taxes), respectively, collected by the central government in district d in year t, and let $p(d)$ denote the province where district d is located. The oil and gas grant per capita is

$$H_{d,t} = \frac{1}{Pop_{d,t}} \left(0.062 \cdot H^O_{d,t} + 0.122 \cdot H^G_{d,t} + \frac{1}{N_{p(d),t} - 1} \sum_{\substack{j \neq d \\ p(j)=p(d)}} \left(0.062 \cdot H^O_{j,t} + 0.122 \cdot H^G_{j,t} \right) \right),$$

where $Pop_{d,t}$ is the population of district d in year t, and $N_{p(d),t}$ is the number of districts in province $p(d)$ in year t. Using the Rystad UCube database (Rystad Energy, 2016), I calculate for each district the total economically recoverable oil and gas resources as of 2000 (and known in 2000)—prior to fiscal decentralisation. I then convert physical endowments into monetary values using the average prices of oil and gas over 2001–2014, and I denote these measures by $E^O_{d,t}$ and $E^G_{d,t}$.[10] Each variable is measured in constant 2010 IDR (billions). The only reason these endowment measures could vary over time is because district and province borders sometimes change.[11] Using the sharing rule, I define the variable

$$E_{d,t} = \frac{1}{Pop_{d,t}} \left(0.062 \cdot E^O_{d,t} + 0.122 \cdot E^G_{d,t} + \frac{1}{N_{p(d),t} - 1} \sum_{\substack{j \neq d \\ p(j)=p(d)}} \left(0.062 \cdot E^O_{j,t} + 0.122 \cdot E^G_{j,t} \right) \right), \tag{A.6}$$

which represents the oil and gas endowment per capita to which district d has a claim for revenue-sharing purposes in year t. Finally, I define the average hydrocarbon endowment per capita over 2001–2014,

$$E_d = \frac{1}{14} \sum_{t=2001}^{2014} E_{d,t}. \tag{A.7}$$

[10]I use the Brent oil price, provided by Rystad, and the Indonesian liquefied natural gas (LNG) price, provided by IndexMundi, which sources from World Gas Intelligence and the World Bank. See https://www.indexmundi.com/commodities/?commodity=indonesian-liquified-natural-gas&months=360.

[11]Fitrani *et al.* (2005) find no consistent relationship between natural resources and the likelihood of a district split from 1998 to 2004.

A.4 Data Appendix

Instrumental Variables

The data used for constructing the instrumental variables come from two sources. The World Bank's Indonesia Database for Policy and Economic Research (INDO-DAPOER) provides district land area and population by year.[12] Data on oil and gas reserves come from the proprietary UCube database maintained by Rystad Energy (2016), an international oil and gas consulting company.[13] I define oil and gas endowments as the value of reserves that were known to exist as of the year 2000. I assign hydrocarbon assets to districts using the geographic coordinates of the assets in combination with a shapefile of district borders provided by the Indonesian Statistical Bureau. For the purpose of natural resource revenue sharing, district territory includes sea territory that extends up to four nautical miles from the coastal shoreline (Law No. 22/1999). However, assigning hydrocarbon assets to districts according to this rule leads to severe underestimation of endowments—judging from the discrepancy between predicted and actual oil and gas grant revenue—in a few archipelagic districts. The error is likely due to the shapefile's omission of many small islands which extend the claims of these districts to hydrocarbon resources. For example, Kabupaten Natuna has 272 islands, but only a few dozen are present in the shapefile. To compensate, I instead assign offshore hydrocarbon assets to the nearest district provided that the assets are located within 80 nautical miles of the shoreline.

[12]INDO-DAPOER is hosted at http://databank.worldbank.org/data/reports.aspx?source=1266.
[13]For details, see https://www.rystadenergy.com/services/upstream-solution.

Revenue and Expenditure

Data on intergovernmental grants come from the Ministry of Finance (*Kementerian Keuangan*).[14] Each year district mayors report on the district's finances to the Ministry of Finance. Data on other revenue sources, as well as expenditure disaggregated by economic classification and function, come from the Ministry of Finance and INDO-DAPOER. INDO-DAPOER provides data on revenue and expenditure broken down by economic classification up to either 2012 or 2013, depending on the variable. I add data from 2013–2014 using budget reports from the Ministry of Finance. I also replace missing or obviously incorrect values in INDO-DAPOER using the Ministry of Finance data. Expenditure by function is available from INDO-DAPOER through 2012. Some data on expenditure by function in 2013 and 2014 are available from INDO-DAPOER for a limited set of districts, however I omit these years to avoid bias due to selective attrition.

Realised expenditure is missing in at least one year over 2002–2005 for a small number of districts. To minimise imbalance in the panel, I replace missing realised expenditure with budgeted expenditure for districts where budgeted and realised expenditure never differed by more than 15% over the period 2001–2004.

The final fiscal dataset includes grant revenue, other sources of revenue, and expenditure by economic classification for the years 2001–2014; and expenditure by function for the years 2001–2012. All fiscal variables are expressed in constant 2010 IDR 1 million (approximately USD 100) per capita.

[14] The Ministry of Finance data are hosted at http://www.djpk.kemenkeu.go.id/.

Public Goods and Services

Data on public service delivery come from the Village Potential Statistics (*Pendataan Potensi Desa*, or PODES) survey waves of 2000, 2003, 2005, 2008, 2011, and 2014.[15] Each survey is filled out by the village head and includes information on public goods and services related to education, health, and infrastructure, among other information. PODES 2000 was enumerated in September–October of 1999, and PODES 2003 was enumerated in August of 2002. Subsequent surveys were enumerated in April or May of the year in the title. I define the year of each observation as the enumeration year, resulting in triennial data over 1999–2014. The surveys are intended to cover every village in Indonesia. Due to a massive tsunami in 2004, PODES 2005 is missing all districts on Nias Island.[16] A special survey was conducted on Nias in 2005, but it lacks data on the number health personnel and health care centres. Villages on Nias Island are therefore excluded.

I merge villages across the survey waves of 2000 through 2014 using village identifiers, village names, and two official crosswalks provided by the Central Bureau of Statistics (*Badan Pusat Statistik*) spanning 1998–2013 and 2010–2015. In many cases the crosswalk information is incomplete or does not perfectly align with the information in PODES. To minimise the chances of an incorrect merge, I first perform a fuzzy merge on the village identifier and the village name, imposing an exact match in the identifier and a very close match in the village name.[17] Unmerged villages are then merged via exact matches of unique village names within each subdistrict. Any remaining unmerged villages are then merged via exact matches of unique village names within each district. To maximise the success rate of this

[15]PODES data can be purchased from the Central Bureau of Statistics at https://silastik.bps.go.id/.
[16]These districts are Nias, Nias Utara, Nias Barat, Nias Selatan, and Gunung Sitoli.
[17]This is performed in Stata using the `reclink2` command (Wasi and Flaaen, 2015). I impose a minimum matching score of 0.97.

procedure, I heavily rely on manual inspection to correct cases of subdistrict identifier recodings that are missed by the crosswalks as well as subtle variation in the spelling of village names. The merge rate, defined as the percentage of villages in the 2014 wave that were successfully merged across all six waves, is very high in most districts, averaging 95.1% with a median of 99.6%. Only 3% of districts in the sample have a merge rate of less than 50%.

To test for changes in the gradient in average hydrocarbon endowment per capita prior to decentralisation, I add the 1993 and 1996 waves of PODES. These waves were enumerated in 1993 and 1996 (no month given). No crosswalk exists for years prior to 1998. I therefore perform the same merge procedure describe above, except that I match 1993 identifiers to 1996 identifiers, and 1996 identifiers to 1998 identifiers. (I continue to also impose a fuzzy merge on village name.) Some identifier recodings, splits, and amalgamations lead to a lower merge rate than for the other waves, yet the merge rate is still high. Around 98% of villages in PODES 2000 were successfully merged to PODES 1996, while 96% of villages in PODES 1996 were successfully merged to PODES 1993.

Around 12% of villages that existed in 1999 split into multiple villages by 2014. To maintain a consistent unit of observation, I aggregate village outcomes up to 1999 borders. Out of the 67,704 villages that existed in 1999, 64,702 (or 96%) were successfully merged across all PODES waves from 2000 to 2014. Of these villages, 48,537 are located in districts included in the analysis sample. For the analysis that examines trends prior to decentralisation, I aggregate village outcomes up to 1993 borders.

I exclude villages that were involved in an amalgamation during the sample period (around 2% of villages). I further exclude villages with data that appear to be unreliable. First, I drop villages with reported annual population growth of more than 25% or less than

−25% in any time period. Second, I drop villages with reported annual population growth of more than 10% followed by a population decline of more than 10% in the next period, or vice versa. Finally, I drop villages with implausibly large changes in public goods from one survey year to the next. The data cleaning procedure reduces the sample of villages by 10%. The final dataset is a balanced panel of around 44,000 villages located in the districts included in the analysis sample (defined below).

I construct the following measures of public goods at the village level:

- **Public Kindergartens**: Number of public kindergartens in the village.
- **Public Primary Schools**: Number of public primary schools in the village.
- **Public Secondary Schools**: Number of public secondary schools in the village. It aggregates junior and senior secondary schools in the village.
- **Doctors**: Number of doctors in the village. This variable is missing in 1999.
- **Midwives**: Number of midwives in the village. This variable is missing in 1999.
- **Health Care Centres**: Number of primary health care centres in the village. It aggregates public health centres (*puskesmas*), supporting public health centres (*puskesmas pembantu*), and polyclinics (*poliklinik*). These facilities have trained doctors and nurses that provide basic medical care. This variable is missing in 2008.[18]
- **Paved Road**: Indicator variable equal to one if the main village road is made of asphalt, as opposed to gravel, dirt, or other materials.

[18] Polyclinics are relatively rare compared to public health centres and supporting public health centres. The results are very similar when polyclinics are excluded from the health care centres variable.

I then aggregate these measures to the district level. Villages are assigned to districts based on 2014 district borders, so the composition of villages within a district does not change when a district splits into multiple districts. I express the first six measures as the number of public goods per 10,000 people by summing across all villages in the district, dividing by the aggregate population of these villages, and multiplying by 10,000.[19] I use *Paved Road* to calculate the share of villages in the district with a paved road.

Lastly, I construct an overall index of public service delivery. I standardise each outcome variable using its mean and standard deviation in the full sample in 2002. Then I take the average of the standardised outcome variables for each district-year observation.

District Elections

Data on the direct elections of district mayors (*Pemilihan kepala daerah*, or *Pilkada*) in years 2005–2008 were generously provided by Martínez-Bravo *et al.* (2017). I constructed the data for 2010–2013 and 2015 from various sources. The General Elections Commission (*Komisi Pemilihan Umum*, or KPU) shared data for 2010–2013 via email. These data were missing information on roughly half of the elections in 2013. With the help of a research assistant, I filled in the remaining information using district government websites, Indonesian Wikipedia, and local news articles. The 2015 data come from a KPU website.[20] No mayoral elections were held in 2009 or 2014.

The election variables are:

[19] I impute 2014 village population, which is missing in the PODES, based on village population in 2011 and an assumed annual growth rate equal to the median annual growth rate from 1999 to 2011 for villages in the sample.
[20] http://infopilkada.kpu.go.id/sitap-2015/.

- **Number of Candidates**: Number of candidates running in the first round of the election.

- **Herfindahl Index**: $\sum_i s_i^2$, where s_i is the vote share obtained by candidate i in the first round.

- **Number of Parties in Winning Coalition**: Number of parties in the coalition of the winning candidate.

- **Incumbent Reelected**: Indicator variable equal to one if the incumbent won the election. This variable is missing for elections in which the incumbent could not run due to the term limit.

- **Margin of Victory**: Difference in the vote shares of the first-place and second-place candidates in the first found, in percentage points.

Corruption and Governance Quality

I measure corruption in 2000 using establishment-level data from the Indonesian manufacturing survey of large- and medium-sized firms (*Survei Industri Besar/Sedang*, or IBS).[21] This dataset contains the universe of manufacturing establishments with at least 20 workers. The outcome variable is the value of "gifts, charitable contributions, donations, etc." paid by the establishment to external parties (i.e., not to employees). The dataset reports the current district where the establishment is located—not the subdistrict or village—so establishments are identified at the level of 2000 district borders.

[21] IBS data can be purchased from the Central Bureau of Statistics at https://silastik.bps.go.id/.

The second set of corruption variables come from the Economic Governance Survey conducted by KPPOD (Regional Autonomy Watch) and the Asia Foundation. The survey consists of two waves, enumerated in 2007 and 2010, which contain essentially non-overlapping sets of districts. Together, the two waves cover almost every district in Indonesia. The United States Agency for International Development funded the 2007 wave, and the Australian Agency for International Development funded the 2010 wave. The survey is designed to measure the effects of local governance on the business environment. There are 14 survey questions related to corruption, grouped into three categories: perceptions of local government corruption, informal costs, and payments in exchange for security. I also generate z-scores summarising the responses in each category.

Baseline District Characteristics

Data on baseline district characteristics come from the Integrated Public Use Microdata Series (IPUMS) International (Minnesota Population Center, 2020). The data consist of a 10-percent random sample of the 2000 Indonesian Census. All calculations make use of population weights.

The baseline variables are:

- **Ethnic Fractionalisation**: $1 - \sum_j s_j^2$, where s_j is the share of the population that belongs to ethnic group j. It is the probability that two individuals randomly drawn from the population belong to different ethnic groups.
- **Urbanisation Rate**: Share of the population living in an urban area.
- **Share of Population Aged 15–64**: Self-explanatory.

- **Share of Population with a Primary Education**: Share of the population that has completed primary school.

- **Share of Population with a Secondary Education**: Share of the population that has completed secondary school.

Sample Selection

To ensure that all districts in the sample operate within the same institutional environment, I omit provinces that have a special administrative or fiscal arrangement with the central government. These provinces are DI Yogyakarta, which has special autonomy status; DKI Jakarta, whose districts are managed by the province; Nanggroe Aceh Darussalam, which has special autonomy status and receives special autonomy funds; and Papua and Papua Barat, which both receive special autonomy funds.

