Resource Shocks and Local Public Goods: A Tale of Two Districts[*]

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FIRST DRAFT: October 7, 2014
THIS DRAFT: January 18, 2016

[*] Thanks to Julian Dierkes, Fabrizio Gilardi, Alan Jacobs, Stefanie Walter, seminar participants at LSE, Oxford, UBC, the University of Zürich, and participants at the International Political Economy Society and the Midwest Political Science Association for comments on earlier drafts. We are responsible for all errors.

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Introduction

Although the politics of natural resource wealth is a central issue in contemporary political economy, the linkages between the extraction of natural resources and the local communities that extract them remain poorly understood. Because natural resource extraction is a localized activity, it should have consequences that vary spatially within resource-dependent states. Moreover, investments in resource extraction technologies may generate disproportionately large spillover effects in the communities where resource extraction takes place, especially given the immense resources held by multinational firms engaged in extractive activities. Analyses of the local political economy of natural resource extraction, however, are generally complicated by the complex administrative structures and intergovernmental transfer rules that determine the extent and conditions under which resource rents flow to the communities in which resources are extracted.

This manuscript examines the micro-level consequences of resource revenues on public service provision using evidence from Indonesian Papua. Specifically, we focus on the Bintuni gas fields in the district of Teluk Bintuni in West Papua province, and the Grasberg mine in the district of Mimika in Papua province. Each district is the site of heavy resource extraction, but the Grasberg mine has operated for decades while the Bintuni gas fields only began to produce gas in 2009. Exploiting the onset of resource revenue flows in Teluk Bintuni after 2009, we use detailed qualitative information on Indonesian budgetary laws and Papuan special autonomy provisions to construct a model of resource revenue flows from national to provincial to district governments, and from there to villages, in decentralized Papua and West Papua. This model implies a triple-difference (DDD) estimator that identifies how resource shocks affect village-

level public service provision. Using multiple waves of the Indonesian village census, we find consistent evidence of disproportionately slower growth in electrification after the onset of resource revenue flows. We find no consistent evidence that resource shocks affected the provision of government-supported village-level health care facilities or primary schools. Additional results involving non-state provided electricity, violence, and other features of local political economies suggest that our findings can be attributed to a decrease in the accountability of politicians and bureaucrats that is associated with the onset of resource revenue flows.

Our manuscript makes two broad contributions. First, we provide a micro-level analysis of the effects of natural resource revenues on public service provision. We join several recent analyses of the political and institutional foundations of the "resource curse" to highlight the specific channels linking resources to political and economic outcomes (see e.g. Dunning 2008; Jones Luong 2010; Morrison 2013; Ross 2012; Smith 2007), but leverage the power of a subnational research design to identify micro-level effects on local communities. Second, we provide a new perspective on the linkages between local public services and global markets, illustrating how multinationals' own activities shape the availability of public services in resource-producing regions. In doing so, we highlight the importance of the *specific* multi-level governance structures that condition the flow of resource wealth from multinationals to host governments. These are the institutions that transmit resource wealth to local communities where resources are extracted, and the details matter. In cases like Indonesian Papua, for example, naïve regressions of resource production on economic and political outcomes will miss the specific channels of multilevel governance through which resource effects must operate. "Cross-level" and "cross-scale" governance interactions are topics of special concern in public administration, environmental management, and related literatures (see e.g. Adger et al. 2006), but receive less

attention in political science. Nevertheless, we join recent theoretical and empirical analyses in American and comparative politics in calling for more attention to multilevel governance in contemporary democracies (see e.g. Hooghe and Marks 2003, Berry 2008).

In the next section we review the literatures on the resource curse and multilevel governance in decentralized states, highlighting that subnational effects of resource rents remain understudied. We then describe the Papuan case in more detail, comparing and contrasting the gas and mining industries and explaining how resource rents flow through the central government to provinces, producing districts, and ultimately to villages. The following section describes our empirical model, then presents our main results. We then explore several mechanisms that might explain the negative relationship that we have uncovered between the onset of resource revenues and public services. The final section concludes.

Natural Resources and Multilevel Governance

An immense body of research has explored the links between dependence on natural resource revenues and a host of political and economic ills, with foundational studies and subsequent work finding significant relationships between natural resource revenues and slower economic growth (Sachs and Warner 1995), increased likelihood of civil war (Collier and Hoeffler 2000), and less democratic government (Ross 2001). Other work has questioned the premise that the presence of natural resources has unconditionally negative effects on political and economic outcomes. There are clear exceptions in countries like Botswana, Norway and the United States, and the resource curse appears only to have manifested itself in developing countries after the wave of nationalization in the 1960s and 1970s (Ross 2012). Scholarship in the "conditionalist" (Morrison 2013) camp has studied how the type and quality of fiscal and political institutions shape the effects of natural resource wealth on a country's economic and

political outcomes. Related work examines how institutional quality interacts with the properties of particular natural resources to produce negative or positive effects on economic growth (Mehlum, Moene, and Torvik 2006; Boschini, Pettersson, and Roine 2007; Menaldo 2014).

While much of this literature has focused on its effects at the national level, it is natural to examine how the potential negative effects of natural resource wealth filter down to the subnational level. Yet relatively little work has focused on how subnational regions may experience the resource curse, or how that curse is mediated by fiscal and political institutions. This is puzzling, given that natural resource exploitation—in tiny petrostates excluded—is always spatially concentrated. Spillover effects from resource extraction should be spatially concentrated as well. But more importantly, it is also the case that natural resources that produce "a large, opaque, and volatile flow of revenues in the hands of the state" (Ross 2012: 225) will be unequally distributed by that state. State policies and institutions that govern inter-jurisdictional and fiscal relations mediate the terms of that unequal distribution.

Existing research on the subnational consequences of natural resource wealth has provided mixed evidence of its effects. In Brazilian municipalities, fiscal windfalls from oil production have been associated with higher levels of corruption and lower quality mayoral candidates (Brollo et al. 2013), and lead to higher spending on some public goods, but there is some evidence that some revenues are lost to corruption and patronage. In contrast, Aragón and Rud (2013) find a highly localized natural resource "blessing" in higher income and welfare indicators among the population living in proximity to a large mine in Peru. Some work examines the resource curse in the US context, finding dependence on natural resource extraction slows economic growth variously at the state and county level, with politicians using oil rents to stay in office longer (Goldberg, Wibbels, and Mvukiyehe 2008; James and Aadland 2011). Still

other work on subnational consequences of resource wealth analyzes the effects of natural resources on civil conflict (see e.g. Buhaug and Gates 2002; Lujala 2010).

The subnational politics of resource wealth, though, differs in that ownership of natural resources often lies with the central government. As a result, rents may not accrue to the localities where resources are found—unless fiscal arrangements allow it. Revenue sharing between national governments and producing regions is predicated on the idea that such regions should share in the benefits of producing oil (Ross 2012: 239). However, this means that they also will be subject to fluctuating revenues. A review of literature on the role of the subnational resource curse (Paler 2011, 15) found that there has been little work connecting revenue sharing agreements in fiscally decentralized settings to resource booms and busts.

There are two important differences between our work and the small but growing body of literature on the subnational resource course. First, our work focuses on the effects of revenue *shocks*, ascertaining whether the sudden influx of new resource wealth alters the dynamics of public goods provision. In contrast, existing work on the subnational resource curse (e.g. Goldberg, Wibbels, and Mvukiyehe 2008; Caseli and Michaels 2013; Brollo et al. 2013; for an exception see Aragon and Rud 2013) has focused on the effects of natural resource revenues over the long term, making it difficult to separate the effects of resource revenue onset from the political and economic equilibrium found in resource-rich regions. We isolate the short-term effects of resource rents by comparing before and after revenue onsets. Second, our work elucidates the specific institutional arrangements that govern public goods provision and transfers. This highlights a crucial contribution that subnationally-focused literature can make, capturing the specific institutional arrangements that matter for revenue sharing and transfers, rather than employing general proxies for "good" or "bad" institutions (Morrison 2009, 1122).

In sum, we make two broad contributions to the literature on the subnational resource curse. First, mindful of the challenges of associating resource revenues with a resource "curse" (Menaldo 2014), we design a research strategy that allows us to focus on the starkest form of revenue shock: the onset of large-scale resource revenue flows from a single facility in a local context where they had not previously been present. Second, we highlight how such an account must be embedded in a broader analysis of local and national political economies.

Resource Wealth and Inter-Governmental Transfers in Papua

Understanding how resource revenues affect local public service provision requires integrating three pieces of information: (1) fiscal budgeting laws that govern revenue sharing across administrative units, (2) the resource profiles of local jurisdictions, and (3) who is responsible for providing various kinds of public services. In this section, we address (1) and (2), showing how the characteristics of Indonesian Papua embed resource producing districts into a national political economy of natural resource extraction and transfers.[1] We reserve our discussion of (3), responsibility for village-level public services, for the following section.

Transfers

Transfers from the Indonesian central government have been the key source of revenue in Indonesian Papua for decades, even preceding Indonesia's decentralization reforms in 2001. Given outsized central government transfers of all forms, Papua and West Papua *as provinces* are less fiscally dependent on resource rents than some other resource-rich provinces. But this

[1] In Appendix Figure S2 we show price trends for copper and natural gas (Panel A), resource revenues in three important districts (Panel B), and total revenues in those districts (Panel C).

masks substantial variation across districts within Papua. In 2009, for example, Mimika district received the 20th highest amount of revenue sharing transfers in Indonesia—440 billion rupiah.

The three main forms of fiscal transfers from Indonesia's central government to provinces and districts are general allocation funds (*dana alokasi umum*), special allocation funds (*dana alokasi khusus*), and revenue sharing funds (*dana bagi hasil*). In addition, Papua and West Papua receive additional transfers in the form of special autonomy funds (*dana otonomi khusus,* or *dana otsus*). We discuss these in the Supplementary Materials: the first two types of transfer function equivalently across Papua and West Papua as in the rest of Indonesia.

