

Creative Infrastructure Financing for Regional Development: Lessons from Indonesia's Sub-national Lending Model

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Abstract

Infrastructure plays a vital role in improving productivity and accessibility, lowering logistics costs, facilitating trade, and attracting investment. Nevertheless, local governments in Indonesia face substantial fiscal and regulatory constraints that impede infrastructure development. Conventional financing sources—such as central government transfers and regional budgets (APBD)—often fail to keep pace with the growing demand for infrastructure investment. Recent policy reducing intergovernmental fiscal transfers has further limited the capacity of local governments to independently fund infrastructure projects. In response, PT Sarana Multi Infrastruktur (PT SMI), a state-owned enterprise under the Ministry of Finance, offers a range of financial instruments—including subnational loans, blended finance, and public-private partnerships (PPP)—as alternative solutions to help bridge the infrastructure financing gap. Among these instruments are low-interest subnational loans for infrastructure development under the National Economic Recovery (PEN) program, which were disbursed during the COVID-19 pandemic. This paper seeks to assess the impact of PEN loans on regional capital expenditure using a staggered difference-in-differences (DID) approach, followed by a fixed effects model linking capital spending to regional economic growth. The DID analysis employs a panel dataset constructed from PT SMI's internal data, regional financial reports, and datasets obtained from the Central Bureau of Statistics. The treatment group comprises regions that received PEN loans, while the control group includes regions that did not receive such loans during the study period. In addition, this study investigates implementation challenges and proposes policy recommendations for innovative infrastructure financing. Specifically, it addresses the following questions: (1) To what extent do creative financing mechanisms influence capital spending? and (2) How is local capital spending associated with changes in regional economic growth and revenue? As Indonesia restructures its regional financing framework through the implementation of a new statute governing central-regional fiscal relations (UU HKPD & PP HKFN), this research provides timely, policy-relevant evidence on how innovative public financing schemes can support economic growth and the country's structural transformation in the years ahead.

Keywords: Infrastructure Financing, Infrastructure Spending, Regional Development, Subnational Finance, Economic Growth, Indonesia

I. Introduction

Infrastructure development is widely recognized as a critical driver for economic growth and improved social welfare. Well-planned and accessible infrastructure enhances productivity, improves access to public services and markets, reduces logistics and transaction costs, and attracts domestic and foreign investments (Calderón dan Servén, 2010). Empirical evidence consistently highlights a positive correlation between infrastructure investment and economic development outcomes, particularly in emerging economies (Foster, V., et al., 2023). A World Bank study employing macroeconomic growth regression models across multiple countries found that the social and economic rates of return on infrastructure projects range from 30% to 80%, depending on the type of infrastructure (Estache, 2007). Despite its importance, infrastructure development in Indonesia continues to face significant constraints, particularly due to fiscal limitation.

Acknowledging these limitations, there is growing interest among policymakers and academics in exploring creative infrastructure financing mechanisms as viable alternatives to conventional fiscal instruments (OECD, 2021). Creative financing for development refers to the use of innovative financial instruments and mechanisms designed to mobilize resources beyond conventional public funding sources with the aim of bridging critical development financing gaps (Anbumozhi, et al., 2023). Despite the increasing awareness and adoption of creative financing mechanisms in infrastructure development, there remains a significant gap in empirical research evaluating their actual impact, particularly in the context of developing economies like Indonesia. Most existing studies focus on the design of financing instruments or institutional frameworks, with limited attention to how these instruments or mechanisms influence public investment outcomes or regional economic performance (ADB, 2021). The lack of credible, evidence-based evaluations restricts policymakers' ability to assess the effectiveness of creative financing in enhancing infrastructure spending and promoting equitable growth. This study seeks to fill this knowledge gap by providing empirical evidence on the effect of creative financing instruments—on regional capital spending and economic outcomes.

In response to this research gap and policy need, this study focuses on two primary objectives. First, to quantify the impact of creative financing mechanisms—specifically the PEN loans—on regional capital expenditure. Second, to examine the relationship between capital spending and regional economic performance, particularly in terms of GDP growth

and local revenue generation. Accordingly, the study seeks to answer two key research questions: (1) To what extent can creative financing mechanisms impact capital spending at a sub-national level? (2) How does the level of local capital spending associate with changes in regional economic growth and revenue? Answering these questions should then provide useful insight into how developing countries like Indonesia can accelerate efforts in infrastructure development, and potentially economic growth, despite fiscal constraints.