I drop the handful of districts that are missing expenditure data in 2005, as this year is important for measuring baseline outcomes prior to the general grant reform. The five districts on Nias Island are excluded as they are missing data on public services in 2005, as already mentioned. The final sample contains 348 districts with non-missing data on revenue, expenditure, and public service delivery.

A.5 Magnitude of Grant Shocks

Figure A.2 displays histograms of the absolute two-year change in revenue for each of the two grants. I use two-year changes instead of one-year changes to account for the small amount of persistence in the oil and gas grant shocks. The general grant shock is measured over the period 2005–2007, while the oil and gas grant shock is measured over all two-year periods, starting with 2001–2003. Panel (a) shows the results for the entire sample of districts. Both shocks are skewed to the right, and the skew is greater for the oil and gas grant. The mean of the general grant shock (0.49) greatly exceeds the mean of the oil and gas grant shock (0.07), which is unsurprising as only a small fraction of districts receive significant amounts of oil and gas revenue.

The empirical results will, to a great degree, reflect the responses of a subsample of districts that are highly exposed to the grant shocks. I therefore consider the distribution of grant shocks for these districts. Panel (b) displays the general grant shock histogram for districts exceeding the 75th percentile of land area per capita in 2006 and not located in hydrocarbon-rich provinces, as well as the oil and gas grant shock histogram for districts exceeding the 95th percentile in average hydrocarbon endowment per capita. For these two subsamples, the mean of the general grant shock (1.10) is close to the mean of the oil and gas grant shock (1.00). (Note, however, that the rightward skew is still greater for the oil and gas revenue shock.) Thus, the per-period value of shocks to the general grant and oil and gas revenue are reasonably similar for districts with significant exposure to the shocks.

A.6 Time-Series Properties of the Grants

Institutional details and graphical evidence indicate that over-time variation in the general grant is dominated by a single permanent shock, while over-time variation in the oil and gas grant is dominated by transitory shocks. This subsection compares the time-series properties of the two grants in a more rigorous fashion by employing two quantitative measures: volatility and persistence.

First, I measure the volatility of each grant using the within-district coefficient of variation, defined as the within-district sample standard deviation divided by the overall sample mean.[22] The working hypothesis is that the oil and gas grant is more volatile than the general grant. The within-district coefficient of variation of the oil and gas grant (1.54) is nearly five times that of the general grant (0.32), confirming that the oil and gas grant is more "volatile" than the general grant. However, this measure does not capture the persistence of shocks.[23]

Next, I estimate the persistence of each grant over time using autoregressions. In principle one could apply time-series estimators to aggregate values of the two grants. However, because the dataset contains few time periods (14 years) and many districts, a dynamic panel model is more appropriate. I specify the model

$$Grant_{d,t} = \sum_{j=1}^{J} \alpha_j \, Grant_{d,t-j} + \eta_d + \psi_{r(d),t} + \nu_{d,t} \tag{A.8}$$

separately for each grant variable, where η_d is a district fixed effect and $\psi_{r(d),t}$ is an region-by-year effect. The sum of the autoregressive coefficients, $\sum_{j=1}^{J} \alpha_j$, captures the persistence of the process.

Table A.3 presents estimates of the coefficients in equation (A.8) for $J = 1$ and $J = 3$. Panel A presents the results for the general grant, and Panel B presents the results for

[22]Formally, define the within-district sample variance as $\tilde{S}_x = \sum_d \sum_t (x_{dt} - \overline{x}_{d\cdot})^2/(N - D)$, where $\overline{x}_{d\cdot} = \sum_t x_{dt}/T_d$, T_d is the number of time periods observed for district d, $N = \sum_d T_d$ is the total number of observations, and D is the number of districts. Define the overall sample mean as $\overline{\overline{x}} = \sum_d \sum_t x_{dt}/N$. Then the within-district coefficient of variation is $\sqrt{\tilde{S}_x}/\overline{\overline{x}}$.

[23]To see this, consider an example with two grants and four time periods. For any constant μ, the first grant equals $\mu - 1$ in the first two periods and $\mu + 1$ in the last two periods for all districts. The second grant alternates between $\mu - 1$ and $\mu + 1$ in each period for all districts. The within-unit coefficient of variation is the same for both grants, whereas the first grant exhibits greater persistence.

the oil and gas grant. For both grants we reject the presence of a unit root.[24] Columns 1 and 2 report "OLS levels" estimates that control for region-by-year effects but do not control for district fixed effects. OLS estimates of persistence are biased upwards due to the positive correlation between η_d and lags of *Grant* (Bond, 2002). Therefore, one may view the estimates as an upper bound on the true persistence (asymptotically). The estimated persistence of the general grant ranges from 1.00 to 1.01, while estimated persistence of the oil and gas grant ranges from 0.90 to 0.94. The general grant therefore appears to be more persistent than the oil and gas revenue, however these estimates are likely to be biased.

Columns 3 and 4 report the "within-groups" estimates—commonly called "fixed-effects" estimates—which control for region-by-year effects and district fixed effects. Within-groups estimates of persistence are biased downwards due to the negative correlation between, e.g., the transformed $Grant_{d,t-1}$ and the transformed $\nu_{d,t}$ (Bond, 2002). This asymptotic bias is of order $1/T$, where T is the number of time periods, so the bias declines as the number of time periods grows (Nickell, 1981). Still, the bias is likely to be non-negligible with $T = 14$. Furthermore, the bias is larger the more persistent is the series. Therefore, one may view the within-groups estimates as a lower bound on the true persistence (asymptotically), where the bound is relatively tighter for the oil and gas grant compared to the general grant. The estimated persistence of the general grant ranges from 0.51 to 0.62, and these estimates are quite precise. The persistence of the oil and gas grant is lower, ranging from 0.06 to 0.33, where the former estimate is statistically indistinguishable from zero. The general grant appears to be much more persistent than the oil and gas grant, according to the within-groups estimates, which are likely to be biased downwards for both grants.

[24]This result is based on the unit-root test by Harris and Tzavalis (1999), which assumes persistence is the same across panels and is valid for a fixed number of time periods. We are also able to reject the presence of a unit root in expenditure. (Results available upon request.)

Columns 5 and 6 present system GMM estimates, which do not suffer from Nickell bias and are consistent as the number of districts grows and the number of time periods is fixed.[25] According to these estimates, the persistence of the general grant ranges from 0.96 to 0.97. The estimated persistence of the oil and gas grant ranges from 0.20 to 0.83, though these estimates are imprecise. Overall, the three estimators point to the same conclusion: the general grant is more persistent than the oil and gas grant.[26]

[25]System GMM was developed by Holtz-Eakin *et al.* (1988), Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). I follow the recommendations of Roodman (2009) and Bazzi and Clemens (2013) and "collapse" the instrument matrix to avoid the problem of many weak instruments.

[26]One may also estimate an AR(1) model, $Y_t = \alpha + \beta Y_{t-1} + U_t$, where Y_t is average revenue per capita in year t. The difference in persistence of the two grants is large in this model as well, with or without bias corrections for the small number of time periods. (These results are available upon request.)

A.7 Tables

Table A.1: Summary Statistics

	(1) Mean	(2) Std. Dev.	(3) Min.	(4) Max.	(5) Obs.
Panel A: Fiscal Variables (Annual)					
General Grant Revenue per Capita	1.16	0.87	0.00	7.95	4,726
Oil & Gas Grant per Capita	0.15	0.66	0.00	10.17	4,726
Area p.c. 2006 $\times$ Non-Oil/Gas $\times$ Year $\geq$ 2006	0.08	0.22	0.00	2.72	4,727
Avg. Endowment p.c. $\times$ Agg. Oil & Gas Grant Excl. Own	0.31	1.30	0.00	19.14	4,727
Total Revenue per Capita	2.02	1.84	0.35	23.71	4,677
Special Grant Revenue per Capita	0.12	0.15	0.00	0.99	4,687
Own-Source Revenue per Capita	0.14	0.15	0.00	1.12	4,685
Shared Tax Revenue per Capita	0.14	0.17	0.00	1.18	4,532
Total Expenditure per Capita	2.00	1.82	0.28	22.52	4,673
Personnel Expenditure per Capita	0.89	0.56	0.03	6.69	4,497
Capital Expenditure per Capita	0.54	0.78	0.00	11.49	4,659
Goods & Services Expenditure per Capita	0.38	0.43	0.00	7.45	4,445
Other Expenditure per Capita	0.15	0.23	0.00	5.46	4,409
Education Expenditure per Capita	0.52	0.32	0.00	3.10	3,737
Administration Expenditure per Capita	0.58	0.70	0.01	11.18	3,736
Infrastructure Expenditure per Capita	0.32	0.57	0.00	10.76	3,733
Health Expenditure per Capita	0.16	0.14	0.00	1.80	3,737
Agriculture Expenditure per Capita	0.08	0.10	0.00	1.12	3,720
Land Area in 2006 (Thousands of km^2)	3.77	5.69	0.02	41.99	4,737
Population (Millions)	0.59	0.61	0.03	5.33	4,737
Panel B: Public Goods and Services (Triennial)					
Public Kindergartens per 10,000 People	0.30	0.49	0.00	9.95	1,740
Public Primary Schools per 10,000 People	7.32	3.12	1.60	23.75	1,740
Public Secondary Schools per 10,000 People	1.59	1.16	0.15	10.37	1,740
Doctors per 10,000 People	1.94	1.48	0.00	10.24	1,735
Midwives per 10,000 People	6.06	3.49	0.57	30.76	1,735
Health Care Centres per 10,000 People	2.59	1.71	0.61	17.34	1,392
Share of Villages with Paved Road	0.73	0.25	0.00	1.00	1,740

Notes: All fiscal variables are measured in constant 2010 IDR 1 million ($\approx$ USD 100) per capita. Data on health care centres are unavailable in 2008.

Table A.2: Time Series Regressions of Total Oil and Gas Grants on Total Oil and Gas Production

	Total Oil and Gas Grants (IDR Billions)					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Production Value Weighted According to Sharing Rule (IDR Billions)					
Weighted Oil & Gas Production Value	0.041	−0.013	0.110	0.080	0.029	−0.023
	(0.151)	(0.117)	(0.139)	(0.147)	(0.102)	(0.124)
Lag 1		−0.146	−0.010	−0.081	−0.220	−0.303
		(0.175)	(0.155)	(0.202)	(0.174)	(0.196)
Lag 2			0.220*	0.143	−0.081	−0.201
			(0.106)	(0.151)	(0.224)	(0.282)
Lag 3				−0.096	−0.381	−0.595
				(0.104)	(0.305)	(0.431)
Lag 4					−0.319	−0.556
					(0.285)	(0.444)
Lag 5						−0.259
						(0.314)
Observations	13	13	13	13	13	13
	Panel B: Unweighted Production Value (IDR Trillions)					
Total Oil & Gas Production Value	0.004	0.001	0.014	0.011	0.003	−0.005
	(0.013)	(0.010)	(0.013)	(0.015)	(0.005)	(0.012)
Lag 1		−0.009	0.004	−0.001	−0.017	−0.029
		(0.018)	(0.019)	(0.026)	(0.017)	(0.017)
Lag 2			0.022	0.016	−0.006	−0.021
			(0.012)	(0.019)	(0.016)	(0.022)
Lag 3				−0.007	−0.032	−0.054
				(0.012)	(0.022)	(0.033)
Lag 4					−0.028	−0.049
					(0.023)	(0.036)
Lag 5						−0.023
						(0.027)
Observations	13	13	13	13	13	13

Notes: This table reports estimates from the time-series regression $\Delta H_t = \alpha + \sum_{j=0}^{J} \beta_j \Delta P_{t-j} + \Delta u_{t-j}$, where H_t is total oil and gas grants, and P_t is either weighted oil and gas production value (Panel A) or unweighted oil and gas production value (Panel B). Weighted production uses the weights from the revenue-sharing rule: 0.062 for oil and 0.122 for gas. Standard errors, reported in parentheses, are robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Persistence of Grant Revenue over Time

	OLS Levels		Within Groups		System GMM	
Panel A: General Grant p.c.						
	(1)	(2)	(3)	(4)	(5)	(6)
Lag 1	1.00***	0.89***	0.62***	0.52***	0.97***	0.48
	(0.01)	(0.08)	(0.04)	(0.08)	(0.07)	(0.95)
Lag 2		0.14		0.03		0.56
		(0.10)		(0.08)		(0.95)
Lag 3		−0.01		−0.04		−0.08
		(0.11)		(0.08)		(0.15)
Persistence	1.00***	1.01***	0.62***	0.51***	0.97***	0.96***
	(0.01)	(0.01)	(0.04)	(0.07)	(0.07)	(0.09)
Observations	4,378	3,682	4,378	3,682	4,378	3,682
District clusters	348	348	348	348	348	348
Prov. × year clusters	384	384	358	306	358	306
AR(2) test p-value					0.915	0.566
H_0: unit root p-value	0.000					
Within coef. of var.	0.320					
Panel B: Oil & Gas Grant p.c.						
	OLS Levels		Within Groups		System GMM	
	(1)	(2)	(3)	(4)	(5)	(6)
Lag 1	0.90***	0.66***	0.33***	0.30***	0.20	0.71
	(0.04)	(0.05)	(0.09)	(0.08)	(0.48)	(1.07)
Lag 2		0.08		−0.12		−0.01
		(0.06)		(0.09)		(0.60)
Lag 3		0.20*		−0.13		0.13
		(0.12)		(0.14)		(1.08)
Persistence	0.90***	0.94***	0.33***	0.06	0.20	0.83
	(0.04)	(0.06)	(0.09)	(0.25)	(0.48)	(2.66)
Observations	4,378	3,682	4,378	3,682	4,378	3,682
District clusters	348	348	348	348	348	348
Prov. × year clusters	384	384	358	306	358	306
AR(2) test p-value					0.765	0.483
H_0: unit root p-value	0.000					
Within coef. of var.	1.547					