Special autonomy funds operate differently. The Indonesian legislature granted special autonomy status for Papua in 2001. This represents yet another chapter in the fraught history of the Papuan region in relation to the Indonesian state, which absorbed Papua as the result of a controversial referendum in 1969 (for a recent overview, see Bertrand 2014). The region has been home to simmering conflict between indigenous and non-indigenous communities, a long-running separatist movement, and discontent over misrule from the distant national capital. Under the special autonomy law, and unlike other Indonesian provinces and districts, both Papua and West Papua receive 70% of oil and gas revenues until 2026. For non-oil and gas natural resources, Papua and West Papua receive the same percentages as other provinces via the standard *dana bagi hasil* formula, currently set at 80%. To understand the importance of this provision for local budgets, we turn now to discuss natural resources more generally.

Natural Resources

Papua and West Papua provinces are rich with natural resources, which include valuable petroleum, mining, forestry, and other resources. The districts of Mimika and Teluk Bintuni, however, are distinct in their disproportionately large natural resource bases.

The natural resource revenues of Mimika are dominated by the Grasberg mine, the largest gold mine in the world and one of the world's largest copper reserves. The Indonesian subsidiary of US-based Freeport-McMoRan Copper & Gold, Inc. has operated the site since 1988, though copper and gold exploitation began in 1967 (Nakagawa 2008, 75). The operation has been controversial from its inception, and has attracted significant resistance from local communities. Freeport operations have been the target of repeated protests, sabotage, and blockades that highlight its effect on the environment and local communities. As part of larger government action to suppress the separatist Free Papua Movement (*Organisasi Papua Merdeka*, OPM), these actions have often been met by violence from Indonesia's security forces. Freeport has paid the Indonesian military at least $20 million to protect the mines (Bonner and Perlez 2006).

The Tangguh liquefied natural gas (LNG) site in Teluk Bintuni began operation in 2009; gas reserves at the site were first discovered in 1994. A consortium of national and international contractors operates the site, with BP acting as the primary operator responsible for the project (BP 2014). Started with a capital investment of $5 billion, the site has production and transmission facilities, the LNG plant itself, an airfield, and marine facilities for cargo, and a host of other support facilities. As with the Grasberg facility in Mimika, the Tangguh project has been a source of local tension (Tangguh Independent Advisory Panel 2014).

The Grasberg mine and the Tangguh LNG facility are two of the largest and most prominent natural resource extraction sites in Indonesian Papua. But as noted above, there are many other types of natural resources found across Papuan and West Papuan districts. We hold aside analysis of these other forms of natural resources because they are nowhere near as important for any district's budget as are gas and mining for Mimika and Teluk Bintuni. The one exception is Raja Ampat district, which features a diverse array of natural resource rents. Unlike

Mimika and Teluk Bintuni, Raja Ampat district is not dominated by a single production facility or industry. There are around sixteen nickel production facilities operated by Indonesian companies in the district (Allard 2011). The district also has significant gas reserves in the Salawati block, which have been exploited by several multinational firms (Cahyafitri 2013).

In Table 2, we compare resource rents across the three districts. These data confirm Teluk Bintuni receives far more natural gas resource revenue than does any other district in West Papua province. (No districts in Papua province receive natural gas resource revenue.) By contrast, Mimika receives far more mining revenue than does any other district in Papua province. Finally, the data also show that Raja Ampat district receives ten times the mining revenue of other districts in West Papua, mainly from royalties (it is the only district in West Papua to have received mining royalties in 2010). Its gas revenue does not differ from other districts in West Papua. The data in Table 2 do not distinguish which mining resources, but we know that it is a diverse mix of minerals, not including copper. This explains why we do not observe the dip in revenue sharing transfers in Raja Ampat district in 2009 (see Supplemental Figure S2, Panel B).

In summary, our review of center-region transfers shows that resource rents flow from the national government to the provincial governments of Papua and West Papua, to the districts where resources were extracted (Mimika and Teluk Bintuni, respectively), and to non-resource producing districts. The central differences between mining and natural gas rents in Papua and West Papua are two: the lack of a clear formula for allocating natural gas revenues to producing districts, and a slight difference in the total going to provinces (80% of revenues for mining, 70% of revenues for natural gas). We note, further, that Raja Ampat also has substantial mining and natural gas resources, unlike other districts in West Papua. We will leverage this fact below in order to isolate the effect of the onset of resource rents on local public services.

Empirical Strategy

Our main focus is on the comparison between Mimika and Teluk Bintuni. This allows us to trace the precise effects of a *natural resource revenue shock* on local public service provision. We are able to separate out the effects revenue shocks from the effects of *having natural resources* or *multinational presence* because both of these factors are constant over time across both districts. Moreover, we are able to rule out the most serious inferential threat that we face—that reliance on resource revenue is endogenous to institutional quality (Menaldo 2014)—because the exploitation and taxing of natural resources is not a choice variable at either the district or the village level in Indonesia.[2] Furthermore, we are able to separate the effects of differential commodity prices (or commodity price shocks) because both price increases for copper and natural gas, and temporary shocks to world prices for both from the Global Financial Crisis, are comparable (see Supplemental Figure S2, Panel A). What changed in Teluk Bintuni between 2008 and 2011 was merely the arrival of natural gas revenue from the Tangguh gas facility.

Because resource-producing districts, resource-producing provinces, and non-resource producing districts within resource-producing provinces all benefit from natural resources revenue sharing, and all are responsible for providing public services at the village level, we cannot simply compare Mimika and Teluk Bintuni districts in order to examine changes in local public services resulting from the onset of resource flows. However, the fact that revenue sharing never extends across provincial borders suggests that comparing changes in Mimika and Teluk Bintuni districts relative to other districts in their own provinces will isolate the effects of

[2] It is possible that low quality provincial institutions on Papua and West Papua explain overreliance on natural resources in these two provinces *relative to the rest of Indonesia*.

changes in resource-producing districts on the provision of public services. The differences-in-differences-in-differences (DDD) estimator implied by this conceptual model of revenue sharing in Papua and West Papua is the foundation of our empirical analysis.

Specifically, we model village-level public services y_{it} as a function of the three-way interaction of indicators for resource wealth at the district level (*Resources*, coded 1 for Mimika and Teluk Bintuni districts), dominant resource (which for now we will assume varies at the province level, and which we accordingly capture with the dummy variable *Province*), and pre- versus post-resource revenue onset (*PostOnset*):

$$y_{it} = \beta_0 + \beta_1 Resources_d + \beta_2 Province_p + \beta_3 Resources_d \cdot Province_p + \delta_0 PostOnset_t + \delta_1 PostOnset_t \cdot Resources_d + \delta_2 PostOnset_t \cdot Province_p + \delta_3 PostOnset_t \cdot Resources_d \cdot Province_p + X_{it} + D_d + \varepsilon_{it}$$

Following Imbens and Wooldridge (2007), the DDD term $\hat{\delta}_3$ can be expressed as

$$\hat{\delta}_3 = \left(\bar{y}_{Papua,Resources,PostOnset} - \bar{y}_{Papua,Resources,PreOnset}\right) - \left(\bar{y}_{WestPapua,Resources,PostOnset} - \bar{y}_{WestPapua,Resources,PreOnset}\right) - \left(\bar{y}_{Papua,NonResources,PostOnset} - \bar{y}_{Papua,NonResources,PreOnset}\right)$$

The DDD estimate compares the changes in the average level of public services for villages in resource-dependent districts versus non-resource-dependent districts, for Papua (where resource revenues were present in both 2008 and 2011) versus West Papua (where revenues began in 2009).

Our data on public services at the village level come from the 2008 and 2011 rounds of the Indonesian "Village Potential" Survey (*Survei Potensi Desa*, or PODES). From PODES we obtain a rich set of indicators covering village level infrastructure, geography, social conditions,

and other important factors. PODES covers every inhabited place in Indonesia, and we have nearly 4,500 village-level administrative units across the two provinces.

Our main dependent variables are village-level electrification, health facilities, and primary schools. These are ideal measures of local public services for several reasons. First, they cannot be provided by villages alone, and instead require cooperation across multiple levels of government. In particular, electricity provision within Indonesia is exclusively the mandate of the state-owned electricity corporation *Perusahaan Listrik Negara*, or PLN. PLN notes that providing electricity to remote and underserved areas requires cooperation across multiple levels of government, from PLN itself as a national corporation down to province and district governments (see e.g. PLN 2014). Second, citizens also view electrification, health care, and schools as critically important public services (see e.g. Mohsin 2014). Third, there is evidence that multinational resource extractors are aware of this belief. For instance, the first report of the Tangguh Independent Advisory Panel (2014) describes BP's own position that it has a role in promoting the provision of electricity to villages in Teluk Bintuni district in hopes of lessening dissatisfaction with social conditions in villages in the district. Finally, these public services are common in the new literature on the politics of service provision (see recently Harding and Stasavage 2014; Kramon and Posner 2013; Min forthcoming).

Our measure of village-level electrification is the percentage of households within a village that have access to electricity provided by PLN. Across the two provinces, electrification rates are low (11.8% of households on average in 2008, rising to 13% in 2011), and also skewed (in more than 30% of villages, no households have access to electricity through PLN).

Health care facilities are more varied in character, but like electrification through PLN, they are provided through the cooperation of multiple levels of government and are important

public services from the perspective of both Indonesian citizens and the government. Based on the data available in PODES, we focus on three local-level community health facilities: *Puskesmas*, or community health centers; *Puskesmas Pembantu*, or "helper" community health centers; and *Posyandu*, or family planning and unified health service posts. We describe these more fully in the Supplemental Materials. PODES codes each as a dummy variable for presence or absence, and we use this as our measure of village-level health service provision.

We measure the availability of schooling through the presence of public elementary and middle schools *(sekolah dasar negeri* and *sekolah menengah pertama negeri*). In 2011, public elementary schools were present in 33.6% of villages, and public middle schools were present in 10.3% of villages. Importantly, however, the Indonesian education system relies on both public and private schools to private basic education. Across Indonesia, based on 2014 data, 89.3% of children enrolled in elementary schools are in state-run schools, but in Papua and West Papua provinces the percentages are much lower, at 63.8% and 63.1%, respectively (Kementerian Pendidikan dan Kebudayaan 2015). We will return to the issue of private schooling below.

