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Refining Indonesia's Intergovernmental Transfers Mechanism

Fiscal Capacity Estimation to Incentivize Subnational Tax Effort

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Abbreviations

BBNKB	Bea Balik Nama Kendaraan Bermotor (Transfer of Motor Vehicle Title Fee)
BPHTB	Bea Pengalihan Hak atas Tanah dan Bangunan (Duty on the Acquisition of Land and Building Rights)
CIT	Corporate Income Tax
DAK	Dana Alokasi Khusus (Special Allocation Fund)
DAU	Dana Alokasi Umum (General Allocation Fund)
DBH	Dana Bagi Hasil (Revenue Sharing Fund)
DBHSDA	Dana Bagi Hasil Penerimaan Sumber Daya Alam (Revenue Sharing Fund from Natural Resources)
DID	Dana Insentif Daerah (Regional Incentive Fund)
GRDP	Gross Regional Domestic Product
IMB	Izin Mendirikan Bangunan (Building Permit)
OSR	Own Source Revenue
PAD	Penerimaan Hasil Daerah (Own Source Revenue)
PBB	Pajak Bumi dan Bangunan (Land and Property Tax)
PBJT	Pajak Barang dan Jasa Tertentu (Certain Goods and Services Tax)
PIT	Personal Income Tax
RRS	Representative Revenue System
RTS	Representative Tax System
SNG	Subnational Government
VAT	Value Added Tax

Executive Summary

Dana Alokasi Umum (DAU), or general allocation fund, is Indonesia's most significant central government transfer to subnational governments (SNGs). It is a block grant that aims to resolve horizontal imbalances between regions. Most SNGs rely heavily on this transfer and they have a low share of own source revenues (OSRs). This can partly be attributed to the DAU formula provided by Law 33/2004 that disincentivized SNGs to collect OSRs in favor of higher DAU transfers.

The Indonesian government has recently stipulated a new law on intergovernmental fiscal relations (Law No. 1/2022). The law revised the DAU formulation for each SNG by substituting the sum of *Penerimaan Hasil Daerah* (PAD or own source revenue) and *Dana Bagi Hasil* (DBH or revenue sharing funds) with "potential revenue." The exact estimation method is left to the implementing regulations.

Existing literature provides little guidance and consensus on an ideal estimation framework for local government potential revenue in Indonesia. This paper fills the gap in the literature by developing a conceptual framework for estimating potential revenues for districts in Indonesia and applying it using existing data.

A. Establishing a Conceptual Framework for Potential Revenue Estimation

There is limited knowledge on how potential government revenue should be estimated, especially in the case of Indonesia's SNGs. This paper builds a comprehensive framework to help estimate potential revenues in Indonesia. The framework is illustrated in Figure 1 which shows the three criteria that we use to identify predictors of revenue bases.

> > >

FIGURE 1 - Comprehensive Framework for Potential Revenue Estimation

1. **Identifying conceptual predictors using existing theory**
   Conceptual predictors are indicators that would conceptually and/or theoretically predict SNGs' revenue stream (e.g., taxes).

2. **Empirical evidence**
   Indicators should be tested statistically or proven by existing literature before they get selected to estimate revenue base.

3. **Applicability in Indonesia**
   The tested and selected indicators should be applicable in Indonesia. Thus, these indicators need to be supported by available data in Indonesia.

B. Building and Optimizing Potential Revenue Estimation Model

This paper discusses the application of the conceptual framework for potential revenue estimation using Indonesia's existing macroeconomic indicators. We find that Gross Regional Domestic Product (GRDP), population, and urbanization rate are good predictors for most tax sources. These three indicators also predicted the total district's OSRs well, providing an empirical foundation for an aggregated macro-based model to estimate all OSRs using the abovementioned variables.

C. Distributional Implications of Potential Revenue Estimation

This paper also analyzes the distributional implications of moving to estimated potential revenue in the DAU formula. We find that the equity implications are limited with most districts gaining, or losing, less than 20% of DAU. However, there can be outliers in the estimation.

We explored two approaches to increase the fairness of DAU allocations. First, we add mining GRDP as a control variable to incorporate SNGs' economic landscape, because the mining sector is generally not subject to property tax at the subnational level and instead is taxed at the central level. Second, we control for district fixed effects to account for time-invariant district characteristics. Our simulations show that both approaches help improve the equity implications as well as the model's fit.

However, adding district fixed effects is a much better, fairer, and systematic way to account for district characteristics. While mining GRDP aims to capture districts' distinct economic landscape, applying district fixed effects would control for district characteristics that mining GRDP could not fully capture. We find that including the district fixed effect leads to lower distributional implications.

In sum, the paper provides a viable, theoretical, and an empirical approach to estimate potential revenues for the DAU formula in Indonesia – a macroeconomic model using three main macroeconomic indicators: GRDP, population, and urbanization rate, along with district fixed effects.

The rest of the paper is structured as follows: Section 1 provides a description of Indonesia's system of intergovernmental transfers and subnational taxation. It shows subnational fiscal reliance on transfers rather than OSRs. Section 2 makes the case for reforming the DAU formula and explains recent efforts by the Government of Indonesia on that front. Section 3 discusses the limited existing empirical literature on estimating potential revenues for transfers formula. Section 4 explains and applies our conceptual framework for potential revenue estimation. It also provides the empirical justification to use an aggregated approach to estimation rather than estimating each individual tax base. Section 5 applies the aggregated approach to estimating potential revenues. Section 6 discusses the equity implications and makes the case for using district fixed effects. Finally, Section 7 provides a conclusion of this paper.

1 Subnational Government's Reliance on Transfers to Finance Spending

Indonesia decentralized significant spending authority from the central government to subnational governments (SNGs) during the early 2000s.[1] SNGs are now responsible for delivering essential public services, such as education, health, and infrastructure. Several studies have shown that Indonesia's decentralization was among the largest and most ambitious programs ever to take place (Negara and Hutchinson 2021; Fritzen 2009).

With significant shifts in spending authorities, SNGs are also responsible for collecting revenues to support their operations. Decentralization enables SNGs to collect several types of tax and retributions independently, as stated under Law 28/2009 on Regional Tax and Retributions before eventually being replaced most recently by Law 1/2022. Under this structure, SNGs can generate revenues from the following resources:

- ***Own source revenues (OSRs) or Penerimaan Asli Daerah (PAD)***[2] are revenues that are collected by SNGs through regional tax and retributions. Province- and district-level governments have a different set of taxes that they can collect. Meanwhile, retributions are fees applied to each SNG's public facilities and services. PAD include the following taxes and retributions:

    - District-level taxes: Land and property tax, duty on the acquisition of land and building rights (BPHTB), certain goods and services tax (PBJT),[3] advertising tax, groundwater tax, swallow's nest tax.

1. The central government decentralized most authorities to SNGs, except for constitutional, foreign, defense, religious, and monetary affairs.
2. In this paper, we will use OSR and PAD interchangeably.
3. This includes but not limited to food and beverage/restaurant tax, electric power/street lighting tax, hotel services tax, parking services tax, and art and entertainment tax (karaoke, night clubs, traditional, sports events, etc.).

- Province-level taxes: Vehicle tax, transfer of motor vehicle title fee (BBNKB), heavy equipment tax, cigarette tax, vehicle fuel tax, surface water tax, non-metal minerals and rock tax.

- Regional retributions: General services,[4] business services,[5] and certain licensing.[6]

- ***Intergovernmental transfers*** are revenues transferred from the central government to SNGs.

- ***Other eligible revenues*** are revenues generated through other channels of revenue, such as revenue sharing from provinces and village funds.