Notes: This table shows results from regressing each grant variable on its lags. Panel A presents results for the general grant, and Panel B presents results for oil and gas grant. Each regression includes a full set of region-by-year dummies. Columns 1 and 2 present pooled OLS estimates which do not account for district fixed effects. Columns 3 and 4 present "within-groups" (or "fixed-effects") estimates which account for district fixed effects. Columns 5 and 6 present system GMM estimates which account for district fixed effects and dynamic panel bias. "Persistence" is defined as the sum of the lag coefficients. The AR(2) test p-value corresponds to the null hypothesis of zero serial correlation in the error term. Each panel reports the result of the Harris and Tzavalis (1999) unit-root test, as well as the "within" coefficient of variation, defined as the within-district sample standard deviation divided by the sample mean. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province × year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.4: Dynamic Responses of Total Expenditure to Grants: No Controls

	Response of Total Expenditure per Capita after h Years					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	0.76***	1.09***	1.57***	1.73***	0.85***	0.89***
	(0.09)	(0.17)	(0.33)	(0.22)	(0.16)	(0.16)
Oil & Gas Grant p.c.	0.23***	0.31***	0.55***	0.50***	0.15**	0.27
	(0.07)	(0.09)	(0.15)	(0.07)	(0.07)	(0.19)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.000	0.001	0.000	0.000	0.000
Adjusted p-value	*0.000*	*0.000*	*0.001*	*0.000*	*0.000*	*0.000*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.996	0.298	0.043	0.000	0.818	0.760
Adjusted p-value	*1.000*	*1.000*	*0.216*	*0.003*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	73.8	77.8	78.8	85.0	76.2	87.4
SW F-stat.: Oil & Gas	105.5	94.5	104.4	107.1	129.5	155.9
Observations	4,290	3,957	3,612	3,272	2,924	2,579
District clusters	348	348	348	348	348	348
Prov. × year clusters	358	330	302	274	246	218
	Panel B: Two-Year Changes in Grants ($k = 2$)					
General Grant p.c.	0.86***	1.19***	1.53***	1.11***	0.76***	0.82***
	(0.12)	(0.22)	(0.22)	(0.20)	(0.10)	(0.14)
Oil & Gas Grant p.c.	0.11	0.29***	0.34***	0.13*	0.08	0.29
	(0.08)	(0.11)	(0.05)	(0.08)	(0.16)	(0.21)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.000	0.000	0.000	0.000	0.005
Adjusted p-value	*0.000*	*0.001*	*0.000*	*0.000*	*0.000*	*0.005*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.883	0.204	0.007	0.299	0.991	0.894
Adjusted p-value	*1.000*	*1.000*	*0.042*	*1.000*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	44.4	46.1	44.7	44.8	45.4	45.2
SW F-stat.: Oil & Gas	373.2	300.0	287.1	337.9	313.2	326.5
Observations	3,957	3,612	3,272	2,924	2,579	2,237
District clusters	348	348	348	348	348	348
Prov. × year clusters	332	304	276	248	220	192

Notes: This table reports IV estimates of β_h and δ_h in Equation (1). Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls only for region-by-year effects. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: Dynamic Responses of Total Expenditure to Grants: OLS Estimates

	Response of Total Expenditure per Capita after h Years					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	0.73***	0.87***	1.45***	1.27***	0.76**	0.77**
	(0.10)	(0.20)	(0.25)	(0.31)	(0.33)	(0.34)
Oil & Gas Grant p.c.	0.21***	0.33***	0.54***	0.49***	0.16***	0.16
	(0.07)	(0.07)	(0.12)	(0.04)	(0.05)	(0.13)
p-value: Gen. = Oil & Gas	0.001	0.001	0.000	0.016	0.073	0.190
p-value: Gen. Grant ≤ 1	0.996	0.750	0.038	0.192	0.760	0.752
Observations	4,290	3,957	3,612	3,272	2,924	2,579
District clusters	348	348	348	348	348	348
Prov. × year clusters	358	330	302	274	246	218
	Panel B: Two-Year Changes in Grants ($k = 2$)					
General Grant p.c.	0.81***	0.98***	1.26***	0.92***	0.64**	0.60*
	(0.14)	(0.22)	(0.23)	(0.30)	(0.28)	(0.32)
Oil & Gas Grant p.c.	0.13	0.29***	0.33***	0.16	−0.00	0.16
	(0.09)	(0.09)	(0.07)	(0.10)	(0.15)	(0.19)
p-value: Gen. = Oil & Gas	0.001	0.000	0.000	0.036	0.109	0.364
p-value: Gen. Grant ≤ 1	0.919	0.534	0.125	0.601	0.899	0.892
Observations	3,957	3,612	3,272	2,924	2,579	2,237
District clusters	348	348	348	348	348	348
Prov. × year clusters	332	304	276	248	220	192

Notes: This table reports OLS estimates of β_h and δ_h in Equation (1). Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.6: Dynamic Responses of Total Revenue and Surplus to Grants

	Response of Total Revenue and Surplus per Capita after h Years					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Total Revenue, One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	1.35***	1.95***	1.57***	1.22***	0.90***	0.70***
	(0.25)	(0.28)	(0.25)	(0.21)	(0.23)	(0.14)
Oil & Gas Grant p.c.	1.12***	0.90***	0.69***	0.13	0.40**	0.57***
	(0.24)	(0.16)	(0.19)	(0.19)	(0.19)	(0.09)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.204	0.000	0.000	0.000	0.031	0.230
Adjusted p-value	*0.408*	*0.000*	*0.000*	*0.000*	*0.093*	*0.408*
SW F-stat.: Gen. Grant	84.8	84.8	84.1	97.1	85.0	100.8
SW F-stat.: Oil & Gas	99.0	93.2	95.9	102.7	114.5	154.7
Observations	4,298	3,940	3,601	3,260	2,912	2,568
District clusters	348	348	348	348	348	348
Prov. × year clusters	358	330	302	274	246	218
	Panel B: Surplus, One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	0.79**	1.20***	0.32	−0.33	0.29	0.03
	(0.32)	(0.46)	(0.46)	(0.30)	(0.21)	(0.13)
Oil & Gas Grant p.c.	0.90***	0.62***	0.16	−0.36***	0.26*	0.32**
	(0.21)	(0.22)	(0.27)	(0.11)	(0.14)	(0.14)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.686	0.155	0.722	0.915	0.866	0.078
Adjusted p-value	*1.000*	*0.774*	*1.000*	*1.000*	*1.000*	*0.468*
SW F-stat.: Gen. Grant	82.6	76.9	83.8	96.6	84.5	100.4
SW F-stat.: Oil & Gas	96.3	80.2	95.5	102.0	113.5	152.6
Observations	4,268	3,914	3,577	3,237	2,889	2,546
District clusters	348	348	348	348	348	348
Prov. × year clusters	358	330	302	274	246	218

Notes: This table reports IV estimates of β_h and δ_h in Equation (1). The outcome in Panel A is total revenue per capita, and the outcome in Panel B is surplus (total revenue minus total expenditure) per capita. The estimates in both panels are based on one-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The regressions also control for one-year changes in special grant revenue per capita. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.7: Dynamic Responses of Total Expenditure to Grants: Controlling for Oil and Gas Production

	Response of Total Expenditure per Capita after h Years					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	0.67***	0.81***	1.42***	1.58***	0.69***	0.77***
	(0.12)	(0.23)	(0.40)	(0.40)	(0.23)	(0.29)
Oil & Gas Grant p.c.	0.22***	0.26**	0.53***	0.46***	0.12**	0.25
	(0.07)	(0.11)	(0.17)	(0.06)	(0.05)	(0.17)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.009	0.038	0.003	0.012	0.095
Adjusted p-value	*0.000*	*0.037*	*0.075*	*0.015*	*0.037*	*0.095*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.998	0.797	0.148	0.076	0.913	0.785
Adjusted p-value	*1.000*	*1.000*	*0.738*	*0.456*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	75.6	79.8	83.8	92.1	85.6	92.6
SW F-stat.: Oil & Gas	107.0	95.3	108.9	114.8	160.3	220.5
Observations	4,290	3,957	3,612	3,272	2,924	2,579
District clusters	348	348	348	348	348	348
Prov. × year clusters	358	330	302	274	246	218
	Panel B: Two-Year Changes in Grants ($k = 2$)					
General Grant p.c.	0.70***	1.02***	1.46***	1.00***	0.63***	0.71***
	(0.14)	(0.26)	(0.28)	(0.21)	(0.17)	(0.17)
Oil & Gas Grant p.c.	0.12*	0.31***	0.34***	0.15**	0.15	0.33
	(0.07)	(0.11)	(0.07)	(0.07)	(0.16)	(0.21)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.013	0.000	0.000	0.006	0.064
Adjusted p-value	*0.001*	*0.027*	*0.001*	*0.002*	*0.018*	*0.064*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.986	0.467	0.050	0.508	0.985	0.952
Adjusted p-value	*1.000*	*1.000*	*0.299*	*1.000*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	42.1	43.1	43.7	44.3	44.2	44.8
SW F-stat.: Oil & Gas	419.2	368.4	357.4	392.9	347.7	379.3
Observations	3,957	3,612	3,272	2,924	2,579	2,237
District clusters	348	348	348	348	348	348
Prov. × year clusters	332	304	276	248	220	192

Notes: This table reports IV estimates of β_h and δ_h in Equation (1). Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The regressions additionally control for the value of district oil and gas production per capita. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.8: Mean Responses of Alternative Revenue Sources to Grants

	Mean Responses: $\frac{1}{6}\sum_{h=0}^{5}\beta_h$ and $\frac{1}{6}\sum_{h=0}^{5}\delta_h$		
	Special Grant	Own-Source	Shared Taxes
	(1)	(2)	(3)
	Panel A: One-Year Changes in Grants ($k = 1$)		
General Grant p.c.	0.07***	0.04*	0.01
	(0.03)	(0.02)	(0.04)
Oil & Gas Grant p.c.	0.01	0.03***	−0.03***
	(0.01)	(0.01)	(0.01)
H_0: Gen. = Oil & Gas			
Unadjusted p-value	0.010	0.561	0.271
Adjusted p-value	*0.030*	*0.561*	*0.543*
SW F-stat.: Gen. Grant	93.3	93.2	92.3
SW F-stat.: Oil & Gas	215.1	214.2	147.3
Observations	2,566	2,570	2,557
District clusters	348	348	348
Prov. × year clusters	218	218	218
	Panel B: Two-Year Changes in Grants ($k = 2$)		
General Grant p.c.	0.04	0.03	0.01
	(0.05)	(0.02)	(0.02)
Oil & Gas Grant p.c.	0.01	0.04***	−0.02***
	(0.01)	(0.01)	(0.01)
H_0: Gen. = Oil & Gas			
Unadjusted p-value	0.532	0.550	0.197
Adjusted p-value	*1.000*	*1.000*	*0.591*
SW F-stat.: Gen. Grant	42.8	42.8	43.8
SW F-stat.: Oil & Gas	379.1	374.5	127.0
Observations	2,223	2,227	2,215
District clusters	347	347	347
Prov. × year clusters	192	192	192

Notes: This table reports IV estimates of the mean responses of alternative sources of revenue (per capita) to the general grant, $\sum_{h=0}^{5}\beta_h/6$, and to the oil and gas grant, $\sum_{h=0}^{5}\delta_h/6$, obtained by replacing the outcome in Equation (1) with $\sum_{h=0}^{5}(Y_{d,t+h} - Y_{d,t-k})/6$. Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.9: Dynamic Responses of Total Expenditure to Grants: Controlling for Special Grant

	Response of Total Expenditure per Capita after h Years					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	0.59***	0.82***	1.27***	1.55***	0.63***	0.68***
	(0.13)	(0.22)	(0.36)	(0.28)	(0.20)	(0.22)
Oil & Gas Grant p.c.	0.21***	0.29***	0.53***	0.48***	0.15*	0.26
	(0.08)	(0.10)	(0.15)	(0.07)	(0.08)	(0.20)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.004	0.026	0.000	0.006	0.010
Adjusted p-value	*0.000*	*0.014*	*0.026*	*0.000*	*0.018*	*0.020*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.999	0.793	0.233	0.025	0.969	0.927
Adjusted p-value	*1.000*	*1.000*	*1.000*	*0.153*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	82.7	76.9	83.8	96.8	84.6	99.9
SW F-stat.: Oil & Gas	96.1	80.2	95.5	102.0	114.0	155.4
Observations	4,283	3,929	3,592	3,252	2,904	2,559
District clusters	348	348	348	348	348	348
Prov. × year clusters	358	330	302	274	246	218
	Panel B: Two-Year Changes in Grants ($k = 2$)					
General Grant p.c.	0.63***	0.95***	1.34***	0.90***	0.52***	0.60***
	(0.14)	(0.27)	(0.25)	(0.22)	(0.16)	(0.21)
Oil & Gas Grant p.c.	0.10	0.27***	0.33***	0.14*	0.09	0.28
	(0.08)	(0.10)	(0.04)	(0.08)	(0.16)	(0.22)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.024	0.000	0.002	0.009	0.157
Adjusted p-value	*0.002*	*0.048*	*0.000*	*0.008*	*0.028*	*0.157*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.996	0.576	0.084	0.678	0.999	0.971
Adjusted p-value	*1.000*	*1.000*	*0.502*	*1.000*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	49.8	50.4	52.2	52.8	55.4	55.6
SW F-stat.: Oil & Gas	448.3	385.4	355.5	413.0	403.2	411.3
Observations	3,950	3,587	3,255	2,907	2,562	2,220
District clusters	348	348	348	348	348	348
Prov. × year clusters	332	304	276	248	220	192

Notes: This table reports IV estimates of β_h and δ_h in Equation (1). Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The regressions also control for one- or two-year changes in special grant revenue per capita. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.10: Dynamic Responses of Total Expenditure to Grants: Drop Late Splitters