Electrification, health care, and schooling also provide an important contrast. Village-level electrification is likely to be subject to spillover effects from resource extraction activities themselves. Because integrated mining and gas drilling operations themselves require electricity, provided in some fashion, their existence should lower the cost of providing electricity to those villages nearby. In contrast, no such spillovers are likely in the case of health care facilities[3] or

[3] In general, resource extractors do not have a direct interest in the health of those living near sites of resource extraction, for their formal labor force is drawn from elsewhere and informal labor is abundant and substitutable. Multinationals may have an indirect interest in the health or

primary schools. This will provide us leverage on one possible mechanism linking resource shocks to public service provision.

The identifying assumption of "parallel trends" in difference-in-difference models requires that changes in treated and control groups from pre- to post-treatment would have been identical without the treatment (see Angrist and Pischke 2009: 227-242). Our triple-difference approach relies on a less demanding "parallel trends in trends" assumption. In our substantive application, this assumption holds that the changes in local public services in villages in resource-dependent Mimika district relative to villages other districts in Papua province would have been identical to those villages in resource-dependent Teluk Bintuni relative to villages in other districts in West Papua province. We can further weaken this assumption by including time-varying village-level controls X_{it} as well as district-level fixed effects D_d. Note that given that we have only two periods, we are unable to include village-level fixed effects. We will address plausible objections to our identification assumption of parallel trends in trends below.

We include three main control variables in X_{it}: village population size as proxied by the total number of households in the village (*HH Population*), the remoteness of the village as measured by the distance in kilometers from the village to the office of the district head (*Remoteness*), and an indicator variable denoting those villages with a majority of Muslim residents (*Muslim*). *HH Population* captures the basic expectation that more populous villages should be more likely to enjoy state-provided public services. *Remoteness* captures the state's difficulty in penetrating remote areas in order to deliver public services. And finally, *Muslim* is a rough measure of the Indonesian state's interest in providing public services. In the Papuan

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education of local communities, but primarily to contain social unrest, or to attest to their own corporate social responsibility.

context, it will capture those villages and wards populated by Muslim transmigrants from Java and Sulawesi, as well as indigenous villages along the western and northern coasts in which Islam has had a longer presence.[4]

Another assumption underlying our empirical strategy is that natural gas facilities and mining facilities have similar consequences for local political economies. There are reasons to question how comparable these are. First, mining and natural gas facilities create different environmental impacts: copper and gold mines create arsenic as a result of smelting, and this can render runoff particularly toxic. Second, natural gas facilities often generate their own electricity. These two differences between natural gas and mining facilities may have implications for our findings. It might be that copper and gold mining creates a larger compensatory demand for public services than does natural gas. It could also be that natural gas facilities relieve the district government in Teluk Bintuni from having to access state-provided electricity because Tangguh itself is able to generate electricity for villagers' use.[5] Both of these possibilities might explain why the onset of natural resource revenues harmed public service provision, but neither reflects a resource curse-like causal mechanism. We address these alternative explanations below.

A brief aside on the quality of the PODES data is in order. Papua and West Papua are politically sensitive, economically important, and extremely poor peripheral regions, and the challenges associated with administering a village census there are substantial. This may lead to

[4] To be clear, there is no explicit pro-Muslim policy in providing public services in Indonesia. However, as we show below, majority Muslim villages and wards in Papua and West Papua enjoy more of every type of public good that we can measure.

[5] While PLN is the state's electricity monopoly, private firms may sell electricity legally in places where PLN has not yet extended service.

the data to misrepresent conditions on the ground because of the difficulty of data collection and the incentives faced by government officials at different levels to paint a more positive (or possibly negative) picture. District authorities in Papua, for example, have inflated population statistics to push for the creation of new districts and new sources of rents (Anderson 2013).

We acknowledge these concerns, but barring further evidence do not have a reason to believe PODES data systematically misrepresent service provision in the two provinces in the ways that would threaten our inferences. In particular, PODES is a complete census of Indonesia's villages, where enumerators interview village officials regarding conditions in their villages (Tajima 2014: 69). Although there may be village-level incentives for misrepresenting the data, there is no reason to believe that this misrepresentation is distributed nonrandomly across provinces and resource producing districts. We are not aware of any unique incentive for villages in either Mimika or Teluk Bintuni district to intentionally misreport figures for PODES.

Our preferred specifications are OLS regressions with district fixed effects D_d and robust standard errors clustered by district-year. For health care facilities and schools, this implies a linear probability model. Although we also check the robustness of our results using logit and fractional logit models, we always retain the fixed effects and district-year clustering.

Results

Our baseline results appear in Table 3 (electricity), Table 4 (health care), and Table 5 (schools). Our main interest is in the DDD term, but we begin by discussion the component terms in order to facilitate interpretation.

*** Table 3, Table 4, and Table 5 here ***

First begin with electricity. In both models 1 and 2 in Table 3, the estimate for West Papua is negative and highly statistically significant: on average, fewer households in villages in West

Papua have access to electricity. The estimate for Resources is also negative and highly significant, meaning that on average, households in the resource-wealthy districts of Mimika and Teluk Bintuni have less access to electricity than do non-resource-wealthy districts. The estimates for *PostOnset* and West *Papua* × *PostOnset* are both insignificant, meaning that net of other determinants, there is no general pattern of growth in electrification between 2008 and 2011, either alone or within West Papua in particular. The estimate for *Resources* × *PostOnset*, however, *is* significant, meaning that relative to all non-resource districts, both Mimika and Teluk Bintuni experienced greater electrification between 2008 and 2011. Finally, the coefficient on West *Papua* × *Resources* × *PostOnset*—the DDD term—is negative and highly statistically significant. Electrification in Teluk Bintuni grew more slowly relative to other districts in West Papua than in Mimika relative to other districts in Papua.

Now turn to health care facilities (Table 4). Our baseline estimates find *more* growth in health care facilities in Teluk Bintuni. The same is true for public schools (Table 5). However, results for *posyandu* are no longer significant when we control for village-level observables. We will interpret these results below, but for now, we probe the robustness of these results.

Robustness

Our main concern is non-linearity, given the relative rarity of health care facilities and schools, and the non-normality of the distribution of village-level electrification. To confront these issues, we reestimate each regression in Table 3, Table 4, and Table 5 with a non-linear model.[6] Because the fraction of households with electricity in a village is bounded between 0 and

[6] Puhani (2012) shows that in non-linear difference-in-difference models, the coefficient on the interaction term is the estimate of the treatment effect.

1, we employ fractional logistic regression. For the binary presence or absence of a community health facility or school, we use logistic regression. Our results appear in Supplementary Tables S1, S2, and S3. The results for electrification and for schools are substantively identical in these nonlinear models. In the case of health care, however, our substantive results do change: no longer positive and significant, our DDD estimate for *puskesmas* is now negative and insignificant. Only the positive result for *puskesmas pembantu* remains.

Another concern is the DDD estimator itself. Our estimation strategy requires us to make inferences about the effect of district and province-level indicator variables on village-level outcomes. Rader (2011) proposes that permutation or randomization tests offer a more appropriate way to perform statistical inference on the effect of group-level variables in such contexts. This provides a non-parametric alternative to cluster-robust standard errors, comparing test statistics obtained from a benchmark specification to a set of hypothetical test statistics obtained by randomly assigning placebo treatment status across all possible units.

We propose a simple extension of the permutation test that we term a "double-permutation test." Like a permutation test, we assign treatment status randomly, but because we are comparing the effects both of province-level and district-level treatments, we randomly assign both (see Donohue and Ho 2007: 101-102). This, in effect, creates both "pseudo-provinces" and "pseudo-resource rich districts" from the population of 30 districts in Papua and West Papua. Our exact procedure is as follows:

1. Estimate model 2 in Table 3, and store the estimate $\hat{\delta}_3$ and its T-statistic. We refer to these as the "true" DDD estimate and the "true" T-statistic.
2. Randomly assign each district to belong either to Papua or West Papua.
3. Randomly assign each district to have natural resources or not.

4. Repeat step 1 using the random "West Papua" and "Resources" indicators.
5. Store the estimate $\hat{\delta}_3^*$ as well as its associated T-statistic. We refer to these as the "placebo" DDD estimate and the "placebo" T-statistic.
6. Repeat steps 2 through 6 a total of 500 times.

We follow these procedures two ways. In the first, we independently assign each district to be in Papua or West Papua, and to have resources or not, with equal probability. In a second, more conservative test, we allow the fraction of districts that belong to West Papua to vary uniformly between .2 and .8, and we allow the fraction of districts with natural resources to vary uniformly between .05 and .95. The result in both cases is a distribution of placebo DDD estimates and placebo T-statistics, which we then compare to the true DDD estimate and T-statistic. One complication is that on occasion, this procedure will by chance assign all resource-rich districts to fall within the same province, which will generate a placebo DDD estimate of exactly zero. As a conservative strategy, we discard these failed placebo tests from our analysis.

In Figure 1 we present our results from the second, more conservative double-permutation test.[7]

*** Figure 1 here ***

In the top panel, each figure contains the empirical cumulative distribution of all 500 placebo DDD estimates (less the failed tests). The red dashed line denotes the true DDD estimate. The p-value labeled in each figure is the (one-sided) p-value of the double-permutation test, calculated as the ratio of placebo estimates that are lesser (or greater) than the true estimate to the total number of non-zero placebo estimates. In the bottom figure, we compare true T-statistics to

[7] The results from the less conservative test that assigns provincial status and resource revenues with equal probability are available in Supplemental Figure S3.

placebo T-statistics, calculating the p-values in the same way. Our results for electricity are consistent with the baseline OLS and fractional logit results, with p-values less than .02 for tests of both DDD estimates and T-statistics. In the case of health care and schooling, however, this test reveals the fragility of the main results. The DDD estimate for *puskesmas pembantu* is larger than 95.6% of the placebo DDD estimates, and the DDD estimate for public middle schools is larger than over 99% of the placebo DDD estimates, but their T-statistics lie right in the middle of the distribution of estimated T-statistics. We conclude from this exercise that the estimated positive growth in health care and schooling in Teluk Bintuni district is not a robust finding.[8]

Mechanisms and Additional Results

Why has the onset of local natural gas revenue flows decreased state-provided electricity provision? We consider several potential mechanisms here.