It is widely accepted that capital spending is an important component in the accumulation of physical capital such as infrastructure. However, due to the nature of infrastructure development, the exorbitant upfront capital costs can be a heavy burden on fiscally constrained governments such as Indonesia. Dependence on central government transfers and regional budgets has consistently proven inadequate in meeting the rapidly escalating infrastructure investment demands. According to estimates from the national budget (APBN), regional budgets (APBD), and the National Development Planning Agency (BAPPENAS) estimates that Indonesia requires approximately IDR 1,289 trillion in infrastructure investment annually. However, only about 45% of this need can be met through APBN and APBD funding sources (Bappenas 2020). The situation has been further exacerbated by recent reductions in intergovernmental fiscal transfer, driven by government policies aimed at improving budget efficiency. Furthermore, allocations from the Physical Special Allocation Funds (DAK) in real and nominal terms have been declining since 2016, with an average annual decrease of 6-8% (Maulana, S., 2024). These trends underscore the urgent need for alternative creative financing mechanisms to bridge the infrastructure investment gap.

Why creative financing may be paramount in providing the necessary funding is due to its unconventional nature that are typically catered to fiscally constrained borrowers. Its key characteristics include flexible pricing and loan terms (i.e. concessional or below-market interest rates enabled through fiscal policy synergies), supportive regulatory reforms (i.e. streamlining approval processes and enabling government guarantees to enhance creditworthiness), non-financial support facilities, such as the Project Development Facility (PDF), which helps improve project readiness and bankability by funding feasibility studies and providing transaction advisory services, and risk-sharing mechanisms, particularly through public-private partnership (PPP) arrangements, that help distribute financial and operational risks between public authorities and private sector partners (Mutambatsere and Schellekens, 2020; D.Eggers, et al., 2023; DJPPR MoF, 2023).

In Indonesia, a pivotal actor driving the development of creative infrastructure financing in Indonesia is PT Sarana Multi Infrastruktur (PT SMI), a state-owned enterprise under the Ministry of Finance that is expected to evolve into a national development bank. PT SMI utilizes a range of financial instruments—including subnational loans, blended finance mechanisms, and public-private partnerships (PPPs)—to help close regional infrastructure financing gaps. One notable example of creative financing implemented by PT SMI is the National Economic Recovery (Pemulihan Ekonomi Nasional, PEN) loan program, introduced during the COVID-19 pandemic. Amid the health crisis, national fiscal space contracted significantly due to revenue shortfalls and emergency spending demands, while regional governments faced declining own-source revenues and cuts in central transfers. At the height of the crisis in 2020, regional PAD dropped by 10,1% year-on-year, while intergovernmental transfers saw reductions in real terms by 6% (APBD DJPK database, 2021). In response, the government allocated over IDR 30,43 trillion through PT SMI in the form of concessional PEN loans to help maintain local capital spending. These loans featured below-market interest rates, shorter approval times, and were backed by state guarantees, enabling faster fiscal injections compared to conventional financing schemes. The PEN program was also innovative because it reallocated national budget resources to local governments through a lending mechanism, rather than traditional transfers. This provided regional governments with liquidity to sustain public investment in strategic infrastructure projects that could both stimulate short-term recovery and lay the foundation for long-term growth.

The remainder of this paper is structured as follows. Section 2 presents a review of relevant literature and theoretical foundations on infrastructure financing and subnational development. Section 3 outlines the research methodology and data sources, including the staggered DiD and fixed effects panel models. Section 4 presents the empirical results and key findings of the analysis. Section 5 discusses the policy implications of the findings particularly in the context of Indonesia's fiscal reform agenda and the role of creative financing mechanisms in supporting regional infrastructure. Finally, Section 6 concludes the study by summarizing key insights and offering recommendations for future research and policy development.

II. Literature Review

2.1 The Rise of Creative Financing in Infrastructure Development

In recent years, the use of creative financing instruments has gained significant traction across both developed and developing countries as a strategic response to the rising costs associated with infrastructure upkeep and development (Singla et al., 2021; Estache, et al., 2015). This trend reflects the growing recognition that traditional public funding sources alone—such as general budgets or grants—are often insufficient to meet the scale and urgency of infrastructure investment needs, especially under fiscal constraints.