	Response of Total Expenditure per Capita after h Years					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	0.68***	0.99***	1.60***	1.47***	0.67***	0.65***
	(0.14)	(0.17)	(0.23)	(0.25)	(0.23)	(0.14)
Oil & Gas Grant p.c.	0.21*	0.36***	0.54***	0.42***	0.08**	0.01
	(0.11)	(0.13)	(0.20)	(0.08)	(0.03)	(0.15)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.001	0.000	0.000	0.000	0.007	0.001
Adjusted p-value	*0.002*	*0.000*	*0.000*	*0.001*	*0.007*	*0.002*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.989	0.529	0.004	0.032	0.922	0.993
Adjusted p-value	*1.000*	*1.000*	*0.027*	*0.161*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	48.8	45.8	33.8	78.7	50.2	75.1
SW F-stat.: Oil & Gas	65.1	69.1	72.5	124.6	104.4	405.6
Observations	3,966	3,657	3,338	3,023	2,701	2,382
District clusters	322	322	322	322	322	322
Prov. × year clusters	358	330	302	274	246	218
	Panel B: Two-Year Changes in Grants ($k = 2$)					
General Grant p.c.	0.78***	1.22***	1.48***	0.94***	0.54***	0.65***
	(0.12)	(0.19)	(0.22)	(0.19)	(0.12)	(0.15)
Oil & Gas Grant p.c.	0.15*	0.38***	0.37***	0.11	−0.07***	0.09*
	(0.08)	(0.12)	(0.04)	(0.09)	(0.03)	(0.05)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.000	0.000	0.000	0.000	0.002
Adjusted p-value	*0.000*	*0.000*	*0.000*	*0.001*	*0.000*	*0.002*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.959	0.117	0.016	0.630	1.000	0.989
Adjusted p-value	*1.000*	*0.584*	*0.097*	*1.000*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	34.8	34.9	33.2	33.2	33.2	33.0
SW F-stat.: Oil & Gas	240.5	203.9	197.0	214.4	169.6	178.7
Observations	3,657	3,338	3,023	2,701	2,382	2,063
District clusters	322	322	322	322	322	322
Prov. × year clusters	332	304	276	248	220	192

Notes: This table reports IV estimates of β_h and δ_h in Equation (1), omitting districts that split for the first time during the period 2007–2014. Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.11: Dynamic Responses of Total Expenditure to Grants: Asymmetric Responses

	Response of Total Expenditure per Capita after h Years					
	$h=0$ (1)	$h=1$ (2)	$h=2$ (3)	$h=3$ (4)	$h=4$ (5)	$h=5$ (6)
	Panel A: One-Year Changes in Grants ($k=1$)					
General Grant p.c.	0.73***	0.96***	1.64***	1.89***	1.01***	1.18***
	(0.11)	(0.18)	(0.32)	(0.32)	(0.28)	(0.38)
Oil & Gas Grant p.c.$^{+}$	0.29***	0.40***	0.78***	0.79***	0.47*	0.69
	(0.11)	(0.10)	(0.14)	(0.23)	(0.25)	(0.47)
Oil & Gas Grant p.c.$^{-}$	0.04	−0.09	−0.35	−0.64	−1.34	−1.12
	(0.15)	(0.48)	(0.76)	(0.78)	(0.95)	(0.80)
H_0: Symmetry						
Unadjusted p-value	0.253	0.334	0.157	0.137	0.119	0.129
Adjusted p-value	*0.716*	*0.716*	*0.716*	*0.716*	*0.716*	*0.716*
H_0: Gen. = Oil & Gas^{+}						
Unadjusted p-value	0.000	0.000	0.000	0.000	0.063	0.198
Adjusted p-value	*0.000*	*0.000*	*0.001*	*0.000*	*0.125*	*0.198*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.994	0.596	0.021	0.003	0.489	0.317
Adjusted p-value	*1.000*	*1.000*	*0.104*	*0.017*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	68.6	66.9	72.0	88.6	79.7	94.1
SW F-stat.: Oil & Gas^{+}	89.7	84.1	101.5	101.4	96.3	343.8
SW F-stat.: Oil & Gas^{-}	73.4	228.1	448.8	44.8	275.1	202.8
	Panel B: Two-Year Changes in Grants ($k=2$)					
General Grant p.c.	0.84***	1.21***	1.73***	1.29***	0.96***	1.12***
	(0.11)	(0.22)	(0.28)	(0.28)	(0.27)	(0.31)
Oil & Gas Grant p.c.$^{+}$	0.33***	0.58***	0.76***	0.60**	0.63	0.90*
	(0.10)	(0.12)	(0.19)	(0.29)	(0.43)	(0.52)
Oil & Gas Grant p.c.$^{-}$	−0.39***	−0.47	−0.78	−1.11	−1.42**	−1.23*
	(0.15)	(0.47)	(0.68)	(0.76)	(0.70)	(0.67)
H_0: Symmetry						
Unadjusted p-value	0.001	0.044	0.069	0.091	0.060	0.059
Adjusted p-value	*0.008*	*0.221*	*0.235*	*0.235*	*0.235*	*0.235*
H_0: Gen. = Oil & Gas^{+}						
Unadjusted p-value	0.000	0.008	0.000	0.024	0.299	0.583
Adjusted p-value	*0.000*	*0.031*	*0.002*	*0.071*	*0.598*	*0.598*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.933	0.175	0.004	0.150	0.555	0.349
Adjusted p-value	*1.000*	*0.751*	*0.027*	*0.751*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	40.5	42.2	42.7	43.2	43.4	43.8
SW F-stat.: Oil & Gas^{+}	203.9	197.3	189.4	201.6	192.5	179.1
SW F-stat.: Oil & Gas^{-}	190.8	168.2	166.1	145.8	98.2	84.4

Notes: This table reports IV estimates of β_h, δ_h^{+}, and δ_h^{-} in Equation (3). Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.12: Dynamic Responses of Total Expenditure to Grants: Double-Interaction IV

	Response of Total Expenditure per Capita after h Years					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	0.87***	1.48***	1.68***	1.67***	0.94***	1.02***
	(0.14)	(0.13)	(0.26)	(0.19)	(0.11)	(0.25)
Oil & Gas Grant p.c.	0.25***	0.35***	0.57***	0.49***	0.18***	0.28
	(0.06)	(0.08)	(0.12)	(0.06)	(0.06)	(0.19)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.002	0.000	0.001	0.000	0.000	0.086
Adjusted p-value	*0.004*	*0.000*	*0.004*	*0.000*	*0.000*	*0.086*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.819	0.000	0.005	0.000	0.716	0.472
Adjusted p-value	*1.000*	*0.001*	*0.018*	*0.001*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	327.9	297.6	242.9	215.2	260.0	184.9
SW F-stat.: Oil & Gas	5,760.0	4,443.6	3,880.4	5,388.5	4,818.8	4,210.9
Observations	4,290	3,957	3,612	3,272	2,924	2,579
District clusters	348	348	348	348	348	348
Prov. × year clusters	358	330	302	274	246	218
	Panel B: Two-Year Changes in Grants ($k = 2$)					
General Grant p.c.	1.03***	1.39***	1.44***	1.12***	0.76***	0.96***
	(0.27)	(0.33)	(0.23)	(0.11)	(0.21)	(0.20)
Oil & Gas Grant p.c.	0.11	0.30***	0.34***	0.14*	0.10	0.29
	(0.10)	(0.11)	(0.04)	(0.08)	(0.16)	(0.23)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.008	0.002	0.000	0.000	0.053	0.101
Adjusted p-value	*0.024*	*0.007*	*0.000*	*0.000*	*0.105*	*0.105*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.459	0.117	0.025	0.125	0.881	0.577
Adjusted p-value	*1.000*	*0.584*	*0.152*	*0.584*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	259.8	295.1	254.7	223.4	315.3	243.5
SW F-stat.: Oil & Gas	314.2	304.2	293.0	325.9	355.5	315.0
Observations	3,957	3,612	3,272	2,924	2,579	2,237
District clusters	348	348	348	348	348	348
Prov. × year clusters	332	304	276	248	220	192

Notes: This table reports IV estimates of β_h and δ_h in Equation (1), using $A_d \cdot 1(t \geq 2006)$ as an instrument instead of $A_d \cdot N_d \cdot 1(t \geq 2006)$. Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.13: Dynamic Responses of Total Expenditure to Grants: Controlling for Non-Oil/Gas $\times$ Year $\geq$ 2006

	Response of Total Expenditure per Capita after h Years					
	$h = 0$ (1)	$h = 1$ (2)	$h = 2$ (3)	$h = 3$ (4)	$h = 4$ (5)	$h = 5$ (6)
	Panel A: One-Year Changes in Grants ($k = 1$)					
General Grant p.c.	0.80***	1.09***	1.71***	1.75***	0.81***	0.89***
	(0.07)	(0.14)	(0.28)	(0.30)	(0.24)	(0.26)
Oil & Gas Grant p.c.	0.19**	0.22**	0.45***	0.44***	0.14**	0.24
	(0.08)	(0.10)	(0.15)	(0.06)	(0.05)	(0.18)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.000	0.000	0.000	0.002	0.000
Adjusted p-value	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	*0.001*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.997	0.244	0.006	0.006	0.785	0.669
Adjusted p-value	*1.000*	*0.977*	*0.035*	*0.035*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	61.4	59.4	65.1	69.0	65.0	75.6
SW F-stat.: Oil & Gas	121.8	104.1	132.5	167.3	186.3	350.1
Observations	4,290	3,957	3,612	3,272	2,924	2,579
District clusters	348	348	348	348	348	348
Prov. $\times$ year clusters	358	330	302	274	246	218
	Panel B: Two-Year Changes in Grants ($k = 2$)					
General Grant p.c.	0.88***	1.28***	1.65***	1.13***	0.72***	0.83***
	(0.09)	(0.21)	(0.31)	(0.24)	(0.17)	(0.20)
Oil & Gas Grant p.c.	−0.00	0.13	0.20***	0.06	0.02	0.23
	(0.09)	(0.09)	(0.06)	(0.07)	(0.15)	(0.21)
H_0: Gen. = Oil & Gas						
Unadjusted p-value	0.000	0.000	0.000	0.000	0.000	0.002
Adjusted p-value	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.907	0.089	0.017	0.295	0.948	0.801
Adjusted p-value	*1.000*	*0.446*	*0.103*	*1.000*	*1.000*	*1.000*
SW F-stat.: Gen. Grant	39.8	41.4	42.4	42.9	43.1	43.6
SW F-stat.: Oil & Gas	136.3	172.5	164.8	120.4	191.9	111.7
Observations	3,957	3,612	3,272	2,924	2,579	2,237
District clusters	348	348	348	348	348	348
Prov. $\times$ year clusters	332	304	276	248	220	192

Notes: This table reports IV estimates of β_h and δ_h in Equation (1). Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The regressions also control for one- or two-year changes in $N_d \cdot 1(t \geq 2006)$. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.14: Dynamic Responses of Total Expenditure to Grants: Drop Hydrocarbon-Rich Provinces

	Response of Total Expenditure per Capita after h Years					
	$h=0$ (1)	$h=1$ (2)	$h=2$ (3)	$h=3$ (4)	$h=4$ (5)	$h=5$ (6)
	Panel A: One-Year Changes in Grants ($k=1$)					
General Grant p.c.	0.81***	1.11***	1.84***	1.75***	0.78***	0.79***
	(0.06)	(0.13)	(0.30)	(0.26)	(0.19)	(0.15)
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	1.000	0.214	0.003	0.002	0.868	0.919
Adjusted p-value	*1.000*	*0.868*	*0.014*	*0.014*	*1.000*	*1.000*
KP F-stat.: Gen. Grant	42.5	40.6	41.3	41.2	41.8	41.7
Observations	3,706	3,418	3,120	2,825	2,524	2,224
District clusters	301	301	301	301	301	301
Prov. × year clusters	295	272	249	226	203	180
	Panel B: Two-Year Changes in Grants ($k=2$)					
General Grant p.c.	0.94***	1.43***	1.73***	1.17***	0.71***	0.82***
	(0.08)	(0.22)	(0.28)	(0.24)	(0.12)	(0.14)
H_0: Gen. Grant ≤ 1						
Unadjusted p-value	0.775	0.026	0.005	0.235	0.993	0.903
Adjusted p-value	*1.000*	*0.134*	*0.033*	*0.990*	*1.000*	*1.000*
KP F-stat.: Gen. Grant	23.6	23.7	23.7	23.8	23.9	23.8
Observations	3,418	3,120	2,825	2,524	2,224	1,928
District clusters	301	301	301	301	301	301
Prov. × year clusters	273	250	227	204	181	158

Notes: This table reports IV estimates of β_h in Equation (1), omitting hydrocarbon-rich provinces. Panel A presents estimates based on one-year changes in grants, and Panel B presents estimates based on two-year changes in grants. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The first-stage F-statistic is the Kleibergen and Paap (2006) *rk* statistic. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.15: Mean Responses of Public Service Delivery to Grants: Controlling for Baseline Covariates × Year Effects

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.293	-0.911^{***}	1.096^{***}	0.453^{*}	1.155^{**}	0.897^{*}	0.025	0.512^{***}
	(0.184)	(0.259)	(0.157)	(0.260)	(0.575)	(0.468)	(0.021)	(0.152)
Oil & Gas Grant p.c.	0.034	-0.214^{***}	0.229	0.048	0.316	0.251	0.024^{**}	0.091
	(0.087)	(0.075)	(0.233)	(0.150)	(0.223)	(0.179)	(0.010)	(0.125)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.193	0.004	0.000	0.117	0.134	0.169	0.927	0.014
Adjusted p-value	*0.583*	*0.024*	*0.000*	*0.583*	*0.583*	*0.583*	*0.927*	
SW F-stat.: Gen. Grant	60.5	60.5	60.5	61.5	61.5	58.6	60.5	60.5
SW F-stat.: Oil & Gas	115.5	115.5	115.5	118.5	118.5	129.3	115.5	115.5
Observations	1,392	1,392	1,392	1,388	1,388	1,044	1,392	1,392
District clusters	348	348	348	347	347	348	348	348
Prov. × year clusters	111	111	111	111	111	83	111	111