Despite having various taxes and retribution, SNGs in Indonesia remain largely dependent on intergovernmental transfers to finance their spending. Intergovernmental transfers comprised around 60 percent of total district revenues and 55 percent of total province revenues in 2020 (Figure 2). SNGs' reliance on transfers has decreased substantially since 2001,[7] when the decentralization policy was first implemented under Law 22/1999 on Regional Governments and Law 25/1999 on Intergovernmental Fiscal Transfers. These laws were replaced by Law 32/2004 and 33/2004, and recently by Law 1/2022. The different types of intergovernmental transfers in Indonesia are briefly described below:

- ***The general allocation fund (Dana Alokasi Umum or DAU)*** is a non-earmarked, general-purpose block grant that constitutes the largest portion of central government transfers (49 percent of total transfers for district-level and 29 percent for province-level government in 2020). This transfer aims to equalize SNGs' capacity to fund their operational needs.

- ***Special allocation fund (Dana Alokasi Khusus or DAK)*** is another grant that aims to fund specific responsibilities that align with national priorities. This special purpose grant comprises physical DAK *(DAK Fisik)* to finance capital expenditures, and non-physical ones *(DAK Non-Fisik)* to finance public service delivery operational costs. DAK comprised about 15 percent of total transfers in 2020 for district-level and 37 percent for province-level government.

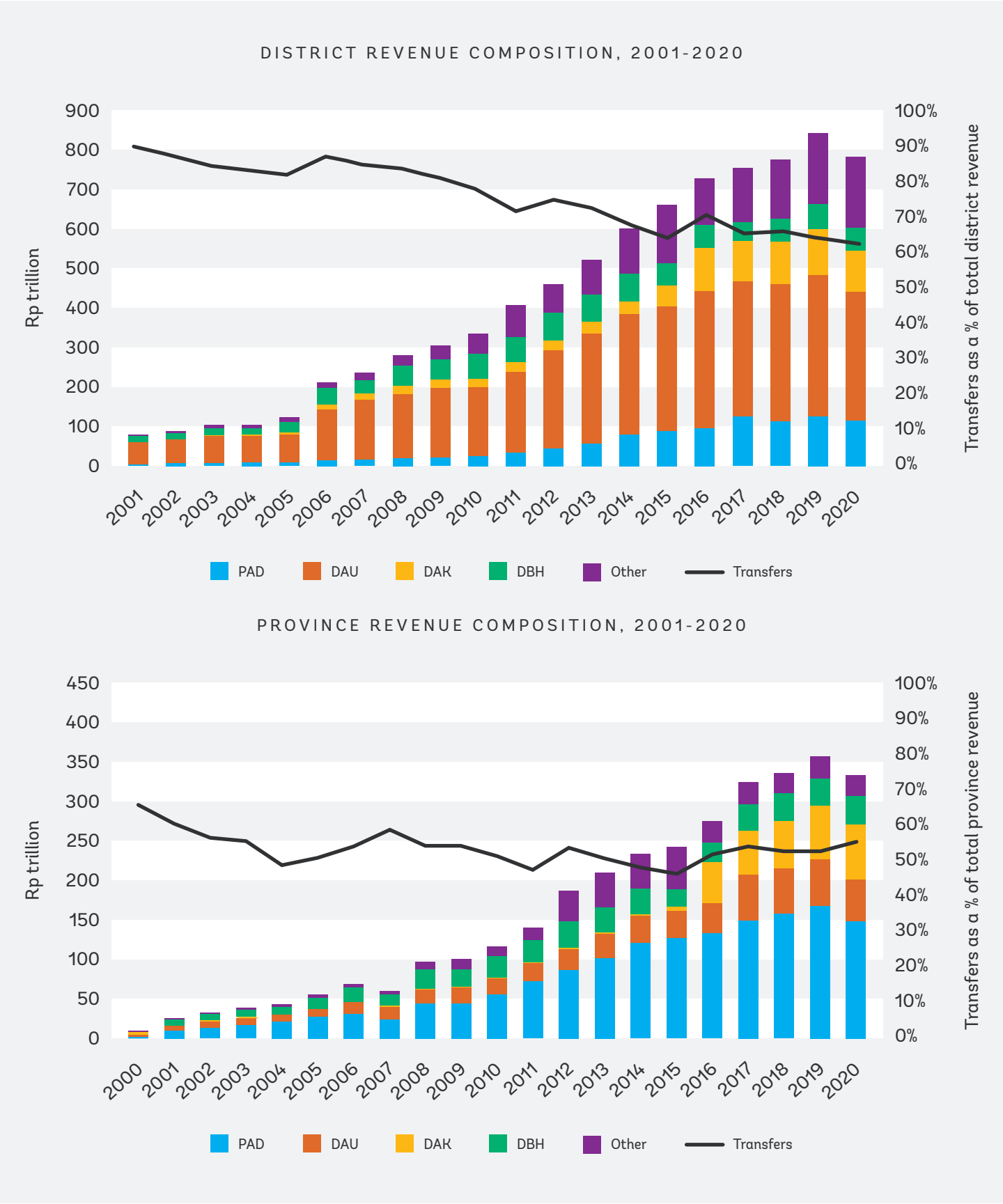
- SNGs also receive **revenue sharing funds *(Dana Bagi Hasil or DBH)***, a central government redistribution of tax revenues to SNGs.[8] DBH comprised about 9 percent of total transfers in 2020 for district-level and 20 percent for province-level government.

- Finally, there are other transfers that constitute 27 percent of the total transfers pool for district-level and 14 percent for province-level governments. These include autonomy funds for specially treated regions, regional incentive grants *(Dana Insentif Daerah* or DID) for SNGs with better governmental performance, village funds for funding development projects in villages, and de-concentration funds for funding national programs under specific line ministries.

4. Retribution fees applicable for general services, such as for medical, cleaning, civil administration, funeral, parallel parking, traditional market, vehicle emission testing, fire hazard maintenance, official map printing, lavatory waste management (septic tank), weight remeasurement service for traditional market transactions *(tera ulang)*, educational retribution fees, telecommunication tower maintenance services, and traffic light and pedestrian maintenance.
5. Retribution fees applicable for commercial purposes. An example is the utilization of regional assets (land and property) for commercial affairs: wholesale market, auction house, bus terminal, government-managed parking buildings, government-owned hotel and dormitories, slaughtering house, government-owned port, recreation and sports venues, water passage facilities, and government retailer products.
6. Retribution fees applicable for specific permits, including construction permit (IMB), alcoholic drink sales permit, crowd permit, transportation route permit, aquaculture and fisheries permit, and expatriate working permit.
7. Transfers to districts declined from 90 percent of district revenue in 2001 to 62 percent of district revenue in 2020. Transfers to provinces declined from around 61 percent of provincial revenue in 2001 to 55 percent of provincial revenue in 2020.
8. Central government taxes eligible for DBH include property tax on mining, forestry and plantation, personal income tax, value-added tax, as well as other income from tobacco excises and natural resource revenues.

> > >

FIGURE 2 - Districts and Provinces' Revenue Compositions, 2001–2020



Source: Ministry of Finance; World Bank staff calculations.
Note: DAK = *Dana Alokasi Khusus* (Special Allocation Fund), DAU = *Dana Alokasi Umum* (General Allocation Fund), DBH = *Dana Bagi Hasil* (Revenue Sharing Fund), PAD = *Pendapatan Asli Daerah* (own source revenue), Rp = Indonesian rupiah.

DAU's significant contribution to district revenues is partly a result of the regulatory structure of intergovernmental transfers. District governments primarily rely on the DAU to finance their spending, which contributes about 41 percent of total district revenues. This heavy reliance on the DAU is partly due to the regulatory framework, which mandates the central government to allocate at least 26 percent of net domestic revenue for DAU[9] and eventually distributes 90 percent of all DAU to district-level governments.