We begin first by considering whether resource revenues have heightened the stakes of local conflict in the tense political environment of Indonesian Papua, standing in the way of the extension of local public services. From the PODES data, we obtain a binary indicator that captures the presence of mass violence within the village (*Violence*). We first estimate our standard OLS and logit models to check whether violence is higher in villages located in resource-producing districts, or whether it has risen since 2008 in Teluk Bintuni. The results appear in Supplementary Table S4. In three out of four models, we find a *negative* relationship between resource revenues and village-level violence. More importantly, in all four models we find that violence is lower in 2011 in Teluk Bintuni relative to the rest of West Papua, and

[8] Note that our use of a permutation-based test is limited to exploring the sign and statistical significance of our DDD estimate versus a sharp null of no causal effect of resource shocks on village-level public services.

relative to Mimika. We then reestimated our baseline OLS models of electricity, health care, and schooling using village-level violence as an additional covariate. The results appear in Supplementary Table S5. Villages experiencing mass violence tend to enjoy *higher* levels of state-provided electricity and state-provided health care. It is possible that this finding simply represents better local administrative capacity to report violence in those places that also enjoy some state presence. Another interpretation is that violence clusters precisely around places where the state is present, although such an interpretation is beyond the scope of this manuscript (see Tajima 2013). Most importantly, we can conclude that an increase in local violence does not explain our finding that resource shocks lead to lower levels of public service provision.

Another possibility is that the existence of natural gas revenues rather than *onset* of natural resource revenue flows is associated with slower growth in electrification, in which case it is the specific characteristics of particular commodities that matters, not the revenues that they generate. Recall that in addition to Teluk Bintuni district, Raja Ampat district in West Papua also produces natural gas, and has done so for almost two decades. However, by 2012 (see Table 2) the natural resource revenues from Raja Ampat were no different than those for any other district in West Papua, and were also dwarfed by Teluk Bintuni. To test whether it is the onset of revenues rather than the existence of natural gas facilities that explains our findings, we redefine *Resources* as an indicator variable for each of the three districts (Teluk Bintuni, Raja Ampat, and Mimika) and then add another indicator variable *Gas Discovery* for Teluk Bintuni. We then estimate a quadruple-difference model that interacts *Resources* and *Gas Discovery* to isolate the effect of the onset of resource revenue flows. Our results appear in Supplementary Table S6. Our results differ depending on whether we control for village-level covariates: in Model 1 in Supplementary Table S6 we find that Teluk Bintuni villages grew in electrification more than

Raja Ampat, but the sign reverses in Model 2, our preferred specification. This is evidence that the onset of natural gas resource revenue flows rather than the presence of natural gas explains lower levels of electrification in Teluk Bintuni.

We also entertain four possibilities about spillover effects. Perhaps villages are substituting electricity generated from non-official sources for electricity provided by PLN, which would indicate positive private sector spillovers—if this is true then what appears to be a resource "curse" is simply a substitution of private services for public services. As a parallel for publicly provided health care, we also investigate whether apothecaries—which unlike *puskesmas*, *puskesmas pembantu*, and *posyandu* are privately provided—are more or less common after resource shocks. As a parallel for public schools, we investigate where private elementary schools are more or less common after resource shocks. We report our results in Supplementary Table S7.

Our results are inconsistent with resource shocks leading to positive spillovers into the private sector. In fact, for non-PLN electricity and apothecaries, the DDD term is negative and highly statistically significant, indicating that both privately-generated electricity and private health care facilities in Teluk Bintuni grew more slowly relative to other districts in West Papua than in Mimika relative to other districts in Papua. Only in the case of private elementary schools do we observe a positive effect of resource shocks on public services. One possible explanation is that constructing private primary schools is a high-profile yet inexpensive way for MNCs to demonstrate their commitment to the communities within which they operate. We are unable to find direct evidence that BP is involved in school construction in Teluk Bintuni, although it has targeted other schooling improvements in the district (Tangguh Independent Advisory Council 2014). Construction of private primary schools may also be a result of increased demand from

the non-indigenous workers with families at the Tangguh facility, as private schools in Papua are where the majority of non-indigenous residents are schooled (Mollet 2007).

It is also possible that the completion of the Tangguh LNG site after 2008 led to a reversion to the baseline rate of growth for electrification in Teluk Bintuni. This would amount to a violation of the "parallel-trends-in-trends" assumption discussed above. The construction of the Tangguh facility employed up to 9,000 people as manual and unskilled laborers, presumably including workers from outside the district (Down to Earth 2007), and this may have "frontloaded" the provision of electricity near the facility itself. The ideal test of this mechanism would be a placebo in time analysis using data from rounds of PODES prior to 2005, but we are unable to find useable PODES data in West Papua prior to 2005. We can, however, examine other implications of this account using the data available to us. If construction spillovers from Tangguh's construction drove an unusually high rate of electrification before 2008 and a reversion to "normal" growth between 2008 and 2011, we would expect that lower growth rates of electrification would be disproportionately clustered in areas closest to the facility itself. While we lack geo-coded data on village locations, the data indicate that most electricity is provided in the most densely populated subdistrict in Teluk Bintuni, located across Bintuni Bay and approximately thirty miles away from the Tangguh facility. This fact is inconsistent with an account in which growth in village level electrification prior to 2008 represented an abnormal spike in electrification rates associated with the construction of the facility itself.

We noted above that two differences between natural gas and mining could affect public service provision. Perhaps mining is locally more polluting than natural gas extraction, and creates a larger compensatory demand for public services. In principle this is possible, although we think it unlikely that village governments in Mimika are obtaining more electricity to make

up for pollution from Grasberg. It could also be that the Tangguh facility relieves the district government in Teluk Bintuni from having to access state-provided electricity because Tangguh itself is able to generate electricity for villagers' use. This too is plausible, but recall that we find that *non-PLN* electricity has also grown more slowly in Teluk Bintuni relative to expectations. As these data would include electricity from the Tangguh facility itself, it is unlikely that substitution to the Tangguh facility's own electricity explains slower growth in PLN electricity.

The final mechanism that we entertain involves the effects of new resource flows on the incentives of district politicians to respond to citizen demands for public services. This mechanism parallels Brollo et al.'s (2013) analysis of the effects of nontax revenues on the behavior of local politicians. Under conditions of non-transparency about how resource revenues are distributed and used at the provincial and district level, the substitution of opaque resource revenues in place of other forms of central government transfer offers greater leeway for local elites to use these funds as they prefer. Resource revenues can be used to buy political support from voters or intermediaries, or for private consumption, in either case lessening the pressure on governments to distribute public services. Local elections in both provinces provide a weak mechanism of accountability. In 2013, Mimika's district head election featured 99.5% turnout and less than .1% of spoiled ballots, rates that independent observers agree are unobtainable without manipulation of ballot results (IPAC 2014). Nevertheless, resource revenues may give local leaders even less reason to push for more public service provision, and may also insulate district politicians and bureaucrats from oversight by provincial and central governments.

Due to legal restrictions on our conducting field research on local politics in Indonesian Papua, we do not have sufficient qualitative evidence to evaluate empirically whether the onset of revenue flows has changed politicians' incentives to provide public services in ways that are

consistent with these mechanisms. (We discuss these restrictions further in the Supplemental Appendix.) However, such an account is consistent with common perceptions among regional specialists that political accountability is poor in resource-rich Papuan and West Papuan districts.

Conclusion

This manuscript has studied the micro-level consequences of resource shocks, finding that the onset of natural resource revenues at the district level can retard the provision of public service provision at the village level in Indonesian Papua. Specifically, we have documented that the onset of natural gas production in Teluk Bintuni district led to slower growth in electrification relative to other districts in West Papua and to other resource-rich districts in Papua. These effects are present in village-level electrification, but not in other public services such as village-level health facilities and schooling, which we interpret as reflecting negative spillovers on public service provision among those public services that are most closely related to the infrastructural demands of resource extraction. Our finding of slower growth in electrification from sources other than the state electricity monopoly PLN suggests that these effects are not the result of positive spillover effects into local private economies.

Our findings contribute to the growing literature on the subnational resource curse. They also point to the partial success of institutional arrangements in ameliorating the effects of the resource curse, offering evidence consistent with a "conditionalist" interpretation of the resource curse. While we find that the onset of resource revenue flows did have negative effects on public service provision, the fiscal arrangements provided under special autonomy in Indonesian Papua may also have smoothed out fluctuations in resource transfers even during the downturns of the Global Financial Crisis. While reducing the effect of resource shocks on *revenue transfers*, however, the vulnerability of resource-dependent areas to other negative spillovers appears

unchanged. Exploring these combinations of inherent and mutable properties of natural resources offer a promising avenue for further research.

Finally, this manuscript also illustrates the challenges of studying the subnational effects of resource extraction. Understanding how resource-producing communities confront revenue flows requires understanding how local communities are embedded into complex multilevel governance structures as well as the specific features of inter-governmental fiscal relations. Moreover, our case studies of BP and Freeport in Teluk Bintuni and Mimika reveal that relations between multinational firms and local governments are just as important as relations between multinationals and national governments. Future research into the subnational resource curse must be attentive to local, national, and global economic dynamics in order to understand exactly how resource-producing districts suffer from their resource endowments.

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Table 1: Natural Resource Revenue Sharing

Resource	Allocation			
	Center	*Province*	*Producing District*	*Other Districts*
Forestry				
Concessions	20%	16%	64%	0%
Royalties	20	16	32	32
Mining				
Land rent	20	16	64	0
Royalties	20	16	32	32
Oil				
Rest of Indonesia	85	3	6.5	6.5
Papua and West Papua	30	70		
Gas				
Rest of Indonesia	70	6	12	12
Papua and West Papua	30	70		

Note: "Rest of Indonesia" excludes Aceh province. Adapted from World Bank 2005, 26; Agustina et al. 2012.

Table 2: Natural Resource Revenue Sharing Transfers (2010 and 2012)

	Papua		West Papua		
	Mimika	*Average Others (Papua)*	*Teluk Bintuni*	*Raja Ampat*	*Average Others (West Papua)*
Mining Royalties (2010)	542155.87	19362.71	234.66	2346.60	234.66
Mining Rents (2010)	616.13	57.59	4.92	157.13	21.70
Gas Rents (2012)	0.00	0.00	35344.39	3743.56	3743.56

Note: In millions of Indonesian rupiah. Authors' calculations. Data for mining royalties and rents from Wicaksono (2014). Data for gas rents from Direktorat Jenderal Perimbangan Keuangan (2012).