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Because the data on health care centres are missing in 2008, β_0 and δ_0 are not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$ and $\sum_{h\in\{3,6\}} \delta_h/2$. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The regressions additionally control for year effects interacted with the following variables (measured in 2000): ethnic fractionalisation, urbanisation rate, share of population aged 15–64, share of population with a primary education, share of population with a secondary education, and log GDP per capita. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.16: Mean Responses of Public Service Delivery to Grants: No Controls

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.346***	−0.616***	1.158***	0.551***	1.465***	0.849**	0.061***	0.605***
	(0.131)	(0.226)	(0.141)	(0.210)	(0.487)	(0.414)	(0.020)	(0.117)
Oil & Gas Grant p.c.	0.070	−0.207***	0.264	0.095	0.358***	0.269*	0.026*	0.119
	(0.086)	(0.065)	(0.208)	(0.141)	(0.036)	(0.145)	(0.013)	(0.119)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.045	0.042	0.000	0.036	0.020	0.126	0.092	0.001
Adjusted p-value	*0.179*	*0.179*	*0.000*	*0.179*	*0.121*	*0.184*	*0.184*	
SW F-stat.: Gen. Grant	99.4	99.4	99.4	99.3	99.3	96.7	99.4	99.4
SW F-stat.: Oil & Gas	65.7	65.7	65.7	65.7	65.7	154.1	65.7	65.7
Observations	1,392	1,392	1,392	1,388	1,388	1,044	1,392	1,392
District clusters	348	348	348	347	347	348	348	348
Prov. × year clusters	111	111	111	111	111	83	111	111

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Because the data on health care centres are missing in 2008, β_0 and δ_0 are not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$ and $\sum_{h\in\{3,6\}} \delta_h/2$. Each regression controls for region-by-year effects. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.17: Mean Responses of Public Service Delivery to Grants: Controlling for Special Grant

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.366*	−0.801***	1.437***	0.553*	1.608**	0.778*	0.054*	0.655***
	(0.195)	(0.237)	(0.220)	(0.315)	(0.794)	(0.456)	(0.029)	(0.187)
Oil & Gas Grant p.c.	0.073	−0.179**	0.256	0.092	0.358***	0.231	0.027**	0.119
	(0.089)	(0.087)	(0.246)	(0.146)	(0.074)	(0.146)	(0.013)	(0.129)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.130	0.004	0.000	0.115	0.096	0.195	0.330	0.005
Adjusted p-value	*0.479*	*0.023*	*0.000*	*0.479*	*0.479*	*0.479*	*0.479*	
SW F-stat.: Gen. Grant	88.8	88.8	88.8	88.7	88.7	66.0	88.8	88.8
SW F-stat.: Oil & Gas	55.3	55.3	55.3	55.1	55.1	74.9	55.3	55.3
Observations	1,343	1,343	1,343	1,340	1,340	995	1,343	1,343
District clusters	348	348	348	347	347	348	348	348
Prov. × year clusters	111	111	111	111	111	83	111	111

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Because the data on health care centres are missing in 2008, β_0 and δ_0 are not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$ and $\sum_{h\in\{3,6\}} \delta_h/2$. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The regressions also control for special grant revenue per capita. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.18: Mean Responses of Public Service Delivery to Grants: Controlling for Oil and Gas Production

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.322*	−0.813***	1.311***	0.503*	1.558*	0.694	0.044	0.586***
	(0.182)	(0.266)	(0.184)	(0.289)	(0.800)	(0.462)	(0.028)	(0.159)
Oil & Gas Grant p.c.	−0.012	−0.245**	0.061	0.003	0.356	0.086	0.007	−0.000
	(0.031)	(0.113)	(0.193)	(0.133)	(0.285)	(0.100)	(0.018)	(0.097)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.065	0.033	0.000	0.080	0.108	0.179	0.200	0.001
Adjusted p-value	*0.323*	*0.199*	*0.000*	*0.323*	*0.325*	*0.358*	*0.358*	
SW F-stat.: Gen. Grant	42.0	42.0	42.0	42.3	42.3	46.8	42.0	42.0
SW F-stat.: Oil & Gas	413.6	413.6	413.6	404.3	404.3	191.9	413.6	413.6
Observations	1,344	1,344	1,344	1,341	1,341	996	1,344	1,344
District clusters	348	348	348	347	347	348	348	348
Prov. × year clusters	111	111	111	111	111	83	111	111

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Because the data on health care centres are missing in 2008, β_0 and δ_0 are not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$ and $\sum_{h\in\{3,6\}} \delta_h/2$. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The regressions additionally control for the value of district oil and gas production per capita. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.19: Mean Responses of Public Service Delivery to Grants: Drop Late Splitters

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.285	−0.851***	1.150***	0.473*	1.066**	0.939**	0.041*	0.519***
	(0.184)	(0.274)	(0.143)	(0.267)	(0.503)	(0.443)	(0.022)	(0.145)
Oil & Gas Grant p.c.	−0.027*	−0.095	0.014	−0.050	0.395***	0.051	0.021**	−0.011
	(0.016)	(0.066)	(0.172)	(0.142)	(0.083)	(0.099)	(0.010)	(0.087)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.099	0.009	0.000	0.059	0.220	0.054	0.390	0.002
Adjusted p-value	*0.297*	*0.054*	*0.000*	*0.271*	*0.440*	*0.271*	*0.440*	
SW F-stat.: Gen. Grant	46.3	46.3	46.3	46.3	46.3	50.8	46.3	46.3
SW F-stat.: Oil & Gas	411.5	411.5	411.5	414.0	414.0	664.8	411.5	411.5
Observations	1,288	1,288	1,288	1,284	1,284	966	1,288	1,288
District clusters	322	322	322	321	321	322	322	322
Prov. × year clusters	111	111	111	111	111	83	111	111

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Because the data on health care centres are missing in 2008, β_0 and δ_0 are not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$ and $\sum_{h\in\{3,6\}} \delta_h/2$. The sample omits districts that split for the first time during the period 2007–2014. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.20: Mean Responses of Public Service Delivery to Grants: Asymmetric Responses

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.371*	−0.792***	1.465***	0.577*	1.574**	0.910*	0.070**	0.684***
	(0.197)	(0.275)	(0.226)	(0.296)	(0.662)	(0.504)	(0.031)	(0.184)
Oil & Gas Grant p.c.$^+$	0.137	−0.235***	0.577**	0.218	0.817***	0.396**	0.064***	0.297*
	(0.122)	(0.072)	(0.270)	(0.201)	(0.178)	(0.173)	(0.019)	(0.156)
Oil & Gas Grant p.c.$^-$	−0.178*	−0.006	−0.915***	−0.314	−1.220***	−0.931***	−0.105**	−0.522**
	(0.105)	(0.207)	(0.350)	(0.312)	(0.447)	(0.279)	(0.052)	(0.211)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Symmetry								
Unadjusted p-value	0.139	0.378	0.004	0.221	0.000	0.000	0.006	0.009
Adjusted p-value	*0.418*	*0.441*	*0.020*	*0.441*	*0.002*	*0.003*	*0.025*	
H_0: Gen. = Oil & Gas$^+$								
Unadjusted p-value	0.227	0.013	0.001	0.157	0.179	0.249	0.854	0.055
Adjusted p-value	*0.785*	*0.076*	*0.008*	*0.785*	*0.785*	*0.785*	*0.854*	
SW F-stat.: Gen. Grant	57.2	57.2	57.2	58.3	58.3	43.1	57.2	57.2
SW F-stat.: Oil & Gas$^+$	135.0	135.0	135.0	131.1	131.1	141.5	135.0	135.0
SW F-stat.: Oil & Gas$^-$	82.1	82.1	82.1	82.7	82.7	55.7	82.1	82.1

Notes: This table reports IV estimates of the mean responses of public goods to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, to increases in the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h^+/3$, and to decreases in the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h^-/3$, obtained from the regressions $Y_{d,t+h} - Y_{d,t-3} = \beta_h(\overline{G}_{d,t} - \overline{G}_{d,t-3}) + \delta_h^+(\overline{H}_{d,t} - \overline{H}_{d,t-3})^+ + \delta_h^-(\overline{H}_{d,t} - \overline{H}_{d,t-3})^- + \boldsymbol{\phi}'(\boldsymbol{X}_{d,t} - \boldsymbol{X}_{d,t-3}) + \lambda_{r(d),t} + \xi_{d,t}$. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.21: Mean Responses of Public Service Delivery to Grants: OLS Estimates

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.181	−0.266*	0.325**	0.168	0.124	0.345**	0.020*	0.195
	(0.127)	(0.142)	(0.128)	(0.115)	(0.255)	(0.137)	(0.012)	(0.120)
Oil & Gas Grant p.c.	0.032	−0.149**	0.053	0.005	−0.196	0.051	0.014	−0.003
	(0.059)	(0.068)	(0.153)	(0.105)	(0.196)	(0.138)	(0.012)	(0.111)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.280	0.447	0.234	0.246	0.360	0.157	0.744	0.235
Adjusted p-value	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	
Observations	1,392	1,392	1,392	1,388	1,388	1,044	1,392	1,392
District clusters	348	348	348	347	347	348	348	348
Prov. × year clusters	111	111	111	111	111	83	111	111

Notes: This table reports OLS estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Because the data on health care centres are missing in 2008, β_0 and δ_0 are not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$ and $\sum_{h\in\{3,6\}} \delta_h/2$. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.22: Mean Responses of Public Service Delivery to Grants: Double-Interaction IV

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	-0.001	-0.572^{***}	0.899^{***}	0.060	1.455^{***}	0.546^{***}	0.063^{***}	0.286^{***}
	(0.100)	(0.157)	(0.173)	(0.143)	(0.267)	(0.190)	(0.011)	(0.102)
Oil & Gas Grant p.c.	0.048	-0.173^{***}	0.223	0.074	0.371^{***}	0.215^{**}	0.027^{**}	0.098
	(0.063)	(0.053)	(0.176)	(0.100)	(0.066)	(0.102)	(0.013)	(0.088)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.660	0.024	0.003	0.898	0.000	0.129	0.047	0.099
Adjusted p-value	*1.000*	*0.121*	*0.018*	*1.000*	*0.002*	*0.388*	*0.188*	
SW F-stat.: Gen. Grant	255.5	255.5	255.5	268.2	268.2	299.6	255.5	255.5
SW F-stat.: Oil & Gas	6,719.0	6,719.0	6,719.0	6,920.2	6,920.2	6,096.1	6,719.0	6,719.0
Observations	1,392	1,392	1,392	1,388	1,388	1,044	1,392	1,392
District clusters	348	348	348	347	347	348	348	348
Prov. × year clusters	111	111	111	111	111	83	111	111

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Because the data on health care centres are missing in 2008, β_0 and δ_0 are not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$ and $\sum_{h\in\{3,6\}} \delta_h/2$. The estimates use $A_d \cdot 1(t \geq 2006)$ as an instrument instead of $A_d \cdot N_d \cdot 1(t \geq 2006)$. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.23: Mean Responses of Public Service Delivery to Grants: Controlling for Non-Oil/Gas $\times$ Year $\geq$ 2006

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.358*	−0.822***	1.434***	0.587*	1.335**	0.841	0.063**	0.644***
	(0.197)	(0.266)	(0.225)	(0.300)	(0.652)	(0.528)	(0.031)	(0.177)
Oil & Gas Grant p.c.	0.038	−0.111	0.070	0.011	0.377**	0.234	0.010	0.049
	(0.096)	(0.087)	(0.286)	(0.156)	(0.156)	(0.170)	(0.012)	(0.142)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.147	0.010	0.000	0.082	0.162	0.281	0.093	0.006
Adjusted p-value	*0.441*	*0.058*	*0.000*	*0.408*	*0.441*	*0.441*	*0.408*	
SW F-stat.: Gen. Grant	60.8	60.8	60.8	62.0	62.0	60.5	60.8	60.8
SW F-stat.: Oil & Gas	255.9	255.9	255.9	258.7	258.7	327.0	255.9	255.9
Observations	1,392	1,392	1,392	1,388	1,388	1,044	1,392	1,392
District clusters	348	348	348	347	347	348	348	348
Prov. $\times$ year clusters	111	111	111	111	111	83	111	111

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Because the data on health care centres are missing in 2008, β_0 and δ_0 are not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$ and $\sum_{h\in\{3,6\}} \delta_h/2$. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The regressions also control for $N_d \cdot 1(t \geq 2006)$. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.24: Mean Responses of Public Service Delivery to Grants: Drop Hydrocarbon-Rich Provinces

	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
General Grant p.c.	0.322	-0.845^{***}	1.395^{***}	0.591^{*}	1.592^{**}	0.818	0.052	0.619^{***}
	(0.212)	(0.283)	(0.208)	(0.311)	(0.700)	(0.546)	(0.033)	(0.182)
Baseline mean outcome	0.191	8.011	1.220	1.665	5.701	2.599	0.641	-0.001
KP F-stat.: Gen. Grant	62.9	62.9	62.9	64.2	64.2	62.9	62.9	62.9
Observations	1,204	1,204	1,204	1,200	1,200	903	1,204	1,204
District clusters	301	301	301	300	300	301	301	301
Prov. × year clusters	91	91	91	91	91	68	91	91

Notes: This table reports IV estimates of the mean response of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, in Equation (4), omitting hydrocarbon-rich provinces. Because the data on health care centres are missing in 2008, β_0 is not identifiable for this outcome, so the table reports $\sum_{h\in\{3,6\}} \beta_h/2$. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. The baseline mean of the outcome variable is measured in 2002. Adjusted p-values use the Holm correction for multiple hypothesis testing. The first-stage F-statistic is the Kleibergen and Paap (2006) rk statistic. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.25: Mean Responses of Public Service Delivery to Grants: Excluding Outcomes from the Index One-by-One