9. This is calculated by subtracting revenue sharing funds (DBH) from the national tax revenue.

2

Case for Reforming the General Allocation Fund (DAU) Formula to Incentivize Subnational Government Tax Efforts

The DAU formula under Law 33/2004 became a disincentive for districts to collect revenue bases assigned to them. The DAU formula equalizes the difference between fiscal needs and fiscal capacity. Prior to Law 1/2022, fiscal capacity was proxied using actual district's own source revenues (PAD) and revenue sharing funds. Under this formulation, district DAU allocation decreases when districts collect more tax and non-tax revenues which is a clear disincentive for district revenue mobilization (Figure 3 shows the formulas wherein an increase in PAD leads to a reduction in DAU).

> > >

FIGURE 3 - The DAU Formula Under Law 33/2004

$$DAU_i = \left(\frac{\textbf{\textit{Fiscal Gap}}_i}{Total\ Fiscal\ Gap} \right) * Total\ DAU\ Pool$$

$$\textbf{\textit{Fiscal Gap}}_i = Fiscal\ Needs_i - \textbf{\textit{Fiscal Capacity}}_i$$

$$\textbf{\textit{Fiscal Capacity}} = \delta_1 PAD_i + \delta_2 DBH_i,\ 0 < \delta \leq 1$$

Source: Government of Indonesia, Law 33/2004.

The DAU formula aims to resolve horizontal imbalances among local governments by covering SNG deficits. This is reflected by how the DAU formula considers the fiscal gap, which measures the difference between fiscal needs (i.e., necessary expenses) and fiscal capacity (i.e., SNG's revenue, such as own source revenue and revenue sharing funds) (Takahata, Khoirunurrofik, and Dartanto 2021). DAU's ability to cover the SNG deficit remains limited, given that DAU is predetermined in the national budget (APBN). Given the strong focus on equalization, the DAU formula treated PAD as a deduction factor to accommodate more funding for SNGs with less capability to generate their own revenue.

Existing literature provides limited evidence to support the use of PAD as a fiscal capacity proxy. This is because estimating fiscal capacity has been conceptually and empirically challenging. Yilmaz and Zahir (2020) explained that some countries concentrate only on assessing revenue-raising ability, while others focus more on ensuring that districts have the capacity to provide similar public service packages to their citizens but are paying less attention to revenue collection capabilities. Martinez-Vasquez and Boex (1997a) argued that using the amount of revenues collected as a measure of fiscal capacity is associated with several problems. For example, two regions with similar "fiscal capacity" may eventually generate different amount of revenues due to differences in compliance or tax rate. Furthermore, the study also argued that using actual data may be harmful if the quality of such data is questionable. Thus, using actual collected revenues, such as PAD and DBH in the case of Indonesia, can be misleading when determining a district's true fiscal capacity. As an alternative, Martinez-Vasquez and Boex (1997b) and Shah and others (1994) proposed some proxies to measure fiscal capacity such as macro indicators (i.e., personal income/disposable income, regional GDP) and the representative tax system (RTS).[10]

In the case of Indonesia, changes to fiscal capacity measurement have evolved numerous times and can be seen (Table 1). However, PAD has always been a primary indicator for the fiscal capacity formula.

> > >

TABLE 1 - Evolution of Fiscal Capacity Formula

2001	2002-2003	2004-2005	2006-Now
$Avg\ (PAD_i + PBB_i + BPHTB_i) * Avg\ (GRDPsdaIndex + GRDPnonsdaIndex + Working\ Age\ Index)$	$PAD_i + DBH^{\wedge}_i + 0.75 * DBHSDA_i$	$0.5 * PAD_i + DBH^{\wedge}_i + DBHSDA_i$	$PAD_i + DBH_i$

Source: Hofman et al. (2006).
Note: PAD = own source revenue *(Penerimaan Asli Daerah),* PBB = property tax, BPHTB = duty on the acquisition of land and building rights, GRDPsda Index = Index of SNGs with dominant revenue from natural resources, DBHSDA = revenue sharing fund from natural resources, DBH^ = revenue sharing funds from tax collections, DBH = revenue sharing funds.

The Indonesian government has recently reformed the DAU formula to incentivize SNG revenue effort through Law 1/2022.[11] This law made several important changes to the architecture of intergovernmental transfer and SNG revenues. The new law has changed the DAU formula for measuring fiscal capacity, that is, determining the potential revenue estimates instead of the historical sum of own source revenue (PAD) and revenue sharing funds (DBH). However, the law leaves it up to the implementing regulations to define the method for estimating the potential revenue, which can be both a challenge and an opportunity.

10. The Representative Tax System (RTS) is an approach where regional governments measure their fiscal capacity by counting the revenue that they could raise if they employed all standard sources at the nationwide average intensity of use (Shah et al. 1994). Several pieces of information are needed, such as information on the tax bases and tax rates for each SNG.
11. Law 1/2022 replaces Law 33/2004 on intergovernmental transfers and Law 28/2009 on subnational revenues.

3 Limited Empirical Evidence on Estimating Potential Revenues

The previous DAU formula theoretically disincentivizes SNGs to collect more OSRs, but empirical evidence remains mixed. With the existing DAU formula, SNGs have the choice to make less effort in collecting OSR to gain transfers in the form of DAU. However, available evidence shows mixed results. Lewis and Smoke (2017) found that due to limited OSR contribution to Indonesia's SNGs' revenue streams, SNGs paid little attention to the negative incentives in the current DAU formula. This contradicts Fadliya and McLeod (2010), who argued that the formula would disincentivize SNGs in generating their revenues. Results were also mixed in other developing economies (Mogues and Benin 2012; Huang, Lo, and She 2012).

Nevertheless, there are strong reasons to review the existing DAU formula and incentivize SNGs to collect more OSRs. Theoretically, Martinez-Vasquez (1997b) shared a concern discussed in the previous section regarding how OSRs could provide misleading representation of SNGs' fiscal capacity. A local government's leaders may also find it politically challenging to increase their region's tax effort. Raising local tax may be seen as an unpopular policy that brings some political costs to local leaders. Hence a stronger incentive for OSR collection by the central government could be useful.

Existing literature provides little to no consensus on how potential revenue should be estimated, particularly those incorporating the characteristics of Indonesia's SNGs. Mawejje and Sebudde (2019) compare various approaches to revenue forecasting methods (Rubin, Mantell, and Pagano 1999; Williams and Kavanagh 2016) and the challenges of utilizing advanced revenue forecasting methods in local governments (Reddick 2004; Batóg and Batóg 2021). However, none of these bodies of literature has shed light on which approach would suit best for Indonesia.

Existing literature identifies several ways of estimating potential revenues. Differences between various approaches are usually related closely to mathematical complexity, data requirements, overall sophistication, and accuracy (Reddick 2004). First, qualitative approaches rely on subjective opinion of experts to forecast revenues. The approach is often used to enhance the results produced using other approaches. Second, extrapolative or trend-based approaches rely on time series analysis of historical revenue data. These approaches provide a more rigorous process for potential revenue estimation and incorporate simple and accessible data. Finally, there are causal approaches, where deterministic or econometric techniques use variables that may play an important role in influencing revenues in the future. While these approaches yield useful information for policymakers, they require more time and resources compared with other approaches.

In practice, some countries use actual revenue data as a proxy for potential revenue. Indonesia,[12] Greece, Portugal, and the United Kingdom are some countries who use this approach. Taking this approach is practical and provides transparency, which are two desirable features of fiscal capacity measurements given that many policymakers are unfamiliar with complex and technically demanding measurements (Martinez-Vazquez and Boex 1997a).