Table 3: Main Results, State-Provided Electricity

	(1)	(2)
Dependent Variable	Electricity (PLN)	Electricity (PLN)
West Papua	-44.030***	-42.669***
	(3.494)	(5.993)
Resources	-71.378***	-61.605***
	(1.515)	(2.146)
Papua × Resources	-dropped-	-dropped-
PostOnset	0.172	-0.339
	(0.382)	(0.401)
West Papua × PostOnset	1.066	0.269
	(1.022)	(1.606)
Resources × PostOnset	3.503***	4.092***
	(0.382)	(0.433)
West Papua × Resources × PostOnset	-5.124***	-13.073***
	(1.022)	(2.176)
HH Population		0.002+
		(0.001)
Remoteness		-0.027***
		(0.007)
Muslim		27.859***
		(3.977)
Constant	79.896***	68.565***
	(1.515)	(2.575)
Observations	8930	8484
Clusters	60	60
Method	OLS, FE	OLS, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table 4: Main Results, State-Provided Health

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Puskesmas	Puskesmas Pembantu	Posyandu	Puskesmas	Puskesmas Pembantu	Posyandu
West Papua	-0.208***	-0.075***	0.004	-0.181***	-0.092***	0.000
	(0.018)	(0.012)	(0.026)	(0.024)	(0.021)	(0.038)
Resources	-0.149***	-0.160***	-0.414***	-0.117***	-0.120***	-0.337***
	(0.016)	(0.009)	(0.020)	(0.020)	(0.011)	(0.024)
Papua × Resources	-dropped-	-dropped-	-dropped-	-dropped-	-dropped-	-dropped-
PostOnset	0.007+	-0.011	-0.012	0.003	-0.015	-0.019
	(0.004)	(0.014)	(0.038)	(0.004)	(0.014)	(0.040)
West Papua × PostOnset	0.005	-0.056**	-0.055	0.002	-0.069**	-0.051
	(0.005)	(0.020)	(0.050)	(0.005)	(0.022)	(0.048)
Resources × PostOnset	0.016***	-0.072***	-0.082*	0.019***	-0.064***	-0.074+
	(0.004)	(0.014)	(0.038)	(0.004)	(0.014)	(0.040)
West Papua × Resources × PostOnset	0.077***	0.185***	0.156**	0.018**	0.210***	0.029
	(0.005)	(0.020)	(0.050)	(0.006)	(0.023)	(0.050)
HH Population				0.000*	-0.000	0.000*
				(0.000)	(0.000)	(0.000)
Remoteness				-0.000**	-0.000+	-0.000**
				(0.000)	(0.000)	(0.000)
Muslim				0.041**	0.199***	0.242***
				(0.015)	(0.038)	(0.041)
Constant	0.279***	0.454***	0.955***	0.238***	0.400***	0.868***
	(0.016)	(0.009)	(0.020)	(0.023)	(0.014)	(0.025)
Observations	8951	8951	8951	8505	8505	8505
Clusters	60	60	60	60	60	60
Method	OLS, FE	OLS, FE	OLS, FE	OLS, FE	OLS, FE	OLS, FE

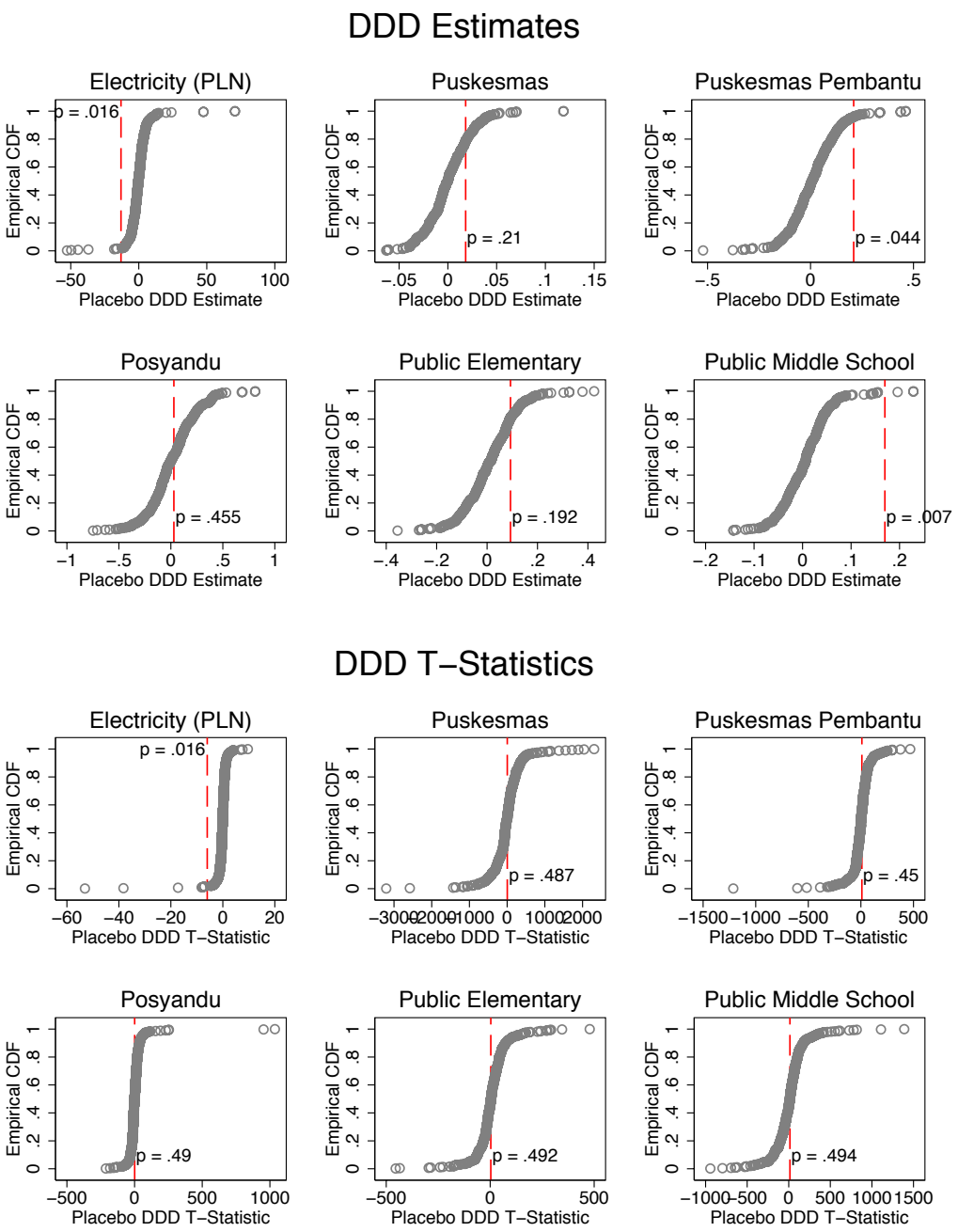
Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table 5: Main Results: Public Schools

	(1)	(2)	(3)	(4)
Dependent Variable	Public Elementary	Public Middle School	Public Elementary	Public Middle School
West Papua	-0.172***	-0.202***	-0.181**	-0.181***
	(0.027)	(0.025)	(0.057)	(0.038)
Resources	-0.295***	-0.145***	-0.178***	-0.077**
	(0.017)	(0.020)	(0.023)	(0.022)
Papua × Resources	-dropped-	-dropped-	-dropped-	-dropped-
PostOnset	-0.018	0.022***	-0.024*	0.020***
	(0.012)	(0.005)	(0.011)	(0.005)
West Papua × PostOnset	-0.025	-0.022*	-0.048	-0.036***
	(0.033)	(0.008)	(0.032)	(0.010)
Resources × PostOnset	0.006	0.014**	0.015	0.015**
	(0.012)	(0.005)	(0.011)	(0.005)
West Papua × Resources × PostOnset	0.121***	0.198***	0.093**	0.170***
	(0.033)	(0.008)	(0.032)	(0.012)
HH Population			0.000+	0.000+
			(0.000)	(0.000)
Remoteness			-0.000**	-0.000***
			(0.000)	(0.000)
Muslim			0.450***	0.184***
			(0.039)	(0.022)
Constant	0.765***	0.310***	0.604***	0.222***
	(0.017)	(0.020)	(0.026)	(0.025)
Observations	8951	8951	8951	8505
Clusters	60	60	60	60
Method	OLS, FE	OLS, FE	OLS, FE	OLS, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Figure 1: Double-Permutation Tests



This figure shows the results of six "double-permutation" tests (see text for description). The red vertical lines correspond to our "true" DDD estimates (top) and T-statistics (bottom) in Table 3 and Table 4. The gray circles reflect the empirical cumulative distribution function of 500 "placebo" DDD estimates (T-statistics) that are not equal to exactly zero (indicating a failed placebo test). The p-values are the ratio of placebo estimates (T-statistics) that are lesser (or greater) than the true estimate to the total number of non-zero placebo estimates (T-statistics).

Supplementary Materials

Resource Shocks and Local Public Services: A Tale of Two Districts

Contents

Transfer Mechanisms in Indonesia

Because the provisions for central transfers vary between Papua/West Papua and other Indonesian provinces, we focus first on common transfer mechanisms before turning to the unique special autonomy provisions in Papua and West Papua.

Papua and West Papua provinces and districts receive general allocation funds (DAU) following the same formula as other provinces and districts within Indonesia. This is calculated based on own-source revenue generation and other revenue sharing funds (Agustina et al 2012, 372). As a result, actual DAU allocations vary widely in how they are distributed within provinces. As in the rest of Indonesia, special allocation funds (DAK) are also provided to certain provinces or districts in Papua and West Papua for financing or capital investment.

Revenue sharing funds (DBH) derive from two sources (Fadliya and McLeod 2010, 4): natural resource revenue sharing funds (*dana bagi hasil sumber daya alam,* DBH SDA) and local personal income tax and land taxes. Our focus here is exclusively on natural resource revenue sharing.