	Public Services Index Excluding the Following Outcome:						
	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages
	Kindergarten	Primary	Secondary	Doctors	Midwives	Health Centres	Paved Road
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
General Grant p.c.	0.456***	0.721***	0.343**	0.637***	0.617***	0.698***	0.682***
	(0.086)	(0.187)	(0.163)	(0.169)	(0.166)	(0.211)	(0.181)
Oil & Gas Grant p.c.	0.089	0.144	0.063	0.120	0.116	0.150	0.123
	(0.079)	(0.138)	(0.081)	(0.125)	(0.141)	(0.129)	(0.135)
H_0: Gen. = Oil & Gas							
Unadjusted p-value	0.000	0.004	0.087	0.004	0.006	0.014	0.004
SW F-stat.: Gen. Grant	63.6	63.6	63.6	63.6	63.6	63.6	63.6
SW F-stat.: Oil & Gas	77.5	77.5	77.5	77.5	77.5	77.5	77.5
Observations	1,392	1,392	1,392	1,392	1,392	1,392	1,392
District clusters	348	348	348	348	348	348	348
Prov. × year clusters	111	111	111	111	111	111	111

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (4) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Each outcome is the public services index excluding one service outcome, as indicated. Each regression controls for region-by-year effects and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.26: Effects of Grants on Political Competition

	Number of Candidates (1)	Herfindahl Index (2)	Number of Parties in Winning Coalition (3)	Incumbent Reelected (4)	Margin of Victory (5)
	Panel A: Effects of Grants in Election Year				
General Grant p.c.$_t$	−1.081*	0.090	2.291**	−0.088	−0.452
	(0.617)	(0.088)	(1.137)	(0.146)	(9.071)
Oil & Gas Grant p.c.$_t$	−0.390*	0.001	0.475	0.032	−0.444
	(0.228)	(0.022)	(0.314)	(0.098)	(2.362)
Dependent variable mean	4.18	0.37	3.12	0.29	18.21
p-value: Gen. = Oil & Gas	0.231	0.262	0.069	0.351	0.999
SW F-stat.: Gen. Grant	12.0	12.6	11.9	16.5	12.6
SW F-stat.: Oil & Gas	18.2	18.4	18.9	13.5	18.5
Observations	781	720	875	514	700
District clusters	306	284	349	234	276
Prov. × year clusters	197	187	212	178	178
	Panel B: Effects of Grants in Year Before Election				
General Grant p.c.$_{t-1}$	−0.610	0.077	0.762	−0.066	6.301
	(0.533)	(0.078)	(1.423)	(0.125)	(9.127)
Oil & Gas Grant p.c.$_{t-1}$	−0.583*	0.062	0.028	0.097	5.296
	(0.323)	(0.052)	(0.766)	(0.089)	(6.186)
Dependent variable mean	4.18	0.37	3.12	0.29	18.21
p-value: Gen. = Oil & Gas	0.935	0.799	0.382	0.012	0.899
SW F-stat.: Gen. Grant	21.6	20.7	21.1	28.2	20.4
SW F-stat.: Oil & Gas	22.1	20.9	21.5	30.8	20.9
Observations	769	708	863	514	688
District clusters	304	282	347	234	274
Prov. × year clusters	196	186	211	178	177
	Panel C: Effects of Average Grants over Mayoral Term				
Avg. General Grant p.c.	−1.054*	0.064	0.795	−0.046	2.527
	(0.632)	(0.075)	(1.411)	(0.152)	(8.985)
Avg. Oil & Gas Grant p.c.	−1.200	0.078	0.468	0.152	6.775
	(0.768)	(0.077)	(1.559)	(0.170)	(9.304)
Dependent variable mean	4.18	0.37	3.12	0.29	18.21
p-value: Gen. = Oil & Gas	0.802	0.804	0.677	0.110	0.598
SW F-stat.: Gen. Grant	20.6	18.9	22.3	22.4	18.7
SW F-stat.: Oil & Gas	16.8	15.2	18.2	23.0	15.5
Observations	781	720	875	514	700
District clusters	306	284	349	234	276
Prov. × year clusters	197	187	212	178	178

Notes: Panels A and B report IV estimates of β and δ in $Y_{d,t} = \beta G_{d,t-k} + \delta H_{d,t-k} + \boldsymbol{\phi}' \boldsymbol{X}_{d,t-k} + \alpha_d + \lambda_{r(d),t} + \varepsilon_{d,t}$ for $k = 0$ (Panel A) and $k = 1$ (Panel B). Panel C reports IV estimates of β and δ in $Y_{d,t} = \beta \overline{G}_{d,(t-4,t)} + \delta \overline{H}_{d,(t-4,t)} + \boldsymbol{\phi}' \overline{\boldsymbol{X}}_{d,(t-4,t)} + \alpha_d + \lambda_{r(d),t} + \varepsilon_{d,t}$, where $\overline{Z}_{d,(t-4,t)}$ is the average of $Z_{d,t}$ over years $t-4$ to t (i.e., the mayoral term). Each regression controls for district fixed effects, region-by-year effects, and indicators for whether the district has split, defined separately for parent and child districts, as well as three lags of these indicators. Sanderson and Windmeijer (2016) first-stage F-statistics are reported for each endogenous variable. Standard errors, reported in parentheses, are robust to heteroskedasticity and two-way clustering by district and province-by-year. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.27: Baseline Characteristics and Outcomes by Exposure to Grant Shocks

	(1) High Exposure to General Grant	(2) High Exposure to Oil & Gas Grant	(3) Difference
Baseline Characteristics			
Log Land Area, 2000	9.475	9.348	0.127
			(0.212)
Log Population, 2000	12.605	12.387	0.219
			(0.177)
Ethnic Fractionalisation, 2000	0.730	0.793	−0.063
			(0.043)
Urbanisation Rate, 2000	0.157	0.320	−0.163***
			(0.039)
Share of Population Aged 0–14, 2000	0.357	0.338	0.018**
			(0.007)
Share of Population Aged 15–64, 2000	0.613	0.639	−0.025***
			(0.008)
Share of Population Aged 65+, 2000	0.030	0.023	0.007***
			(0.002)
Share of Population with Primary Education, 2000	0.603	0.627	−0.024
			(0.017)
Share of Population with Secondary Education, 2000	0.113	0.149	−0.036***
			(0.012)
Log GDP per Capita, 2000	2.124	3.577	−1.453***
			(0.184)
Log GDP per Capita Excluding Oil and Gas, 2000	2.118	2.768	−0.650***
			(0.138)
Baseline Outcomes			
Public Kindergartens per 10,000 People, 1999	0.175	0.141	0.034
			(0.070)
Public Primary Schools per 10,000 People, 1999	12.272	10.223	2.049*
			(1.092)
Public Secondary Schools per 10,000 People, 1999	1.651	1.344	0.308*
			(0.156)
Doctors per 10,000 People, 2002	1.178	1.646	−0.468***
			(0.165)
Midwives per 10,000 People, 2002	7.674	5.647	2.027***
			(0.721)
Health Care Centres per 10,000 People, 1999	4.676	3.904	0.772
			(0.530)
Share of Villages with Paved Road, 1999	0.435	0.372	0.063
			(0.072)
Public Services Index per 10,000 People, 2002	0.442	0.094	0.348**
			(0.146)
Observations	58	19	

Notes: This table reports average baseline characteristics and outcomes for districts with high exposure to the general grant shock and districts with high exposure to the oil and gas grant shocks, and the difference of the averages. High exposure to the general grant shock is defined as being in the top 25% in terms of land area per capita in 2006 and not being located in a hydrocarbon-rich province. High exposure to the oil and gas grant shocks is defined as being in the top 5% in terms of average hydrocarbon endowment per capita. Standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.28: Interacting Grants with Baseline Covariates and Controlling for Baseline Covariates × Year Effects

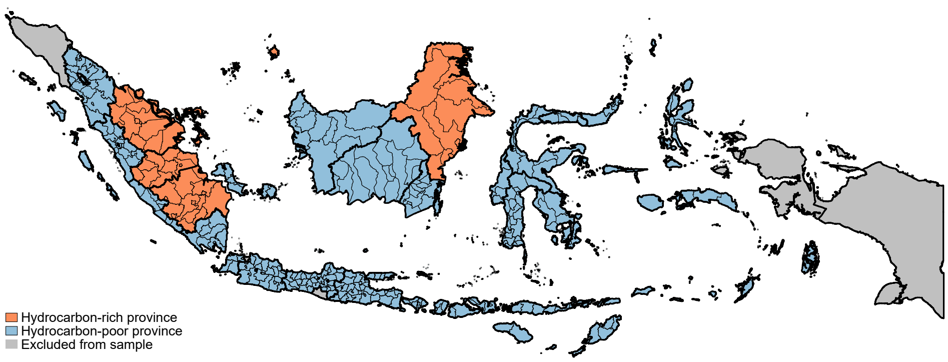
	Public Schools per 10,000 People			Health Personnel & Facilities per 10,000 People			Share of Villages	Index
	Kindergarten (1)	Primary (2)	Secondary (3)	Doctors (4)	Midwives (5)	Health Centres (6)	Paved Road (7)	(8)
General Grant p.c.	0.295	-0.892^{***}	1.159^{***}	0.673^{**}	1.567^{**}	0.366^{*}	0.026	0.542^{***}
	(0.203)	(0.332)	(0.204)	(0.325)	(0.771)	(0.218)	(0.038)	(0.173)
× Ethnic Frac. (Demeaned)	−0.265	1.019	−0.885	1.577	7.723^{**}	2.523	0.098	0.425
	(1.466)	(1.548)	(1.302)	(1.738)	(3.683)	(2.637)	(0.294)	(1.224)
× Urbanisation (Demeaned)	−0.055	4.218^{*}	0.300	1.750	−0.425	3.323	−0.221	0.334
	(1.490)	(2.502)	(2.328)	(3.624)	(9.273)	(3.788)	(0.307)	(2.058)
× Share Aged 15–64 (Demeaned)	7.994	−8.658	−2.546	−0.328	−32.696	−2.462	0.544	2.676
	(6.463)	(12.011)	(7.133)	(12.464)	(37.886)	(9.350)	(2.106)	(6.127)
× Share Prim. Edu. (Demeaned)	4.218	−3.883	2.268	−2.686	11.858	3.078	1.167^{**}	3.786
	(3.739)	(6.104)	(4.622)	(3.802)	(13.373)	(4.619)	(0.520)	(3.641)
× Share Sec. Edu. (Demeaned)	−3.244	−16.060	−6.086	−5.400	−17.051	−13.682	−1.076	−6.422
	(8.814)	(10.745)	(8.325)	(13.168)	(37.919)	(14.967)	(1.443)	(10.521)
× Log GDP p.c. (Demeaned)	-0.811^{***}	−0.138	−0.618	-0.790^{**}	−0.972	1.243^{**}	−0.072	-0.700^{***}
	(0.307)	(0.454)	(0.416)	(0.328)	(1.024)	(0.510)	(0.051)	(0.222)
Oil & Gas Grant p.c.	−0.092	−0.345	0.129	0.280	0.571	0.099	0.007	0.023
	(0.315)	(0.466)	(0.343)	(0.328)	(1.147)	(0.352)	(0.052)	(0.258)
× Ethnic Frac. (Demeaned)	2.407	1.101	0.805	2.138	2.355	1.501	0.258	2.246
	(2.167)	(3.329)	(4.351)	(4.281)	(11.124)	(3.585)	(0.391)	(2.942)
× Urbanisation (Demeaned)	0.648	−0.929	1.707	3.701	1.747	3.019^{*}	0.036	1.559
	(1.658)	(2.825)	(2.297)	(3.191)	(10.461)	(1.794)	(0.232)	(1.795)
× Share Aged 15–64 (Demeaned)	−1.719	11.410	−4.588	4.201	−9.040	−12.169	1.314	−2.247
	(10.660)	(11.724)	(8.433)	(16.436)	(43.862)	(10.703)	(1.947)	(10.715)
× Share Prim. Edu. (Demeaned)	−1.524	−5.336	1.185	3.302	12.532	3.605	−0.415	0.449
	(4.061)	(8.047)	(5.635)	(6.036)	(20.744)	(8.062)	(0.892)	(4.145)
× Share Sec. Edu. (Demeaned)	−2.409	2.880	−7.035	−13.497	−15.953	−10.677	−0.101	−6.228
	(4.296)	(10.654)	(8.274)	(9.911)	(36.601)	(9.410)	(0.981)	(5.688)
× Log GDP p.c. (Demeaned)	−0.006	−0.047	0.059	−0.341	−0.438	0.408^{**}	−0.023	−0.043
	(0.138)	(0.235)	(0.151)	(0.220)	(0.452)	(0.205)	(0.035)	(0.109)
H_0: Gen. = Oil & Gas								
Unadjusted p-value	0.215	0.308	0.005	0.342	0.446	0.473	0.748	0.074
Adjusted p-value	*1.000*	*1.000*	*0.038*	*1.000*	*1.000*	*1.000*	*1.000*	
SW F-stat.: Gen. Grant	49.4	49.4	49.4	48.9	48.9	61.2	49.4	49.4
SW F-stat.: Oil & Gas	32.2	32.2	32.2	31.9	31.9	53.9	32.2	32.2
Observations	1,392	1,392	1,392	1,388	1,388	1,044	1,392	1,392

Notes: This table reports IV estimates of the mean responses of public service delivery to the general grant, $\sum_{h\in\{0,3,6\}} \beta_h/3$, and to the oil and gas grant, $\sum_{h\in\{0,3,6\}} \delta_h/3$, obtained by replacing the outcome in Equation (6) with $\sum_{h\in\{0,3,6\}}(Y_{d,t+h} - Y_{d,t-3})/3$. Average effects of the interaction terms are also reported. First-stage F-statistics for the interaction terms are omitted to conserve space. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