However, some other countries that are willing to go through more complex and rigorous estimation methods adopt macroeconomic modeling, representative revenue systems (RRS), and microeconomic approaches. Estimation using macroeconomic approaches rely on aggregated macroeconomic data for variables that may provide information behind changes in revenues. RRS approaches estimate potential revenues using microeconomic indicators by assessing both tax base and tax rate. This approach utilizes disaggregated economic census data to measure the tax base based on each individual SNG tax. The estimated tax base is then multiplied by the tax rate. However, it is essential to interpret the result with caution, given that this approach does not consider the behavioral response of tax implementation (i.e., once the tax is implemented, that would lead to a reduction in the tax base as taxpayers would respond to the change). United States,[13] Canada,[14] Italy, and Poland use this approach when estimating potential revenues. The microeconomic approach usually utilizes individual tax base (administrative data) and gathers new data from surveys. The sophistication of such models depends on data availability.

12. This is the practice conducted by the Indonesian government prior to the ratification of Intergovernmental Fiscal Relations Law (Law 1/2022).
13. The study found that the RRS approach poorly predicts fiscal capacity in US states, as reflected by weak correlation between the fiscal gap (revenue capacity – expenditure need) and distributed grants (Gordon, Auxier, and Iselin 2016).
14. Taylor, Keenan, and Carbonneau (2002).

4 Conceptual Framework for Estimating Potential Revenues in Indonesia

We build on the existing literature by developing a comprehensive conceptual framework to estimate potential revenues for Indonesia, taking into account the data constraints in the country. This framework aims to identify predictor(s) of potential revenue of the main tax revenue sources at the district level in Indonesia. We use three criteria to identify the predictors, given below:

1. ***Conceptual/theoretical link with revenue source:*** These are variables that we expect in theory to predict the revenue stream.

2. ***Backed by empirical evidence where available:*** Empirical evidence is needed to provide understanding of whether selected indicators in practice predict their respective revenue streams in a robust manner. We search for available empirical literature for indicators identified via the first criteria.

3. ***The indicator accurately predicts respective revenue sources using historic data from Indonesia:*** The selected indicators should be applicable to Indonesia. This means that (1) the data for the relevant indicator should be available for Indonesia, and (2) the indicator should be able to predict respective revenue sources using Indonesia's data.

> > >

FIGURE 4 - Comprehensive Framework for Potential Revenue Estimation

We apply this framework to four categories of district-level taxes in Indonesia, which constitute about 80 percent of the district's OSRs. These groups are (1) recurrent property tax; (2) property transfer tax; (3) street lighting tax; and (4) hotel, restaurant, and entertainment taxes. Table 2 provides a summary of results. For each group, the conceptual predictors were tested separately using Indonesia's subnational fiscal data from 2010 to 2018 for districts with available data. We also reviewed the indicators' ability to predict own source revenues (see Annex A and B for a detailed regression results). We only applied the conceptual framework in this study to districts in Indonesia and not to provinces.[15]

15. We exclude provinces from this model because of their different nature and sample size compared to districts.

> > >

TABLE 2 - Proposed Conceptual Predictors for Each District Groups

Group of revenue sources at district level	Proposed conceptual predictors	Results summary
1. Recurrent property tax and property transfer tax	**Gross regional domestic product (GRDP)** Higher economic activity might mean higher number of properties, higher valuations, and higher number of property transfers. **Total district population** Higher number of people residing in a district might proxy for more properties and hence higher property and property transfer taxes. **Urbanization rate** The urban parts of the country are more likely to have higher property valuations and more transfer of properties.	**Recurrent property tax** • GRDP and total district population have a strong association with property tax revenue. • Using the fixed effect model, all proposed conceptual predictors have strong association with property tax revenue. **Property transfer tax** • GRDP and urbanization rate have a strong association with property tax revenue. • Population has a predictive value once we control for urbanization. *See Table A.1, Table A.2, and Table A.3 for the regression results.*
2. Street lighting tax	**Gross regional domestic product (GRDP) for electricity** Higher economic activity might mean higher number of activities that would need electricity power. **Electricity access** Electricity access is distributed widely via streetlight cables that connect power sources and buildings across the district.	• Both predictors have strong association with street lighting tax in Indonesia. *See Table A.4 for the regression result.*
3. Hotel, restaurant, and entertainment taxes	**Gross regional domestic product (GRDP) or GRDP for the accommodation sector** Higher economic activity might mean higher consumption level. Measures of overall consumption might be associated with higher consumption of hotels, restaurants, and entertainment. **Urbanization rate** The urban parts of the country are more likely to have more hotels and restaurants.	• GRDP, accommodation GRDP and, percentage of urban population have a strong association with these taxes. • Other direct measures of consumption might predict these taxes even better. *See Table A.5 for the regression result.*

Based on the results outlined in Table 2, we found that GRDP, population, and urbanization rate are good predictors for most revenue sources. As a standalone predictor, GRDP is a relatively strong predictor of district revenue sources. Furthermore, sectoral GRDP and urban population help further improve predictability and could be added to the model. Population and urbanization rates are essential variables that could also capture a district's demographic nature. While other similar variables such as working age population and labor force could define a district's productivity, they were not used in this study because of data constraints.[16] Considering how these indicators are easily accessible, an establishment of simple potential revenue estimation model is viable in the case of Indonesia.

The results from the conceptual framework provide a justification for an aggregated, macro approach to estimating potential revenues. This is because the results showed that GRDP, population, and urbanization (in order of importance) are good predictors of most district revenue sources when analyzed separately. This provides a strong reason to use these variables to predict total district revenues.

Table 3 shows that the aggregated model with GRDP, urbanization, and population predicts PAD well. Model (1) shows that GRDP on its own is a good predictor of PAD as shown by the high R-square and model fit. Models (2) and (3) show that adding additional covariates including year fixed effects, population, and urbanization successively improve the model fit as well.

> > >

TABLE 3 - Aggregated Potential Revenue Model

Dep Var: PAD	(1)	(2)	(3)
Total GRDP	0.851***	0.805***	0.369***
	(0.009)	(0.009)	(0.017)
Percent Urban Population			0.374***
			(0.012)
Population			0.410***
			(0.019)
Observations	4024	4024	3846
Adjusted R^2	0.703	0.767	0.840
Year Fixed Effects	No	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We also show that nominal GRDP should be used in the model rather than real GRDP because price changes are reflected in PAD. Table 4 shows that the model fit decreases substantially if we use real GRDP instead of nominal GRDP. The R-square decreases when we compare Model (1) and (2), and again when we compared Model (3) and (4). We add province fixed effects to the model as added controls.

16. Furthermore, incorporating variables such as the labor force or working age population may not significantly enhance the accuracy of potential revenue estimation, especially in a context characterized by a high level of informality in Indonesia (Rothenberg et al. 2016). These variables might not offer optimal predictive value for our model since they provide only a partial representation of the economic landscape.

> > >

TABLE 4 - Empirical Results from Including GRDP in the Model

Dep Var: PAD	(1)	(2)	(3)	(4)
Total Nominal GRDP	0.851***		0.715***	
	(0.009)		(0.028)	
Total Real GRDP		0.833***		0.709***
		(0.010)		(0.028)
Observations	4024	4023	4024	4023
Adjusted R^2	0.703	0.660	0.718	0.715
Year Fixed Effects	No	No	Yes	Yes
Province Fixed Effects	No	No	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5. Adding Relevant Controls and District Fixed Effects Reduces Distributional Implications

Improving the Potential Revenue Estimation Model by Introducing Selected Control Variables

While an aggregated model does have good predictive power, it is also important to look at the distributional implications for districts of adding controls. This section aims to understand how adding more variables to the model would change the DAU allocation of districts. Specifically, we aim to answer the following questions:

1. What are the distributional implications of moving from actual PAD to potential revenues in the DAU formula by using a model that only uses GRDP?