The DBH mechanism has been a subject of intense criticism from activists and analysts alike. One problem is the opacity of the implementing regulations. Despite the 1999 regional autonomy law and 2004 fiscal balance law, one recent analysis holds that

> the proportions of revenue distributed via the DBH mechanism have not varied significantly. Nor has the system ever been clearly explained. Local governments have not had any bargaining power and have tended to take at face value the proportions handed out to them by the central government. Moreover, local governments have not had relevant data with which to contest the appropriateness of the share they have been allocated (Seknas FITRA 2012, 13).

A more damning indictment is that the formula used to allocate DAU and DAK itself takes into account DBH funds, meaning that a region's DAU allocation is reduced as DBH increases. In one formulation, "Natural resource revenue sharing turns out to be a myth for all provinces, all municipalities, and all but a tiny minority of district governments, because the amount received under this heading is exactly offset by the reduction in the entitlement to general allocation funds." (Fadliya and McLeod 2010, 31). Seknas FITRA (2012) bluntly states that DBH "does not actually exist"; "The only areas to receive any funds from the DBH are those whose fiscal capacity is greater than their fiscal needs and their basic allocation."

Indonesia's national legislature passed legislation in 2001 granting special autonomy status for Papua (Law No. 21/2001). Designed to grant Papua and West Papua greater local control over local affairs, the provisions are frequently criticized as having had little to no positive effect on political accountability or political stability (see e.g. Bertrand 2014). Indonesia's central government is currently working on a draft bill to revise parts of the special autonomy legislation, known as "Special Autonomy Plus." The latest draft put forward by the governor of Papua includes further centralization of power at the province level, and the end of direct elections for distrit head (*bupati*) and mayoral posts. A report from the Institute for the Policy Analysis of Conflict (IPAC) remarked that "it is not clear who beyond a tiny elite in Papua province really wants [Otsus Plus]" (IPAC 2013c). An IPAC report on an earlier draft noted a provision would increase the *dana otsus* by 150% from its current figure, and the share of natural resource revenue going to Papua would increase to 90% (IPAC 2013b).

The amount of special autonomy funds (*dana otsus)* for Papua and West Papua is set at two percent of the annual total of the national pool of DAU. Since the split of Papua province (prior to 2002 known as Irian Jaya) into Papua province and West Papua province, the total *dana otsus* allocation has been split between the two provinces, with Papua receiving 70% and West Papua 30% of the total (IPAC 2013b, 8 fn 21). The fund expires in 2021 (World Bank 2005, 1). Precise data are hard to obtain, but in 2013 *dana otsus* totaled Rp 6.22 trillion for Papua and West Papua (IPAC 2013b). In 2003, *dana otsus* comprised 60% of Papua's provincial revenue and 7-23% of revenues for districts and cities within Papua (World Bank 2005, 21). A second form of transfer from the central government to Papua are so-called "special autonomy infrastructural funds." These are determined on a yearly basis with no specific formula. Special autonomy funds are also disbursed from provinces to districts, although such transfers have been erratic and piecemeal despite the existence of a formula meant to govern province-to-district transfers (World Bank 2005, 22; 2007, 123). One particular problem is the rampant corruption of special autonomy funds; the BPK found that roughly 25% of the Rp 19.12 trillion in special autonomy funds from 2001-2010 was either misused or embezzled.

The special autonomy law does not stipulate anything beyond the general provincial allocation about how oil and gas revenues are to be distributed in Papua and West Papua, stating that later special regional regulations (*Peraturan Daerah Khusus*, *perdasus*) will have to specify this. However, most observers believe that these funds, like all DBH funds, mainly benefit the resource producing districts. As of June 2013, there had yet to be any *perdasus* passed regarding how allocations of DBH from oil and gas are distributed. The current draft law (as of October 2013) was produced by a local

university with input from producing regions, and includes specifics on how DBH revenues are distributed among districts. But it remains a draft law only.

Despite the belief that revenue sharing benefits producing districts, these districts have themselves voiced complaints about revenue sharing from provinces. One West Papua provincial legislator complained of the difficulty of figuring out how much producing and non-producing regions should receive given that the amounts fluctuate dramatically per year (Bintang Papua 2013). The Consultative Forum of Oil and Gas Producing Regions (Forum Konsultasi Daerah Penghasil Migas, FKDPM) reported that the problem of transfers to districts has been repeatedly raised through their forum and other fora, specifically noting problems natural gas DBH transfers in Raja Ampat district (FKPDM 2014). A representative from Indonesia's Ministry of Finance promised to help "remind" the Ministry of Home Affairs to deal with percentage allocations. And local citizens have too voiced concerns: groups living near the LNG Tangguh factory in Teluk Bintuni relayed concerns to a West Papua provincial legislator about the fact that they have yet to see visible results of the project (Karoba News 2013). As with *dana otsus* funds, regional governments have complained about lack of transparency in the allocation process for natural resource revenue sharing funds. They do not receive detailed information on prices and production, making it difficult for them to confirm that the amount they receive is in line with what they should be getting, and delays in transfers are frequent (World Bank 2007, 27, 123).

Legal Restrictions on Qualitative Field Research in Indonesian Papua

Our preferred interpretation of the effects of resource shocks on public services in Papua is that it operates by lowering politicians' incentives to be responsive to citizen

demands. Given a lack of transparency about how resource revenues are distributed and used at the provincial and district level, the substitution of opaque resource revenues in place of other forms of central government transfer offers greater opportunities for local elites to skim funds that can be used to consolidate their power. Those funds can be used to buy political support from voters or intermediaries, lessening the pressure on governments to provide public services.

Ideally, we would like to test this causal mechanism using qualitative data from field research in Papua, interviewing key politicians and bureaucrats and collecting original data on how district governments spend their resource revenues. However, we are unable to do this due to legal restrictions on conducting field research in Indonesian Papua. We know this to be true because one of the authors is a member of a research organization that facilitates research by American scholars in Indonesia. Essential to any research project in Indonesia that involves primary data collection by a foreign researcher is legal permission from the Indonesian Ministry of Research and Technology. However, this body refuses to grant legal permissions for scholars at foreign universities who wish to study anything remotely controversial in Indonesian Papua. Natural resource industries are particularly sensitive, given the direct involvement of the Indonesian military in the Grasberg mining operation.

Even worse, in recent months a representative of the Indonesian State Intelligence Agency or the Army's Strategic Intelligence Body (it is not clear which) has participated in most decisions about granting research permits. This makes approval even more unlikely than usual. To our best knowledge, the only permits granted for research in Indonesian Papua in recent years have been for documenting endangered languages and

for non-controversial topics in the environmental and agricultural sciences. We have not attempted to secure a permit ourselves—that very act might create obstacles for obtaining permission for future research in Indonesia—and we are absolutely certain that our application would be rejected. Sadly, the other author of this manuscript—the one who is not a member of a research organization that facilitates research by American scholars in Indonesia—was recently *expelled from Indonesia* because prior to his entry into academia, he was a member of an organization that advocated for greater rights in Papua.

Of course, many scholars of local politics do conduct field research in Papua, and we rely on their analysis throughout this manuscript. It is often possible—if sometimes risky—to do research in Papua as a consultant, an activist, or a private citizen without going through the formal research permissions process. Many brave and talented scholars of Indonesian Papua work this way. However, we emphasize that such research would not comply with Institutional Review Board procedures if we were to undertake it ourselves. So even if we were to conduct such research ourselves, we could not use it in this manuscript. We therefore rely on the secondary literature for qualitative insights about local politics in Indonesia, confident that we have done as much as is legally possible to explore all possible mechanisms linking resource shocks to local public services.

Description of Health Facilities

1. *Puskesmas*, or community health centers (*pusat kesehatan masyarakat*). These deliver basic health care at the subdistrict level. They were present in 8.8% of

villages in 2011.[1] Importantly, while *puskesmas* are administered at the subdistrict level, the number of *puskesmas* per subdistrict in Papua and West Papua ranges from 0 to 11, with an average of 1.6. This means that their presence varies by village, not subdistrict.

2. *Puskesmas Pembantu*, or "helper" community health centers (*pusat kesehatan masyarakat pembantu*). As the name suggests, these facilitate frontline basic health care delivery in places where a *puskesmas* is not available, and were present in 20.1% of villages in 2011. As to be expected, the range across subdistricts is wider than for *puskesmas*, from 0 to 25, with an average of 4.2.
3. *Posyandu*, or family planning and unified health service posts (*pos pelayanan keluarga berencana – kesehatan terpadu*). Unlike the previous two, *posyandu* are understood to be established and managed by village-level communities themselves, although they are facilitated by public health workers (Departemen Kesehatan 2008). These were present in 48.8% of villages in the sample in 2011.

[1] *Puskesmas* are only present in subdistrict capitals, so "village" here refers a village-level administrative unit in one of those subdistrict capitals.