Creative financing for development can be defined as the use of non-conventional mechanisms for mobilizing development finance by engaging new sources and partners while providing financial solutions to development challenges (World Bank, 2009). These instruments are not designed to replace conventional funding but to complement and extend their reach by leveraging fiscal policy synergies, regulatory reforms, and market-based instruments. The application of creative financing may differ substantially between country contexts. In developed countries, where infrastructure systems are largely mature, creative financing tends to focus on the upkeep and modernization of existing assets. In these settings, creative financing decisions are often discretionary- heavily influenced by a government's fiscal strategy, financial condition, and political support for debt. The alternative funding and financing tools in this case are mainly a reworking of existing government instruments such as taxes and bonds outside of its traditional use (Singla et al., 2021). On the other hand, for developing countries whose main concerns revolve around the development of otherwise non-existent infrastructure, creative financing tends to be driven more by necessity than choice. While political will and fiscal space still influence whether subnational governments can access or utilize creative financing mechanisms, the availability and design of these instruments are often shaped externally- primarily through development financing institutions and development agencies. These institutions are able to provide commercial loans with below-market interest rates, longer terms and repayment schedules, as well as technical assistance locally, regionally, and nationally in developing countries where either fiscal and/or technical capacity are lacking (Estache, et al., 2015). For example, concessional loans, blended finance, and PPP risk-sharing schemes are often offered to local governments with limited own-source revenue or borrowing capacity.

2.2 Sub-national Borrowing and Its Effectiveness

Among various creative financing instruments available, sub-national loans have emerged as one of the viable solutions for addressing limited fiscal capacity, especially in the

context of infrastructure financing. A growing body of literature shows that sub-national loans specifically targeted at public capital expenditure are effective in enhancing infrastructure development. In the United States, it has been estimated that every \$1 USD disbursed 3 years prior from State Infrastructure Bank (SIB) loans will result in a \$3.75 USD increase in state and local highway capital expenditure in the current year. These SIB loans typically offer low-interest rates and are aimed towards public and private sponsors of local transportation projects (Chen, 2016). Another study conducted using panel data from South Korea found a significant positive association between local government bonds and per capita capital expenditure. This indicates that municipal borrowing plays a crucial role in enabling infrastructure development and how institutional reforms, such as the introduction of a local bond ceiling system, can further enhance the ability of local governments to invest by providing more flexible borrowing frameworks (Ryu et al., 2022).

Furthermore, in settings where traditional revenue sources fall short, sub-national loans can also serve as a counter-cyclical tool that enables public investment during periods of fiscal stress or economic downturns, such as Covid-19 pandemic (Mutambatsere & Schellekens, 2020). For example, Indonesia's National Recovery Program (*Pemulihan Ekonomi Nasional* or PEN in Indonesian) loans provided a highly concessional interest rate, in some cases a 0% interest rate, to sub-national governments following the Covid-19 pandemic in an effort to boost economic recovery. A difference-in-differences (DID) analysis revealed that average capital spending in recipient regions was 2.33 times greater than in non-recipient regions as a result of these PEN loans (Sofi et al., 2022). However, the robustness of this finding should be interpreted with caution as the study did not test the parallel trends assumption, which is critical for the validity of DiD estimations. Without this test, the estimated treatment effect may be biased—either overstated or understated. Additionally, the specification of the DiD model was not clearly detailed, and there was no indication of controls for time-fixed or region-fixed effects, which may introduce potential biases and limit the internal validity of the results. All this evidence collectively points towards infrastructure development being a function of public capital expenditure.

2.3 Capital Spending and Economic Growth

Stimulating capital expenditure is crucial for infrastructure development which could potentially drive economic growth. Through capital spending, the government allocates

public investment toward long-term assets which can stimulate economic performance by boosting short-term aggregate demand (i.e. creating jobs and increasing procurement activities) and enhancing the productivity of existing private capital (Setiyanto, 2021; Miyamoto et al., 2020). Most public investment, particularly in infrastructure, promotes economic growth through two main channels: productivity, which relates to how the resulting infrastructure lowers production costs and improves service accessibility, thereby supporting business activity and human development, and; efficiency, referring to how much physical infrastructure is provided by a given amount of investment (Gie, 2002). Empirically, several studies found a positive relationship between capital spending and economic growth, particularly in developing economies (Abdullateef et al., 2011; Nyarko-Asomani et al., 2019). However, this relationship between capital expenditure and economic growth has also been found to be ambiguous as the International Monetary Fund (IMF) noted in one of its earlier reports that the empirical evidence of the effects of infrastructure projects and public expenditure on economic growth to be uncertain (IMF, 2005, pg. 13). These results reflect how the link between capital expenditure and economic growth is indirect and most likely subject to a myriad of exogenous factors (Butkiewicz & Yanikkaya, 2011; Herrera, 2007; Ahamed, 2022).