2. How does DAU's overall distribution change when we improve the model by adding population, urbanization, and sectoral GRDP[17] to the model?

3. Would including district fixed effects lead to fairer DAU allocation as we consider time invariant district variant characteristics?

17. We add mining GRDP because it is not subject to district PAD and instead is subject to a central government property tax on mining, forestry, and plantations.

Moving from actual to potential revenue estimates using a GRDP only model would lead to change of less than 30% in DAU for most districts (Figure 5). Our simulations show a lower change in DAU with more districts gaining DAU when we add controls in addition to GRDP. As we improve the model by adding population, urbanization rate, and mining GRDP to predict potential revenue, we find that the number of districts that gained more DAU have increased (see Table B.1 for the regression result). Furthermore, the geographical distribution of DAU is varied with high tax effort districts, such as those on the island of Java-Bali, gaining DAU (Figure 6, Panel A). Districts that would lose DAU are on the islands of Sumatra, Kalimantan, and Papua. Shifting to the improved model helps districts in Central and North Kalimantan, as well as those in the southern part of Sumatra, which gain more DAU (Figure 6, Panel B).

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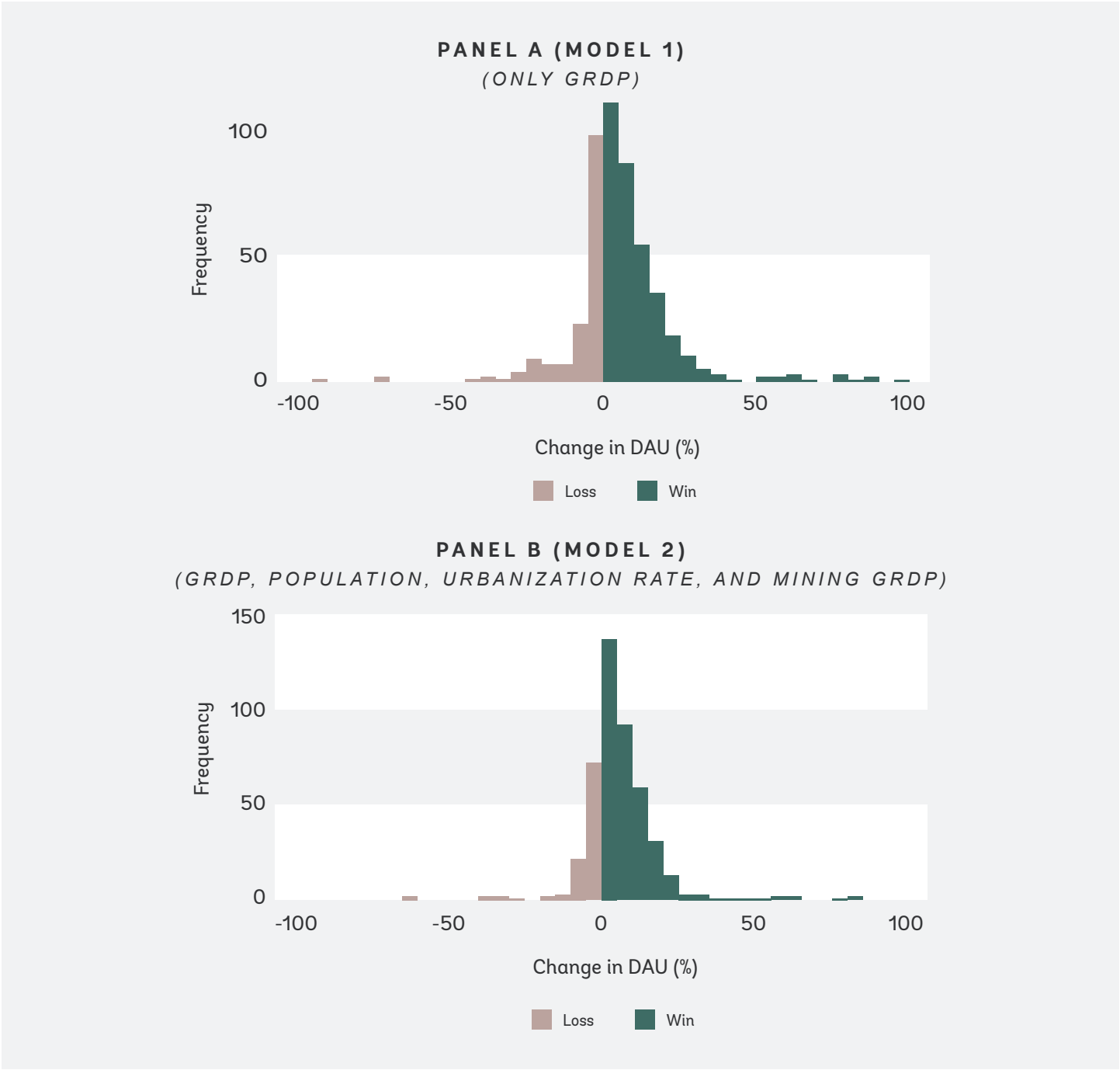
FIGURE 5 - Changes in DAU from Model 1 to Model 2, by Percent Changes and Number of Gaining/ Losing Districts



Note: GRDP = Gross Regional Domestic Product, DAU = *Dana Alokasi Umum* (General Allocation Fund).

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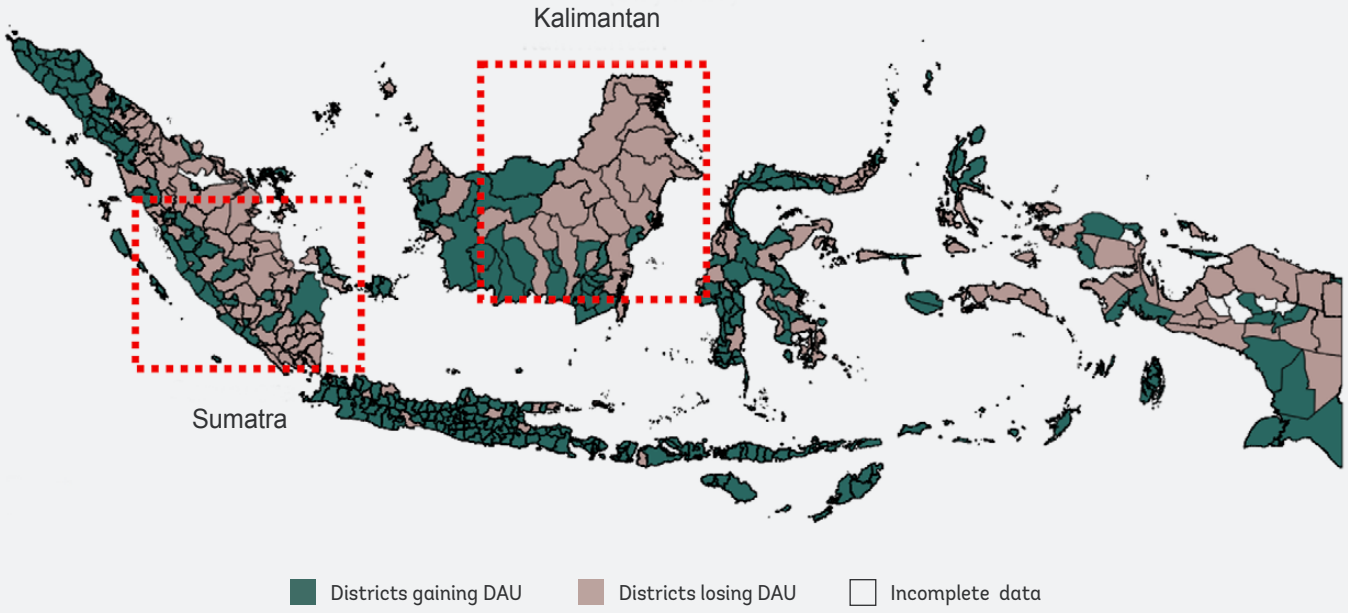
FIGURE 6 - Changes in DAU from Model 1 to Model 2, by Geographical Distribution of Gaining/Losing Districts