Table S1: Fractional Logit Results, Electricity

	(1)	(2)
Dependent Variable	Electricity (PLN)	Electricity (PLN)
West Papua	-1.976***	-1.029**
	(0.182)	(0.375)
Resources	-3.745***	-4.037***
	(0.093)	(0.324)
Papua × Resources	-dropped-	-dropped-
PostOnset	0.029	-0.069
	(0.063)	(0.070)
West Papua × PostOnset	0.069	0.080
	(0.101)	(0.153)
Resources × PostOnset	0.371***	1.020***
	(0.063)	(0.130)
West Papua × Resources × PostOnset	-0.512***	-2.187***
	(0.101)	(0.280)
HH Population		0.002***
		(0.000)
Remoteness		-0.007+
		(0.004)
Muslim		1.422***
		(0.244)
Constant	1.371***	-0.029
	(0.093)	(0.265)
Sigma	-1.976***	-1.029**
	(0.182)	(0.375)
Observations	8930	8484
Clusters	60	60
Model	Fractional logit, FE	Fractional logit, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table S2: Logit Results, State-Provided Health Care

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Puskesmas	Puskesmas Pembantu	Posyandu	Puskesmas	Puskesmas Pembantu	Posyandu
West Papua	-1.581***	-0.287***	-0.268	-0.386	-0.442**	0.310
	(0.125)	(0.067)	(0.312)	(0.274)	(0.167)	(0.455)
Resources	-0.920***	-0.713***	-2.797***	-0.180	-0.576***	-2.003***
	(0.059)	(0.053)	(0.143)	(0.179)	(0.126)	(0.189)
Papua × Resources	-dropped-	-dropped-	-dropped-	-dropped-	-dropped-	-dropped-
PostOnset	0.103*	-0.086	-0.088	0.004	-0.121	-0.169
	(0.046)	(0.107)	(0.269)	(0.052)	(0.107)	(0.295)
West Papua × PostOnset	0.056	-0.297*	-0.287	0.044	-0.380**	-0.221
	(0.062)	(0.131)	(0.327)	(0.064)	(0.134)	(0.341)
Resources × PostOnset	0.091*	-0.353***	-0.290	0.201***	-0.309**	-0.319
	(0.046)	(0.107)	(0.269)	(0.058)	(0.106)	(0.288)
West Papua × Resources × PostOnset	0.581***	0.932***	0.694*	-0.007	1.057***	0.007
	(0.062)	(0.131)	(0.327)	(0.085)	(0.133)	(0.339)
HH Population				0.001***	-0.000	0.001**
				(0.000)	(0.000)	(0.000)
Remoteness				-0.000*	-0.000	-0.001**
				(0.000)	(0.000)	(0.000)
Muslim				0.141	0.965***	2.002***
				(0.149)	(0.158)	(0.245)
Constant	-0.987***	-0.163**	2.962***	-2.314***	-0.349	1.841***
	(0.059)	(0.053)	(0.143)	(0.281)	(0.186)	(0.210)
Observations	8951	8951	8951	8505	8505	8505
Clusters	60	60	60	60	60	60
	Logit, FE	Logit, FE	Logit, FE	Logit, FE	Logit, FE	Logit, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table S3: Logit Results, Public Schools

	(1)	(2)	(3)	(4)
Dependent Variable	Public Elementary	Public Middle School	Public Elementary	Public Middle School
West Papua	-0.784***	-1.217***	-0.104	0.035
	(0.128)	(0.160)	(0.350)	(0.396)
Resources	-1.298***	-0.722***	-0.288	0.455+
	(0.088)	(0.039)	(0.183)	(0.267)
Papua × Resources	-dropped-	-dropped-	-dropped-	-dropped-
PostOnset	-0.094	0.294***	-0.158*	0.260***
	(0.058)	(0.061)	(0.064)	(0.072)
West Papua × PostOnset	-0.114	-0.293**	-0.224	-0.432***
	(0.159)	(0.101)	(0.174)	(0.107)
Resources × PostOnset	0.046	-0.056	0.063	0.022
	(0.058)	(0.061)	(0.066)	(0.075)
West Papua × Resources × PostOnset	0.502**	1.683***	0.433*	1.572***
	(0.159)	(0.101)	(0.172)	(0.120)
HH Population			0.001***	0.001***
			(0.000)	(0.000)
Remoteness			-0.000*	-0.001***
			(0.000)	(0.000)
Muslim			2.123***	1.072***
			(0.235)	(0.141)
Constant	1.181***	-0.902***	-0.287	-2.759***
	(0.088)	(0.039)	(0.216)	(0.394)
Observations	8951	8951	8951	8505
Clusters	60	60	60	60
Method	OLS, FE	OLS, FE	OLS, FE	OLS, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table S4: Effects on Violence

	(1)	(2)	(3)	(4)
Dependent Variable	Violence	Violence	Violence	Violence
West Papua	-0.135***	-0.127***	-2.219***	-2.087***
	(0.012)	(0.014)	(0.270)	(0.276)
Resources	-0.051***	-0.046***	-0.371**	-0.297
	(0.008)	(0.011)	(0.142)	(0.168)
Papua × Resources	-dropped-	-dropped-	-dropped-	-dropped-
PostOnset	0.020	0.018	0.292	0.254
	(0.016)	(0.017)	(0.248)	(0.248)
West Papua × PostOnset	0.028	0.030	1.142***	1.146***
	(0.017)	(0.018)	(0.321)	(0.313)
Resources × PostOnset	0.004	0.005	-0.065	-0.034
	(0.016)	(0.017)	(0.248)	(0.248)
West Papua × Resources × PostOnset	-0.063***	-0.056**	-1.704***	-1.482***
	(0.017)	(0.018)	(0.321)	(0.321)
HH Population		0.000		0.000
		(0.000)		(0.000)
Remoteness		-0.000		-0.001
		(0.000)		(0.001)
Muslim		-0.009		-0.179
		(0.012)		(0.262)
Constant	0.157***	0.154***	-1.763***	-1.727***
	(0.008)	(0.011)	(0.142)	(0.151)
Observations	8951	8505	8951	8505
Clusters	60	60	60	60
Method	OLS, FE	OLS, FE	Logit, FE	Logit, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table S5: Moderating Effects of Violence?

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Electricity (PLN)	Puskesmas	Puskesmas Pembantu	Posyandu	Public Elementary	Public Middle School
West Papua	-42.311***	-0.176***	-0.092***	0.008	-0.172**	-0.175***
	(5.952)	(0.025)	(0.021)	(0.038)	(0.058)	(0.038)
Resources	-61.476***	-0.116***	-0.120***	-0.334***	-0.175***	-0.075**
	(2.122)	(0.020)	(0.011)	(0.024)	(0.022)	(0.022)
Papua × Resources	-dropped-	-dropped-	-dropped-	-dropped-	-dropped-	-dropped-
PostOnset	-0.390	0.002	-0.015	-0.020	-0.025*	0.020***
	(0.401)	(0.004)	(0.014)	(0.040)	(0.011)	(0.005)
West Papua × PostOnset	0.185	0.001	-0.069**	-0.053	-0.050	-0.038***
	(1.617)	(0.005)	(0.021)	(0.048)	(0.032)	(0.010)
Resources × PostOnset	4.078***	0.019***	-0.064***	-0.074+	0.015	0.014*
	(0.432)	(0.004)	(0.014)	(0.040)	(0.011)	(0.005)
West Papua × Resources × PostOnset	-12.916***	0.020**	0.209***	0.032	0.097**	0.172***
	(2.200)	(0.006)	(0.023)	(0.050)	(0.032)	(0.012)
HH Population	0.002+	0.000*	-0.000	0.000*	0.000+	0.000+
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Remoteness	-0.026***	-0.000**	-0.000+	-0.000**	-0.000**	-0.000***
	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Violence	2.819*	0.035*	-0.000	0.061+	0.069**	0.048***
	(1.335)	(0.014)	(0.013)	(0.033)	(0.022)	(0.012)
Muslim	27.885***	0.042**	0.199***	0.243***	0.451***	0.185***
	(3.978)	(0.015)	(0.038)	(0.041)	(0.039)	(0.022)
Constant	68.131***	0.233***	0.400***	0.859***	0.593***	0.215***
	(2.508)	(0.022)	(0.015)	(0.025)	(0.026)	(0.025)
Observations	8484	8505	8505	8505	8505	8505
Clusters	60	60	60	60	60	60
Method	OLS, FE	OLS, FE	OLS, FE	OLS, FE	OLS, FE	OLS, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table S6: Quadruple Difference Models

	(1)	(2)
Dependent Variable	Electricity (PLN)	Electricity (PLN)
West Papua	-44.257***	-43.020***
	(3.633)	(6.203)
Resources	-71.378***	-61.595***
	(1.515)	(2.146)
West Papua × Resources	-dropped-	-dropped-
Gas Discovery	45.692***	64.486***
	(3.633)	(7.902)
West Papua × Gas Discovery	-dropped-	-dropped-
Resources × Gas Discovery	-dropped-	-dropped-
West Papua × Resources × Gas Discovery	-dropped-	-dropped-
PostOnset	0.172	-0.339
	(0.382)	(0.401)
West Papua × PostOnset	1.492	0.922
	(1.020)	(1.631)
Resources × PostOnset	3.503***	4.093***
	(0.382)	(0.433)
West Papua × Resources × PostOnset	-8.886***	-12.239***
	(1.020)	(1.918)
Gas Discovery × PostOnset	3.335***	-1.500**
	(0.000)	(0.469)
West Papua × Gas Discovery × PostOnset	-dropped-	-dropped-
Resources × Gas Discovery × PostOnset	-dropped-	-dropped-
West Papua × Resources × Gas Discovery × PostOnset	-dropped-	-dropped-
HH Population		0.002+
		(0.001)
Remoteness		-0.027***
		(0.007)
Muslim		27.908***
		(3.992)
Constant	79.896***	68.547***
	(1.515)	(2.577)
Observations	8930	8484
Clusters	60	60
Method	OLS, FE	OLS, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Table S7: Non-State Electricity, Health, and Schooling

	(2)	(4)	(5)	(6)
Dependent Variable	Electricity (Non-PLN)	Apothecary	Private Elementary	Private Middle School
West Papua	18.554***	-0.373***	-0.101**	-0.344***
	(4.792)	(0.058)	(0.034)	(0.029)
Resources	3.903	-0.316***	0.001	-0.283***
	(4.069)	(0.055)	(0.019)	(0.019)
Papua × Resources	-dropped-	-dropped-	-dropped-	-dropped-
PostOnset	10.889***	0.005**	-0.004	0.004**
	(2.634)	(0.002)	(0.006)	(0.002)
West Papua × PostOnset	24.038***	-0.002	0.001	-0.006
	(4.468)	(0.004)	(0.028)	(0.006)
Resources × PostOnset	15.543***	0.016***	-0.001	-0.006**
	(2.631)	(0.002)	(0.006)	(0.002)
West Papua × Resources × PostOnset	-12.841**	-0.043***	0.119***	-0.008
	(4.425)	(0.004)	(0.031)	(0.006)
HH Population	-0.001	0.000	0.000	0.000+
	(0.001)	(0.000)	(0.000)	(0.000)
Remoteness	-0.002	-0.000***	-0.000*	-0.000***
	(0.006)	(0.000)	(0.000)	(0.000)
Muslim	-8.602**	0.069***	-0.205***	0.067***
	(2.563)	(0.014)	(0.051)	(0.016)
Constant	9.300*	0.371***	0.451***	0.363***
	(4.122)	(0.058)	(0.026)	(0.025)
Observations	8454	8505	8505	8505
Clusters	60	60	60	60
Method	OLS, FE	OLS, FE	OLS, FE	OLS, FE

Note: Standard errors clustered by Year × District in parentheses. + p<0.10, * p<0.05, ** p<0.01, *** p<0.001.