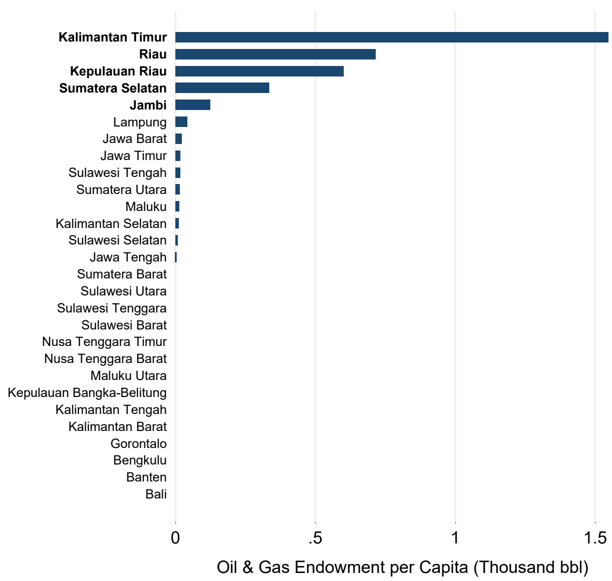
A.8 Figures

Figure A.1: Classification of Hydrocarbon-Rich Provinces

(a) Map of Hydrocarbon-Rich Provinces



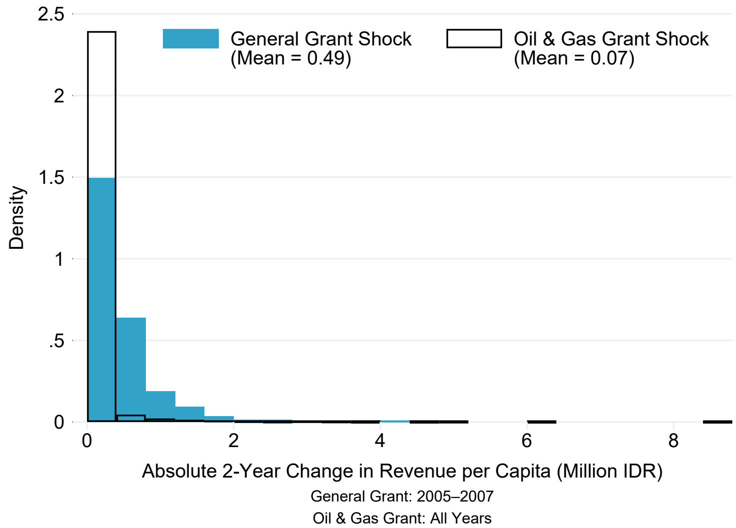
(b) Hydrocarbon Endowment per Capita by Province



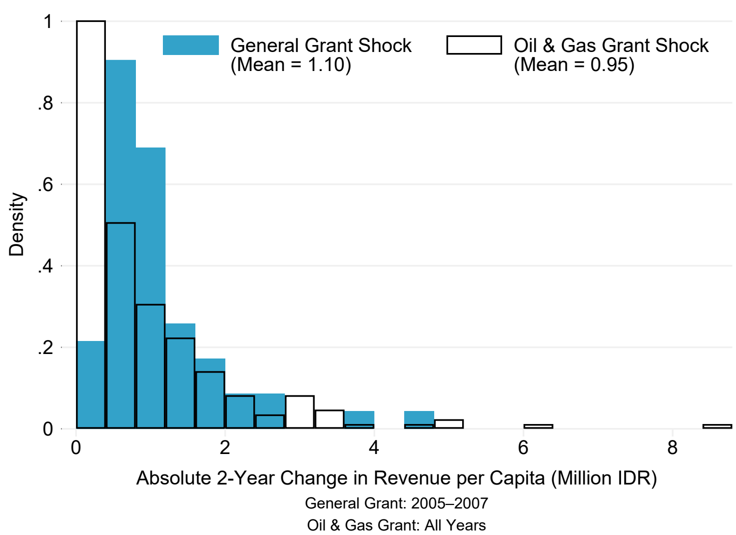
Notes: In Panel (a), district borders (thin lines) and province borders (thick lines) are displayed as they existed in 2006. The hydrocarbon-rich provinces (in bold) are Kalimantan Timur, Riau, Kepulauan Riau, Sumatera Selatan, and Jambi. Panel (b) shows the oil and gas endowment per capita known in 2000 for each province based on 2014 population. Oil and gas endowment per capita is expressed in thousands of barrels of oil equivalent. Kalimantan Utara is combined with its parent province, Kalimantan Timur, consistent with the national government's revenue-sharing policy through 2014.

Figure A.2: Distribution of Grant-Revenue Shocks

(a) All Districts



(b) Districts with High Exposure to Grant Shocks

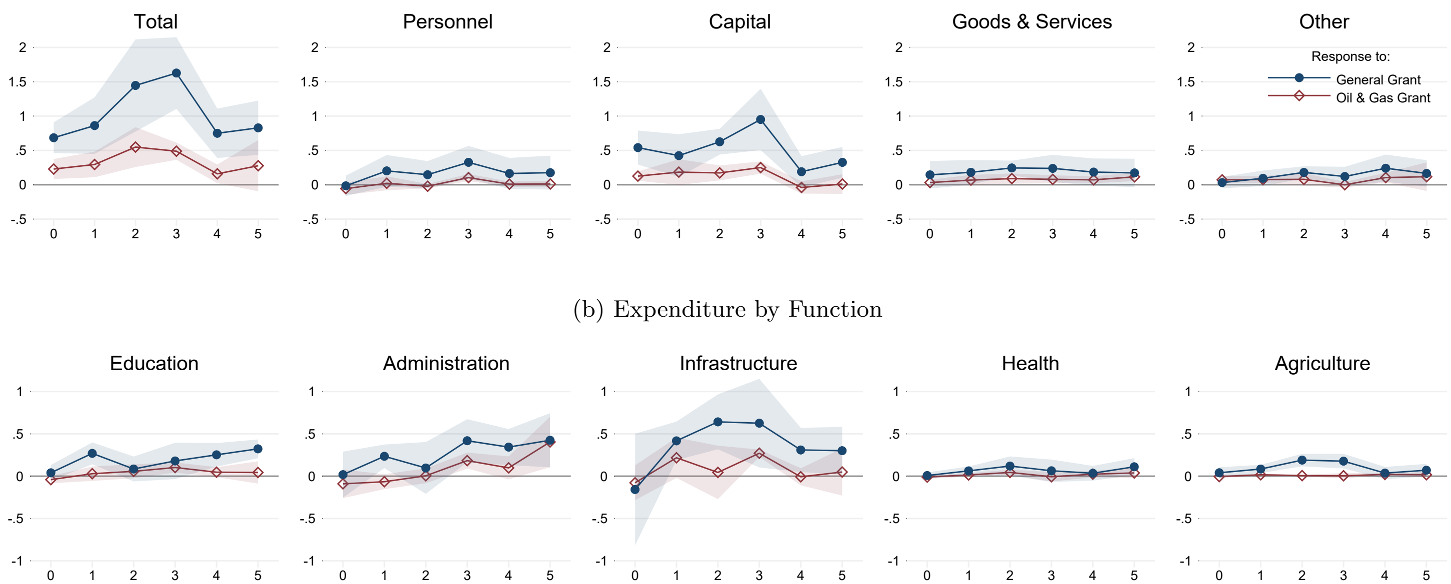


Notes: Each panel displays the distribution of the absolute two-year change in the general grant over 2005–2007 (solid bars) and the distribution of absolute two-year changes in the oil and gas grant over all years (hollow bars). Panel (a) uses the entire sample of districts, and Panel (b) uses the subsample of districts that were highly exposed to the grant shocks. High exposure to the general grant shock is defined as being in the top 25% in terms of land area per capita in 2006 and not being located in a hydrocarbon-rich province. High exposure to the oil and gas grant shocks is defined as being in the top 5% in terms of average hydrocarbon endowment per capita. Revenue is expressed in constant 2010 IDR per capita (millions).

Figure A.3: Dynamic Expenditure Responses to Grants

(a) Expenditure by Economic Classification

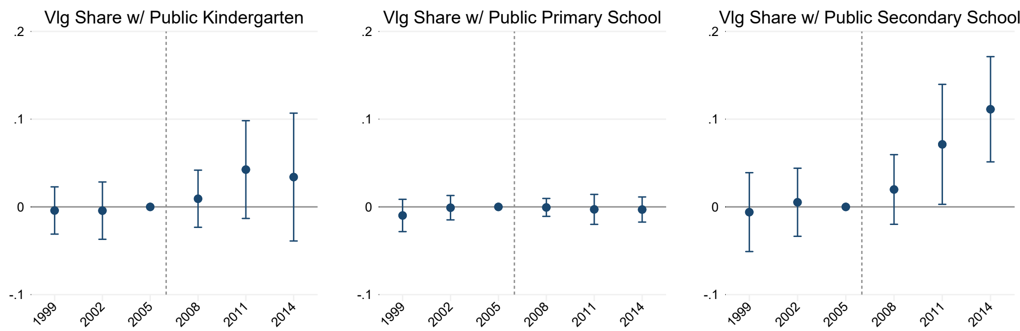
(b) Expenditure by Function



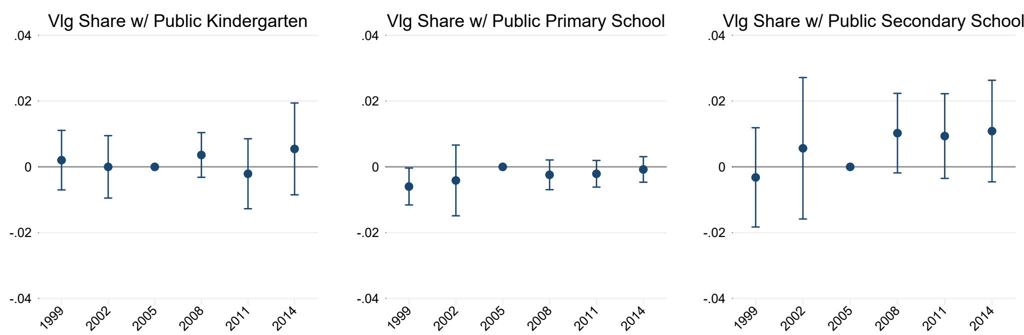
Notes: This figure displays IV estimates and 95-percent confidence intervals for β_h and δ_h from Equation (1), using one-year changes in grants ($k = 1$). Values of h are on the horizontal axis. Confidence intervals are robust to heteroskedasticity and two-way clustering by district and province-by-year.

Figure A.4: Reduced-Form Effects of Grant Exposure on Educational Access over Time

(a) Year-by-Year Gradient in *Area p.c. 2006* × *Non-Oil/Gas* Relative to 2005

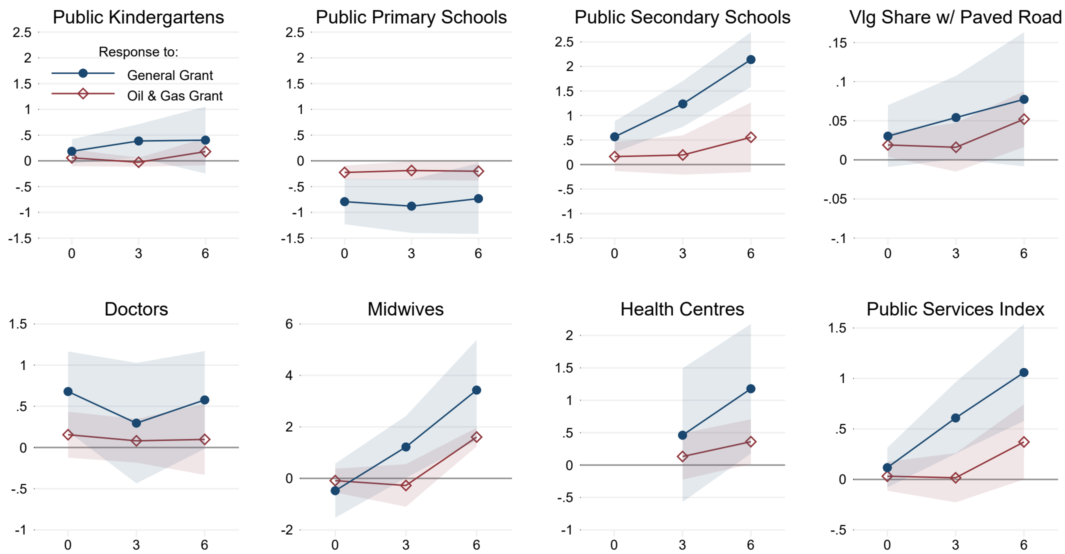


(b) Year-by-Year Gradient in *Average Endowment p.c.* Relative to 2005



Notes: This figure displays point estimates and 95-percent confidence intervals for $\{\theta_s\}_{s\in\mathcal{S}}$ (Panel (a)) and $\{\gamma_s\}_{s\in\mathcal{S}}$ (Panel (b)) in Equation (5). The reference year is 2005. The regressions additionally control for year effects interacted with the following variables (measured in 2000): ethnic fractionalisation, urbanisation rate, share of population aged 15–64, share of population with a primary education, share of population with a secondary education, and log GDP per capita. Average hydrocarbon endowment per capita is measured in constant 2010 IDR 100 millions to make the vertical axes in the two panels similar. Confidence intervals are robust to heteroskedasticity and two-way clustering by district and province-by-year.