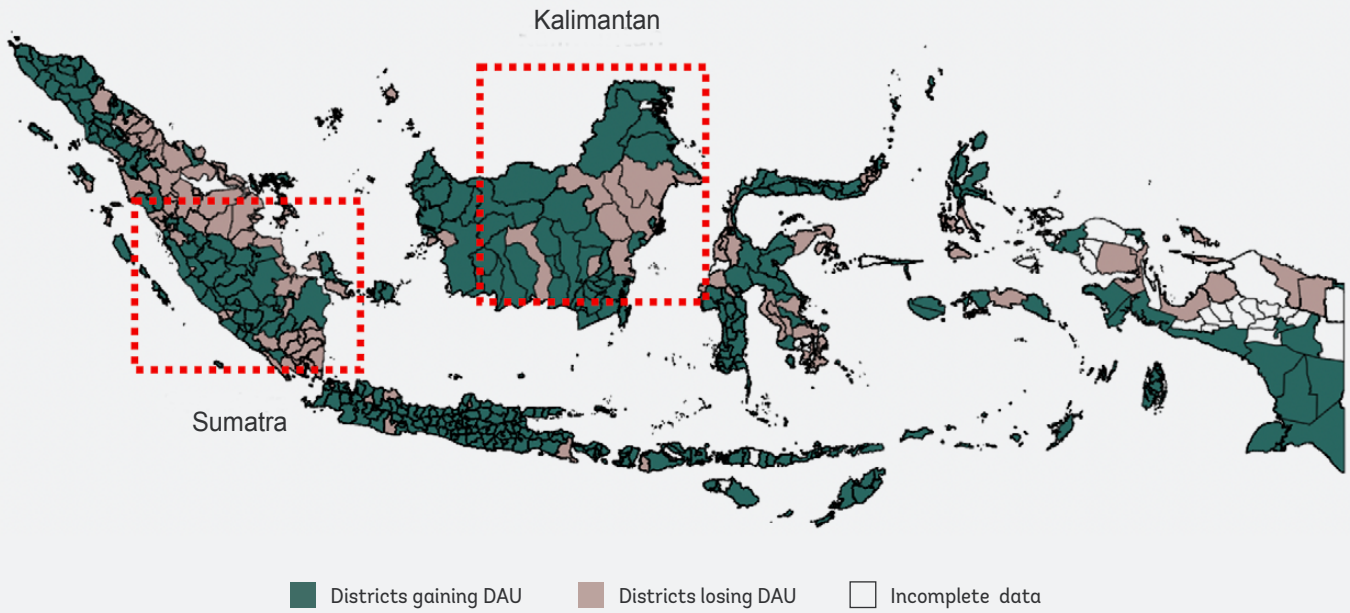
PANEL A (MODEL 1)

(ONLY GRDP)



PANEL B (MODEL 2)

(GRDP, POPULATION, URBANIZATION RATE, AND MINING GRDP)



Including added controls also significantly reduces the DAU change for outliers. Table 5 illustrates how adding controls (Model 2) reduces the DAU change for the top 10 losing and gaining districts. For example, district 3 of the top *10 winning districts* would likely experience a loss of 70 percent of their DAU in the same observed year if the potential revenue estimation model relies only on GRDP, as reflected in Model 1. However, applying Model 2 would benefit this district, as adding more control in the potential revenue estimation model would help increase the DAU allocation to this region by 124 percent relative to the status quo. A major reason for this is that there are GRDP components that are not subject to SNG taxation; for example, the mining portion of GRDP comes from the central government's property taxation. This means that resource rich districts, such as the ones in Kalimantan, benefit when we control for factors such as mining GRDP. Hence, Model 2 has lower distributional implications.

> > >

TABLE 5 - Top 10 Winning and Losing Districts After Modifications in Models 1 and 2

Top 10 winning districts				Top 10 losing districts			
District	% DAU change (Model 1)	% DAU change (Model 2)	Difference (p.p.)	District	% DAU change (Model 1)	% DAU change (Model 2)	Difference (p.p.)
1	-209	186	394	1	1275	107	-1168
2	-132	131	264	2	186	75	-110
3	-70	124	195	3	85	28	-57
4	-71	105	176	4	218	178	-40
5	-95	64	159	5	63	24	-39
6	29	126	97	6	62	36	-27
7	-29	67	97	7	89	63	-26
8	-40	51	92	8	68	42	-26
9	-35	50	86	9	37	21	-16
10	-38	47	85	10	23	10	-13

Notes: "% DAU Change" is defined as the difference between actual and estimated PAD, as a share of DAU. This means that the % DAU change can be lower than -100% of DAU due to a substantial increase of estimated PAD. Figures below -100% are only there for illustrative purposes. DAU = General Allocation Fund, PAD = *Penerimaan Hasil Daerah* (Own Source Revenue).

Incorporating added controls to the model of potential revenue estimation has therefore lower distributional implications. Adding control variables from only GRDP (Model 1) to GRDP, population, urbanization, and mining GRDP (Model 2) helps capture a district's important characteristics relevant to tax potential.

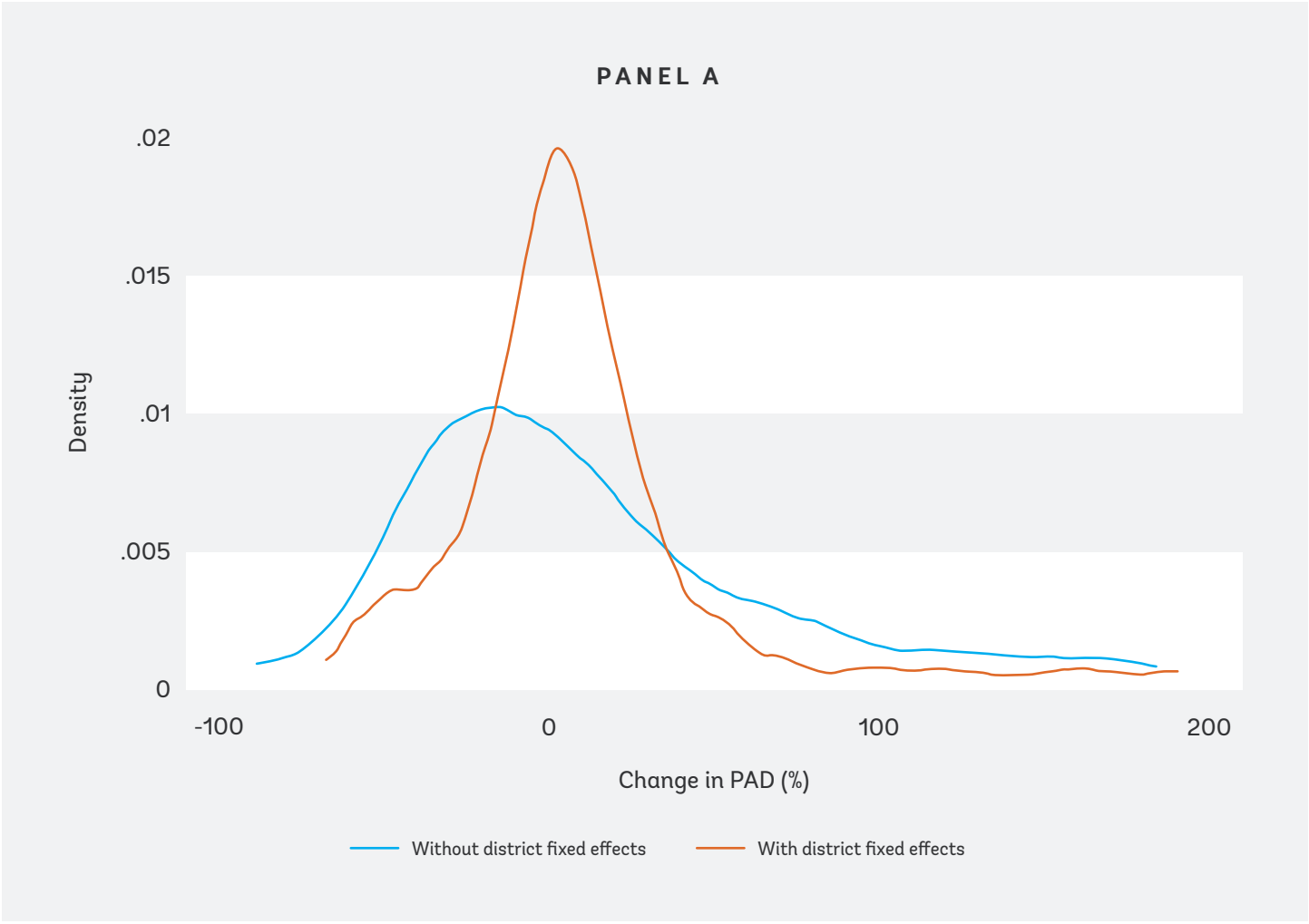
Achieving Fairer DAU Allocations by Including District Fixed Effects in the Model