2.4 Fiscal Capacity Determinants in Indonesia

A very important component in public capital expenditure is the government's fiscal capacity. Economic variables such as regional revenue, revenue sharing fund, and general allocation funds have been found to play an important role in regional capital spending in Indonesia (Sahillawardi, 2025). Furthermore, another study also found significant relationships between public capital expenditure and economic variables such as real economic growth, government budget deficits, government debt, trade openness, and etc, in developing countries (Sturm, 2001). These aforementioned economic variables are important components in measuring a region's fiscal capacity. In the context of Indonesia, its Ministry of Finance refers to a region's fiscal capacity as its ability to generate and manage its own-source revenue. A fiscal capacity index developed by Indonesia's Ministry of Finance utilizes a myriad of economic variables such as, but not limited to, regional revenue, regional transfers, and regional spending (Indonesia Ministry of Finance, 2023). In essence, the literature points towards fiscal capacity, being a function of a government's revenue and debt, having a significant influence over its capital spending.

2.5 Case of Indonesia

For developing countries such as Indonesia, untangling the theoretical framework of how creative financing, capital spending, and economic growth are linked is pertinent to development. According to the aforementioned fiscal capacity index calculated by Indonesia's Ministry of Finance as of 2023, only 8 out of the 38 Indonesian provinces were categorized as having "high" or "very high" fiscal capacities while the rest of the provinces fell under the "very low", "low", or "moderate" categories (Indonesia Ministry of Finance Regulation no. 84-2023, 2023). As regions with stronger fiscal capacity are able to plan, manage, and execute public investments/spending more consistently and effectively (Wang, et al., 2021), Indonesia's low overall fiscal capacity acts as a hindrance to regional infrastructure development. This is reflected in how a study by Lewis (2003) highlighted that regional governments in Indonesia with higher operational surpluses borrowed larger amounts (Lewis, 2003). Borrowing larger amounts can then lead to the ability to undertake larger infrastructure projects which could boost economic growth faster than regions that borrowed less due to having lower fiscal capacities.

In the past, low fiscal capacity throughout Indonesia has led to many local governments struggling to mobilize sufficient own-source revenues and remaining heavily reliant on transfers from the central government for infrastructure development despite rapidly growing demand (Suhendra & Amir, 2006). Without adequate financial resources, despite some national progress in various areas, improvements in health, education, infrastructure, corruption, and other social services have been slower than expected, with large differences in outcomes between regions (Vujanovic, 2017). These issues working in tandem can exacerbate slow and stifled regional economic growth within the country. Thus, economic environments such as Indonesia pose to gain a host of benefits from creative financing mechanisms that fill the financing gaps left by fiscal constraints.

III. Data

This study uses a balanced panel dataset of Indonesian districts and municipalities (kabupaten/kota) covering the period 2017–2023. The observation window is designed to capture not only the periods before and after the disbursement of the government's National Economic Recovery (PEN) loan program in 2020–2021, but also the effects of the COVID-19 pandemic on the regional economies. This timeline allows for the analysis of changes in regional economic and fiscal indicators surrounding this period. The dataset

covers all districts and municipalities in Indonesia where regions that received PEN loans are the treatment group, while regions that did not receive PEN loans serve as the control group in this study.

The dataset is compiled from multiple official sources as well as internally generated variables. Annual regional Gross Domestic Product (GDP) at constant prices is sourced from Indonesia's Bureau of Statistics (BPS) and represents the level of economic output in each region. Local government revenue (PAD) is obtained from the Ministry of Finance of Indonesia and measures the revenue generated by regional governments during a fiscal year. Capital spending data are also collected from BPS, representing the amount of government expenditure on infrastructure and other long-term assets. The Human Development Index (HDI), sourced from BPS, measures the average achievement in key dimensions of human development, including health, education, and standard of living.

Several variables are constructed or obtained to capture fiscal conditions and policy exposure. The Loan variable is derived from in-house data provided by PT Sarana Multi Infrastruktur (PT SMI) and indicates whether a region took out a PEN loan in a given year. The DLoanYear variable, based on the same dataset, records whether the PEN loan had been disbursed within the region's province at or before the year of observation. The Fiscal Capacity Index, obtained from the Ministry of Finance, is an index ranging from 1 to 3 that reflects a region's fiscal capacity, with higher values indicating stronger fiscal resources.