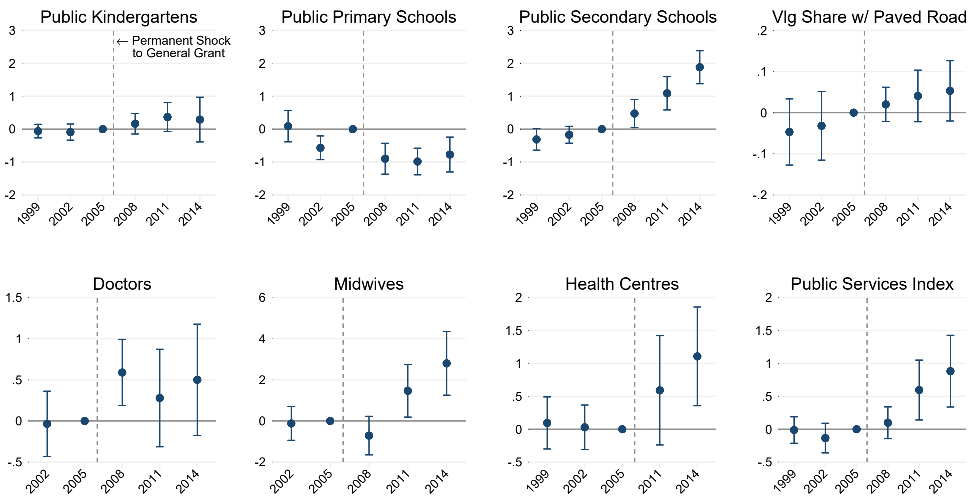
Figure A.5: Dynamic Responses of Public Service Delivery to Grants



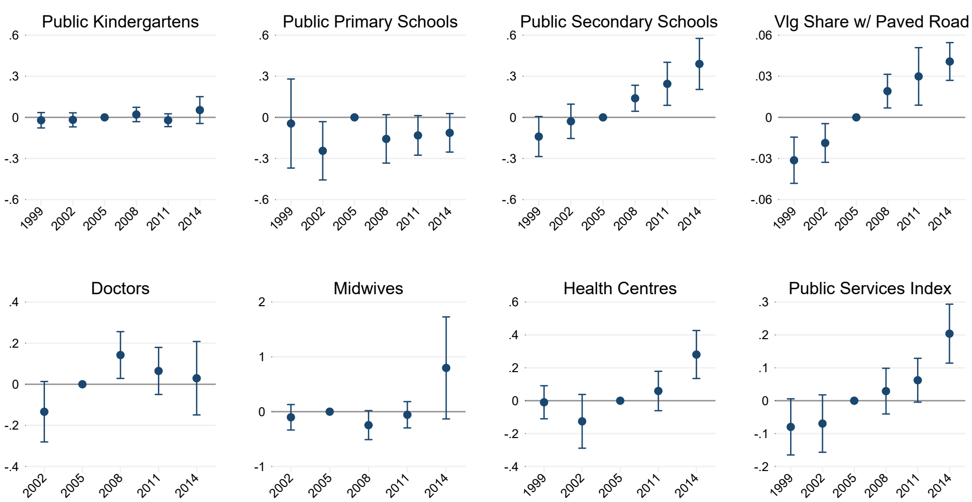
Notes: This figure displays IV estimates and 95-percent confidence intervals for β_h and δ_h from Equation (4). Values of h are on the horizontal axis. The parameters cannot be identified at $h = 0$ for health care centres, because this variable is missing in 2008. Confidence intervals are robust to heteroskedasticity and two-way clustering by district and province-by-year.

Figure A.6: Reduced-Form Effects of Grant Exposure on Public Service Delivery over Time: Controlling for Baseline Covariates × Year Effects

(a) Year-by-Year Gradient in *Area p.c. 2006* × *Non-Oil/Gas* Relative to 2005

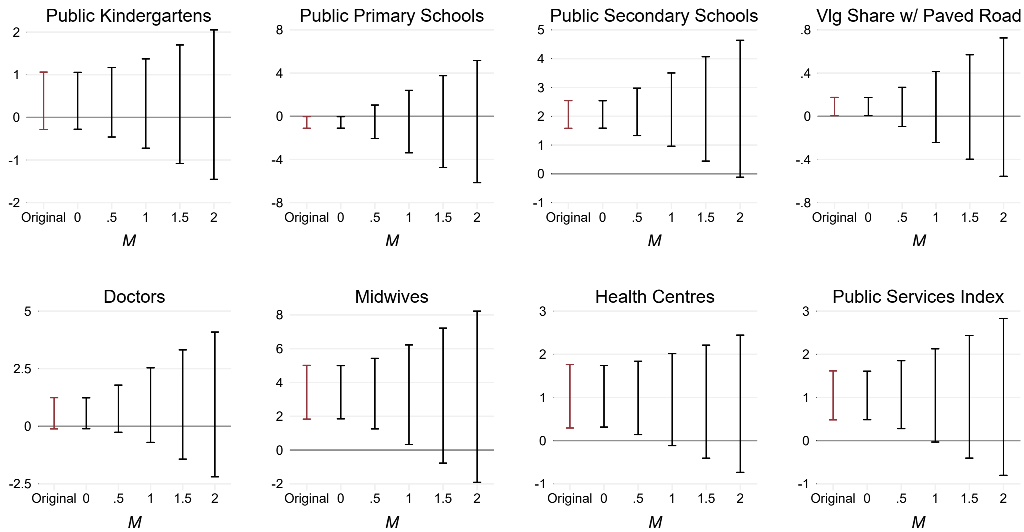


(b) Year-by-Year Gradient in *Average Endowment p.c.* Relative to 2005



Notes: This figure displays point estimates and 95-percent confidence intervals for $\{\theta_s\}_{s\in\mathcal{S}}$ (Panel (a)) and $\{\gamma_s\}_{s\in\mathcal{S}}$ (Panel (b)) in Equation (5). The reference year is 2005. The regressions additionally control for year effects interacted with the following variables (measured in 2000): ethnic fractionalisation, urbanisation rate, share of population aged 15–64, share of population with a primary education, share of population with a secondary education, and log GDP per capita. Average hydrocarbon endowment per capita is measured in constant 2010 IDR 100 millions to make the vertical axes in the two panels similar. Confidence intervals are robust to heteroskedasticity and two-way clustering by district and province-by-year.

Figure A.7: Reduced-Form Effects of General Grant Exposure: Sensitivity Analysis



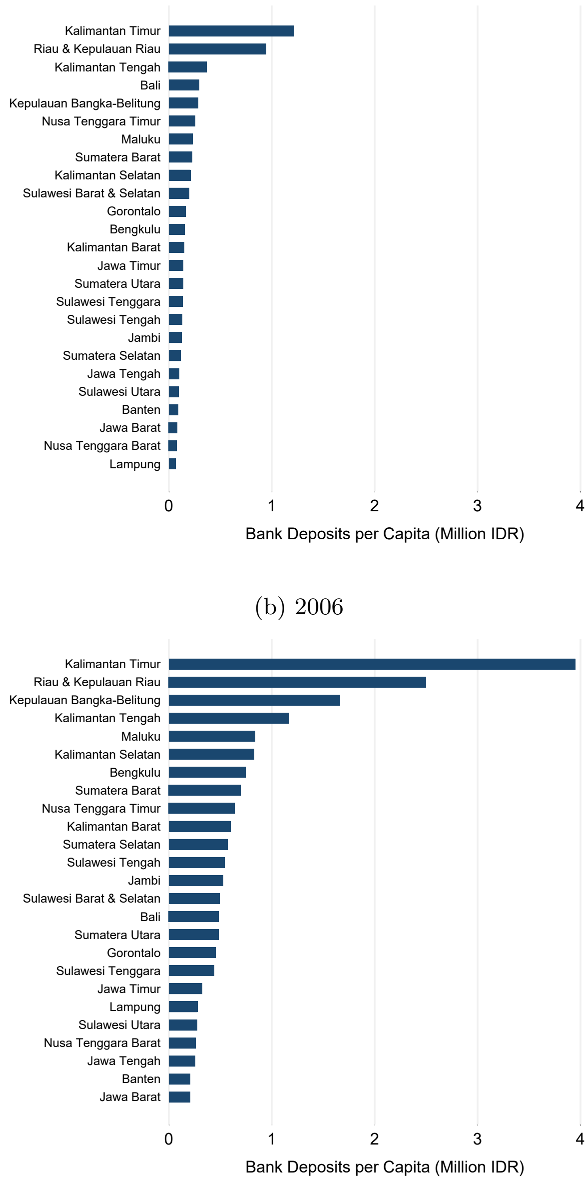
Notes: This figure displays robust 95-percent confidence intervals for θ_{2014} in Equation (5) following Rambachan and Roth (2023). For each M, the confidence interval is robust to the maximum post-treatment violation of the constant gradient assumption being up to M times the maximum pre-treatment violation of the constant gradient assumption. Formally, let ζ_t denote the change in the gradient in exposure to the general grant reform from 2005 to year t that would have occurred in the absence of the reform. (ζ_{2005} is normalised to zero.) For $t < 2005$, ζ_t is identified as the differential pretrend in the gradient. For $t > 2005$, ζ_t quantifies the (hypothetical) bias in our estimate of θ_t in Equation (5) due to a violation of the constant gradient assumption. For a given M, the confidence interval is robust to $\zeta = (\zeta_{1999}, \zeta_{2002}, \ldots, \zeta_{2014})$ such that

$$\zeta \in \left\{\zeta : \forall t \geq 2005,\ |\zeta_{t+3} - \zeta_t| \leq M \cdot \max_{s \leq 2005} |\zeta_s - \zeta_{s-3}|\right\}.$$

Conditional least favourable hybrid confidence sets are produced using the Stata package `honestdid`.

Figure A.8: Outstanding Commercial Bank Deposits Owned by District Government

(a) 2002



(b) 2006

Notes: This figure shows the outstanding commercial bank deposits per capita owned by district governments, expressed in constant 2010 IDR (millions) and aggregated by province. Panel (a) shows deposits in 2002, and Panel (b) shows deposits in 2006.

Affiliations

[1]Department of Economics, Finance, and Legal Studies, University of Alabama, 361 Stadium Dr., Tuscaloosa, AL 35487 USA

References

Arellano, M. and Bond, S. (1991). 'Some tests of specification for panel data: Monte carlo evidence and an application to employment equations', *Review of Economic Studies*, vol. 58, pp. 277–297.

Arellano, M. and Bover, O. (1995). 'Another look at the instrumental variable estimation of error-components models', *Journal of Econometrics*, vol. 68, pp. 29–51.

Bazzi, S. and Clemens, M.A. (2013). 'Blunt instruments: Avoiding common pitfalls in identifying the causes of economic growth', *American Economic Journal: Macroeconomics*, vol. 5(2), pp. 152–186.

Blundell, R. and Bond, S. (1998). 'Initial conditions and moment restrictions in dynamic panel data models', *Journal of Econometrics*, vol. 87, pp. 115–143.

Bond, S. (2002). 'Dynamic panel data models: A guide to micro data methods and practice', Cemmap, Institute for Fiscal Studies.

Christelis, D., Georgarakos, D., Jappelli, T., Pistaferri, L. and van Rooij, M. (2020). 'Asymmetric consumption effects of transitory income shocks', *Economic Journal*, vol. 129(622), pp. 2322–2341.

Fitrani, F., Hofman, B. and Kaiser, K. (2005). 'Unity in diversity? the creation of new local governments in a decentralising indonesia', *Bulletin of Indonesian Economic Studies*, vol. 41(1), pp. 57–79.

Harris, R.D.F. and Tzavalis, E. (1999). 'Inference for unit roots in dynamic panels where the time dimension is fixed', *Journal of Econometrics*, vol. 91, pp. 201–226.

Holtz-Eakin, D., Newey, W. and Rosen, H.S. (1988). 'Estimating vector autoregressions with panel data', *Econometrica*, vol. 56(6), pp. 1371–1395.

Khan, A. and Thomas, J.K. (2008). 'Idiosyncratic shocks and the role of nonconvexities in plant and aggregate investment dynamics', *Econometrica*, vol. 76(2), pp. 395–436, doi: 10.1111/j.1468-0262.2008.00837.x.

Kleibergen, F. and Paap, R. (2006). 'Generalized reduced rank tests using the singular value decomposition', *Journal of Econometrics*, vol. 133(1), pp. 97–126.

Leland, H.E. (1968). 'Saving and uncertainty: The precautionary demand for saving', *Quarterly Journal of Economics*, vol. 82(3), pp. 465–473.

Martínez-Bravo, M., Mukherjee, P. and Stegmann, A. (2017). 'The non-democratic roots of elite capture: Evidence from soeharto mayors in indonesia', *Econometrica*, vol. 85(6), pp. 1991–2010.

Minnesota Population Center (2020). 'Integrated public use microdata series, international: Version 7.3', Minneapolis, MN, https://doi.org/10.18128/D020.V7.3.

Nickell, S. (1981). 'Biases in dynamic models with fixed effects', *Econometrica*, vol. 49(6), pp. 1417–1426.

Obstfeld, M. and Rogoff, K. (1996). *Foundations of International Macroeconomics*, Cambridge, MA: MIT Press, first edn.

Rambachan, A. and Roth, J. (2023). 'A More Credible Approach to Parallel Trends', *Review of Economic Studies*, vol. 90(5), pp. 2555–2591, ISSN 0034-6527, doi: 10.1093/restud/rdad018.

Roodman, D. (2009). 'A note on the theme of too many instruments', *Oxford Bulletin of Economics and Statistics*, vol. 71(1), pp. 135–158.

Rystad Energy (2016). 'Ucube database', https://www.rystadenergy.com/Products/EnP-Solutions/UCube, accessed September 18, 2016.

Sanderson, E. and Windmeijer, F. (2016). 'A weak instrument f-test in linear iv models with multiple endogenous variables', *Journal of Econometrics*, vol. 190, pp. 212–221.

Shah, A., Qibthiyyah, R. and Dita, A. (2012). 'General purpose central-provincial-local transfers (dau) in indonesia: From gap filling to ensuring fair access to essential public services for all', World Bank.

van der Ploeg, F. and Venables, A.J. (2013). 'Absorbing a windfall of foreign exchange: Dutch disease dynamics', *Journal of Development Economics*, vol. 103, pp. 229–243.

Vegh, C.A. and Vuletin, G. (2015). 'Unsticking the flypaper effect in an uncertain world', *Journal of Public Economics*, vol. 131, pp. 142–155.

Wasi, N. and Flaaen, A. (2015). 'Record linkage using stata: Preprocessing, linking, and reviewing utilities', *Stata Journal*, vol. 15(3), pp. 672–697.

World Bank (2007). 'Spending for development: Making the most of indonesia's opportunities', World Bank, Jakarta.

Zeldes, S.P. (1989). 'Consumption and liquidity constraints: An empirical investigation', *Journal of Political Economy*, vol. 97(2), pp. 305–346.