Adding district fixed effects takes the fairness of DAU allocations one step further as it takes time-invariant, district variant characteristics into account. By using a fixed effect approach, the potential revenue estimation model will not be influenced by each district's fixed characteristics (Stock and Watson 2020). For example, if a district has a consistent composition of GRDP (e.g., it earns a consistently high share of GRDP from oil/gas) or a consistently high/low level of tax administration capacity, then the fixed effects model will account for that.

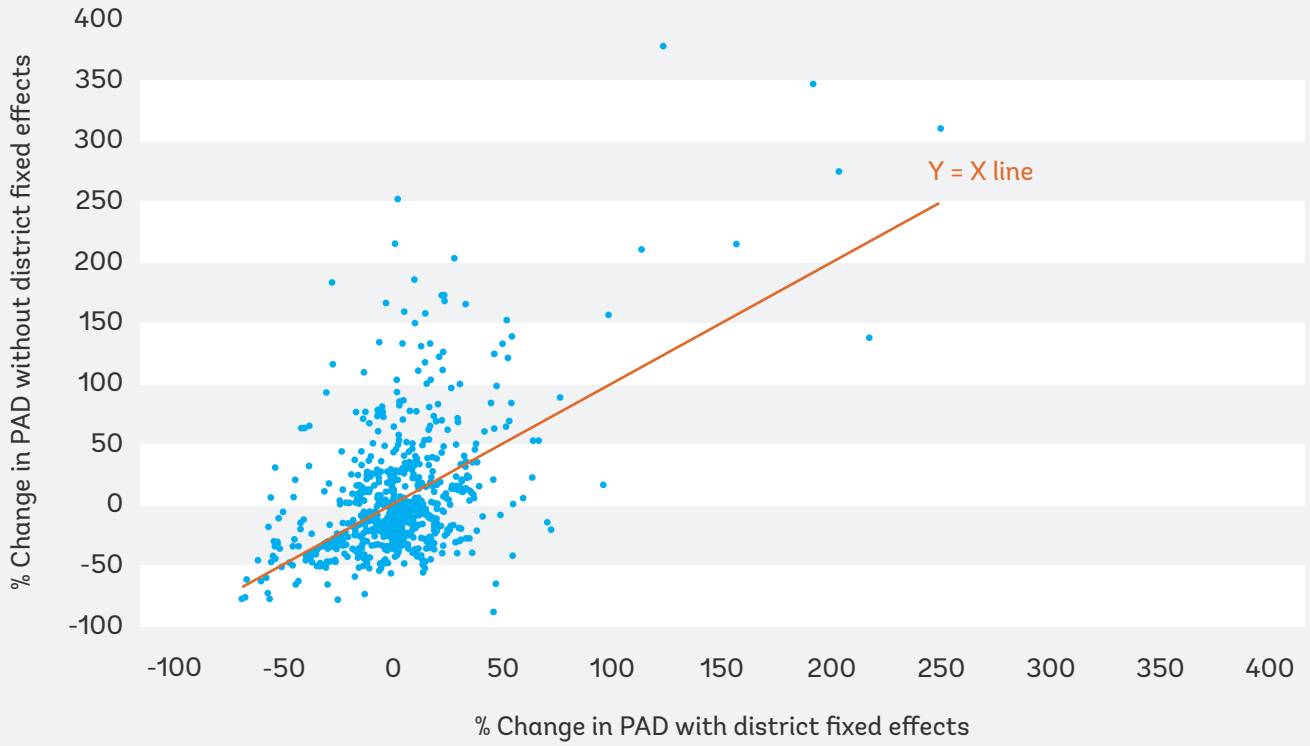
Including district fixed effect leads to lower distributional implications. As illustrated in Figure 7, we found that the model with district fixed effects has a relatively lower change in PAD. This is because without district fixed effects, we are comparing across districts that may be very different from each other. By including district fixed effects, we are using the variation within districts which leads to a fairer DAU allocation.

> > >

FIGURE 7 - Distributional Implications of Running Models with and without Fixed Effects

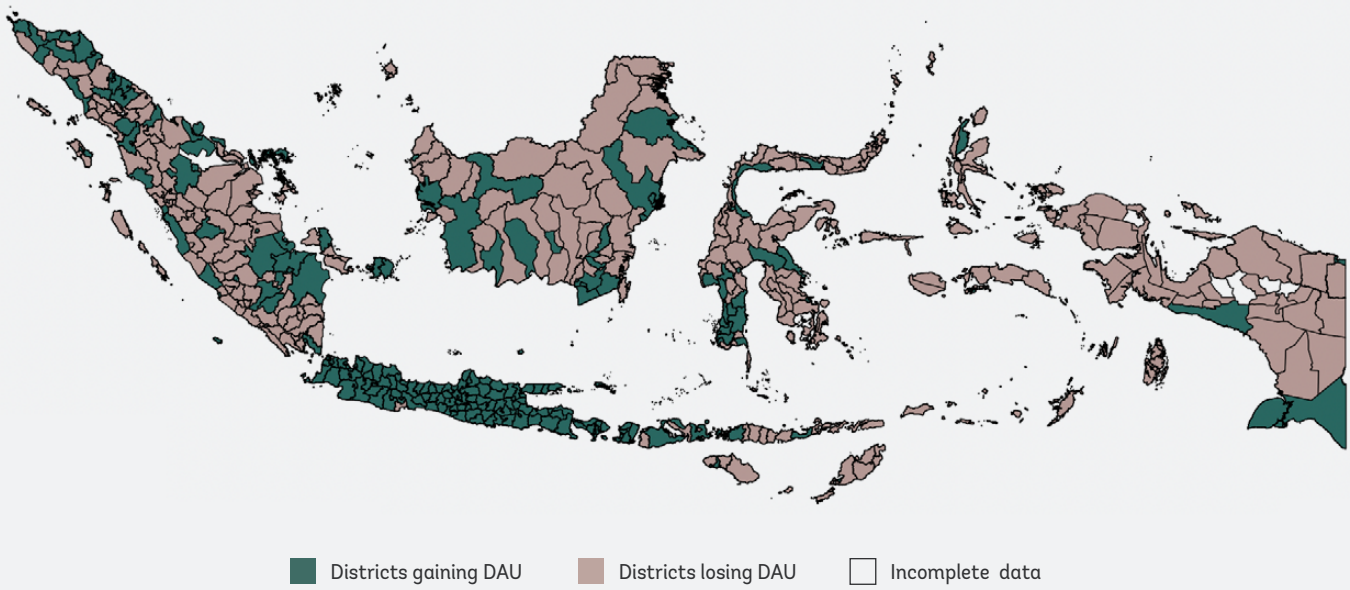


PANEL B



PANEL C - GEOGRAPHICAL DISTRIBUTION OF DAU FOR DISTRICT FIXED EFFECTS MODEL

(GRDP, YEAR AND DISTRICT FIXED EFFECTS)



Note: DAU = *Dana Alokasi Umum* (General Allocation Fund), GRDP = Gross Regional Domestic Product, PAD = *Penerimaan Hasil Daerah* (Own Source Revenue).