Figure S1: Map of Papua and West Papua Provinces

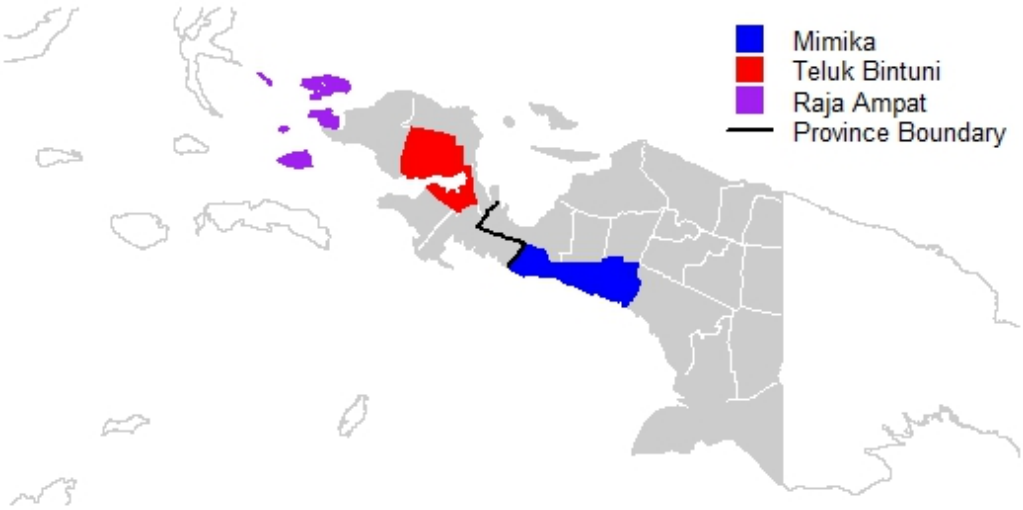
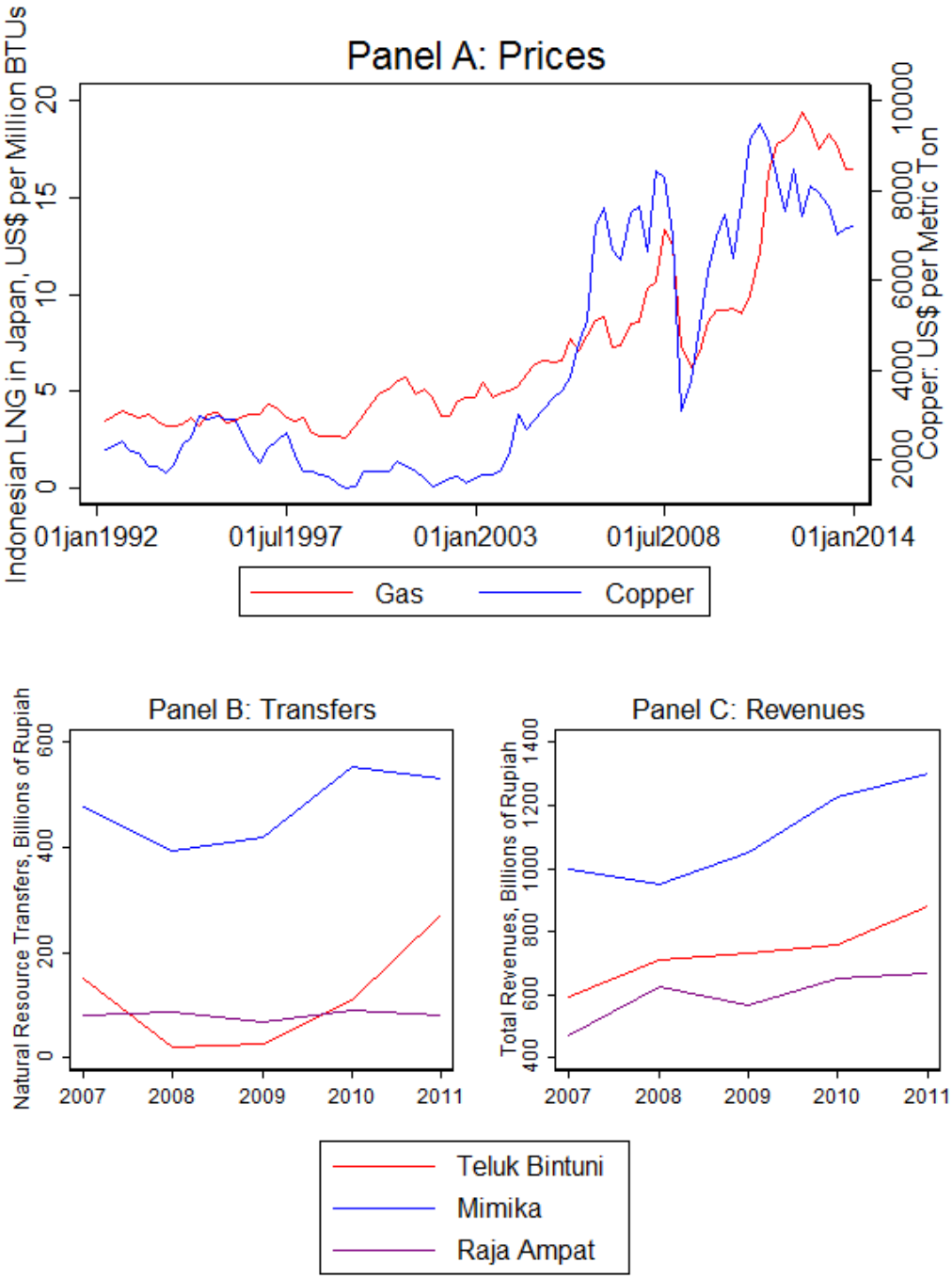
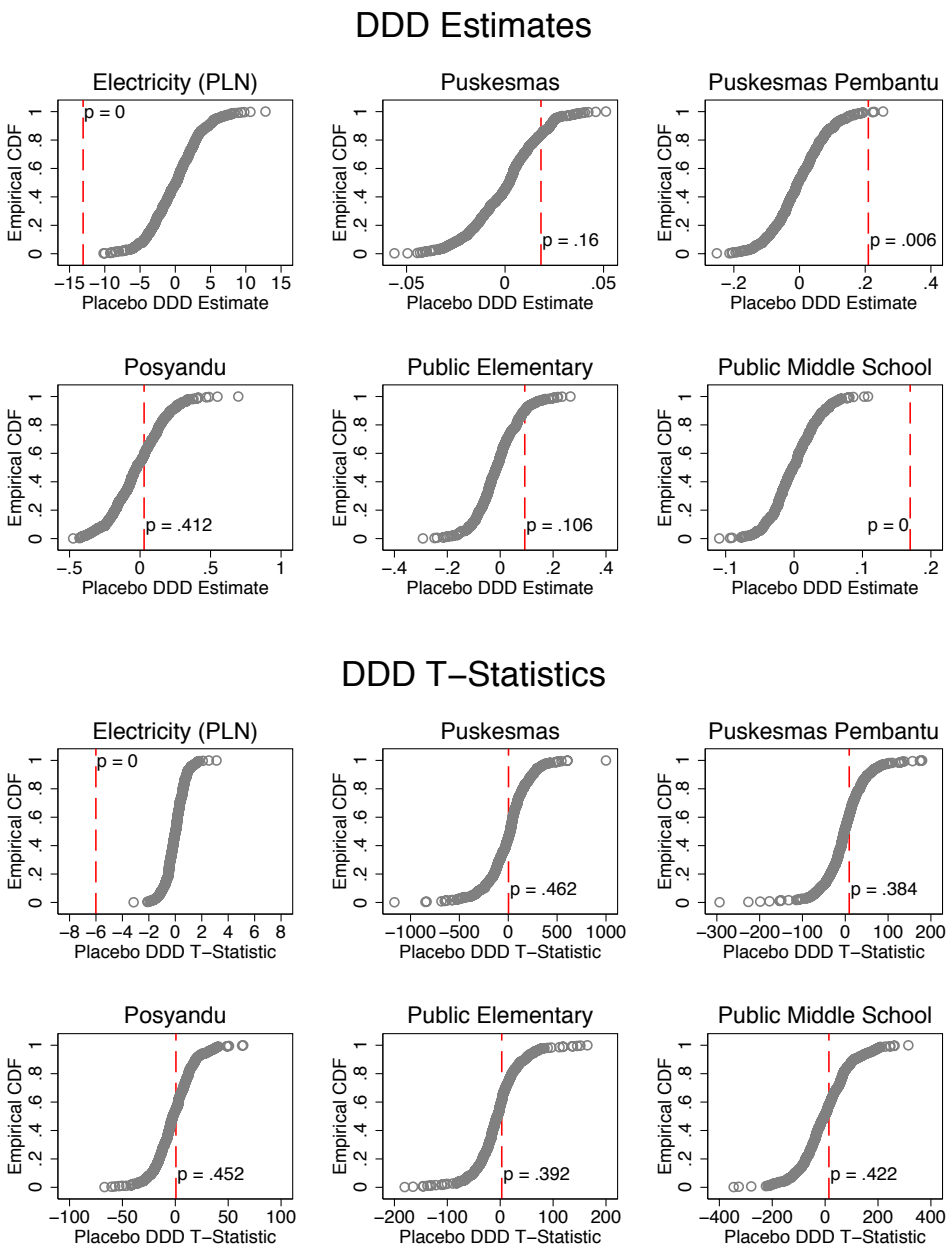


Figure S2: Price Shocks and Revenue Transfers



The top panel shows monthly prices for Indonesian natural gas (in Japan) and world copper prices from 1992 until 2014, from Quandl (2014). The bottom panels shows natural resource transfers and total revenues for Mimika, Teluk Bintuni, and Raja Ampat districts. Data from World Bank (2014).

Figure S3: Double-Permutation Tests with Equal Treatment Probabilities



This figure shows the results of six "double-permutation" tests (see text for description). The procedure is exactly the same as described for Figure 3 in the text, but treatment status is assignment with equal probability for each district.

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