Overall, the inclusion of district fixed effects is a better and simpler way to improve the accuracy of the potential revenue estimation model. District fixed effects help minimize differences between the estimated and actual PAD figures by generating lower mean and standard deviation – in comparison with models that do not use district fixed effects. This approach also does not require additional specific variables, such as mining GRDP, to capture all the characteristics of districts in Indonesia.

6 Conclusion

Indonesia has taken the right step to reform the existing DAU formula by moving from actual SNG revenues to potential revenues as a proxy for fiscal capacity. Indonesia's SNGs are highly reliant on central government transfers, particularly from DAU. As DAU aims to resolve horizontal imbalances among local governments by covering deficits in certain SNGs, its distribution formula provides a disincentive for districts to collect their revenues independently. The new Law 1/2022 changes this situation by replacing PAD and DBH with potential revenue as a proxy for fiscal capacity. The law, however, does not elaborate on the estimation method.

This paper outlines a viable approach to estimating SNGs' potential revenue in Indonesia. Given the limited understanding of how local governments should measure their potential revenues, this paper has developed a comprehensive conceptual framework to identify ideal indicators that could predict potential revenues by considering three criteria:

1. ***Linkage with conceptual/theoretical findings:*** Indicators, in theory, should be able to predict SNGs' revenue stream.

2. ***Availability of empirical evidence:*** Indicators in practice should be able to predict SNGs' revenue stream in a robust manner, as suggested by existing bodies of literature.

3. ***Applicability in Indonesia's case:*** Data for the indicators should be available in Indonesia, which should be able to predict respective revenue sources.

The application of the conceptual framework shows three main predictors of potential revenue. Through several regression tests, we found that GRDP, population, and urbanization rates are good predictors for these revenue sources.

Placing district fixed effects to the potential revenue estimation model resulted in a fairer DAU allocation. This paper explored two approaches in improving the distributional implications of the model: (1) adding control variables that incorporate SNGs' economic landscape and (2) placing district fixed effects. Both approaches aimed to ensure that the potential revenue estimation model would capture SNGs' characteristics so that DAU distribution would incorporate each SNG's realistic capacity subject to their potential. We found that the latter approach minimized distributional implications – as reflected in changes in PAD. District fixed effects are a better way to improve the accuracy of the potential revenue estimation model, given its simplicity in capturing SNG characteristics without identifying specific sectoral GRDP predictors as control variables.

Incorporating a temporal dimension into the future application of the main predictor holds the potential for enhanced effectiveness. While this study primarily focuses on evaluating the predictive capacity of proposed variables for district-level potential revenue across Indonesia, it may be useful to explore the effect of lagged predictors. This could be an important extension of this analysis in the future.

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Annex A.
Regression Results of Conceptual Framework

> > >

TABLE A.1 - Potential Revenue Estimation: Regression Results for Property Tax Revenue

	Dependent Variable: Property Tax Revenue					
log GDP	0.859***	1.062***	0.275***	0.091	0.812***	0.151**
	(0.006)	(0.060)	(0.038)	(0.055)	(0.013)	(0.053)
log Population	0.740***	0.068	1.074***	0.896***	0.704***	0.919***
	(0.028)	(0.056)	(0.124)	(0.147)	(0.044)	(0.060)
Household Size	-0.538***	-0.716***	-0.628***	-0.747***	-0.406***	-0.725***
	(0.148)	(0.051)	(0.045)	(0.090)	(0.052)	(0.083)
log Federal Transfer		-0.0786**		-0.024		-0.025
		(0.026)		(0.016)		(0.016)
Constant	-10.56***	-2.916***	-7.130***	-4.276*	-9.713***	-5.365***
	(0.559)	(0.278)	(1.745)	(2.070)	(0.712)	(0.511)
Fixed Effects	NO	NO	YES	YES	NO	NO
Random Effects	NO	NO	NO	NO	YES	YES
N. of Obs	1275	654	1275	654	1275	654
Adjusted R2	0.892	0.947	0.684	0.75	0.892	0.932

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Source: Awashti et al. (2020).

> > >

TABLE A.2 - Potential Revenue Estimation: Regression Results for Recurrent Property Tax (Fixed Effect)

Dep Var: Property Tax	(1)	(2)	(3)	(4)
Total GRDP	1.204***	0.954***	1.036***	0.622***
	(0.054)	(0.088)	(0.042)	(0.090)
Population		0.379**		0.587***
		(0.145)		(0.118)
Percent Urban Population			0.522***	0.589***
			(0.064)	(0.068)
Observations	2310	2310	2257	2257
Adjusted R^2	0.514	0.524	0.566	0.590
Year Fixed Effects	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

> > >

TABLE A.3 - Potential Revenue Estimation: Regression Results for Property Transfer Tax

Dep Var: Property Transfer Tax	(1)	(2)	(3)	(4)
Total GRDP	1.487***	1.416***	1.209***	0.846***
	(0.094)	(0.148)	(0.062)	(0.090)
Population		0.108		0.522***
		(0.252)		(0.149)
Percent Urban Population			1.003***	1.073***
			(0.082)	(0.088)
Observations	3206	3206	3153	3153
Adjusted R^2	0.428	0.429	0.559	0.570
Year Fixed Effects	Yes	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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TABLE A.4 - Potential Revenue Estimation: Regression Results for Street Lighting Tax

Dep Var: Street Lighting Tax	(1)	(2)	(3)
Electricity GRDP	0.667***		0.640***
	(0.055)		(0.054)
Electricity Access (% of HHs)		2.358***	0.806*
		(0.692)	(0.417)
Observations	3770	3770	3770
Adjusted R^2	0.587	0.221	0.595
Year Fixed Effects	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

> > >

TABLE A.5 - Potential Revenue Estimation: Regression Results for Hotel, Restaurant, and Entertainment Tax

Dep Var: Hotel+Rest+Ent Tax	(1)	(2)	(3)
Total GRDP	1.085***		0.400***
	(0.097)		(0.122)
Accommodation GRDP		1.008***	0.589***
		(0.055)	(0.105)
Percent Urban Population			0.480***
			(0.128)
Observations	3835	3835	3729
Adjusted R^2	0.372	0.479	0.517
Year Fixed Effects	Yes	Yes	Yes
Province Fixed Effects	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Annex B.
Regression Results of Models with Added Controls

> > >

TABLE B.1 - Empirical Results from Including Urbanization Rate and Mining GRDP in the Model

Dep Var: PAD	(1)	(2)
Total Nominal GRDP	0.851***	0.620***
	(0.009)	(0.020)
Population		0.223***
		(0.018)
Percent Urban Population		0.267***
		(0.016)
Total Nominal Mining GRDP		-0.028***
		(0.006)
Observations	4024	3682
Adjusted R^2	0.703	0.725

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$


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