Table 1
Characteristic of treatment and control regions

	Regions that received a PEN loan (treatment)		Regions that did not receive a PEN loan (control)	
	2017 (n = 67)	2023 (n = 67)	2017 (n = 442)	2023 (n = 442)
Capital spending by region in billions of rupiah (mean)	460.94	383.36	326.83	332.68
Regional real GDP in billions of rupiah (mean)	37,239.74	46,719.08	17,060.17	21,174.39
Regional revenue in billions of rupiah (mean)	855.36	987.11	251.85	313.08
Regional Fiscal Capacity Index (mean)	0.92	1.24	1.03	1.45
Regional Fiscal Capacity Index	0.20	0.71	0.13	0.59

(min)				
Regional Fiscal Capacity Index	7.87	3.41	8.53	5.94
(max)				
Human Development Index	69.05	72.12	67.99	71.03
(mean)				
Human Development Index	59.90	63.93	27.87	35.19
(min)				
Human Development Index	83.95	86.69	85.49	88.28
(max)				

Table 1 depicts descriptive statistics for the key indicators used in this study. The indicators are organized by treatment and control groups. Furthermore, the statistics are taken from observations made in 2017, i.e. a period some time before the intervention, and 2023, i.e. a period some time after the intervention. Analyzing the statistics in this manner will help in isolating and comparing the surface-level trends of both treatment and control groups apart from any significant shocks that may be experienced directly before or after the intervention.

When taking a look at capital spending trends between the two groups, it is the case that the level of capital spending in the treatment group is higher both before and after the intervention than compared to the control group. However, capital spending levels in the treatment group declined from 2017 to 2023 while levels in the control group increased during the same period. The mean level of real gross domestic product (RGDP) as well as the mean level of regional revenue among the treatment group regions is also higher than in the control group in both 2017 and 2023. Overall, this could be taken as an indication of the treatment group having more economic activity and output than compared to the control group.

However with that being said, when taking a look at the statistics for regional fiscal capacity, the treatment group displayed lower means than the control group. Although both groups experienced an increase from 2017 to 2023, mean fiscal capacity in the control group remained higher throughout this time reflecting how regions in the treatment group may not be as financially self-reliant despite generating more revenue and having higher economic output. This trend corroborates the need for the treatment group to partake in the PEN loan program as lower fiscal capacity would indicate a higher dependence on the central government for financial aid.

While the statistics highlight important characteristics among the treatment and control groups, it should be noted that analyzing these trends alone is not sufficient. As economic growth and financial capacity greatly vary among Indonesia's different regions, the small population of the treatment group in comparison to the large population of the control group may lead to skewed statistics when analyzing it purely from the trends. Due to this, utilizing an econometric model such as difference-in-differences to evaluate the impact will help in getting closer to isolating the true effects of the PEN loan that this paper seeks to analyze.

IV. Methodology

The first methodology utilized in this paper is a difference-in-differences (DID) analysis to study the causal effects of the PEN loans on a region's infrastructure spending. This method extracts causal estimates by taking away confounding factors that affect both the treatment and control groups upon over time comparisons (see Angrist and Pischke, 2008; Antonakis et al., 2014).

The identification strategy behind this method is the assumption that in the absence of the PEN loans, the volume of a region's infrastructure spending (the outcome trend) within treatment and control groups would be identical. By using DID analysis alongside a panel dataset, the analysis can reveal the true impacts of the PEN loans. To isolate the impacts of the disbursement of the PEN loans on regional infrastructure spending, variations in outcomes between treatment regions and control regions before and after the loans were disbursed are compared.

The treatment group in this analysis consists of the regions that received a PEN loan while the control group consists of regions that did not receive a PEN loan. To account for a region's fiscal capacities, the model includes variables on regional fiscal capacity index as well as a region's local government revenue. The basic DID equation is as follows:

$$\begin{aligned} \log(CapitalSpending)_{it} = & \beta_0 + \alpha_i + \beta_1 Loan_{it} + \beta_2 DLoanYear_{it} \\ & + \beta_3 Fiscal\ Capacity\ Index_{it} + \beta_4 Loan_{it} * DLoanYear_{it} + \delta_t + \epsilon_{it} \end{aligned}$$

(1)

where the dependent variable is *CapitalSpending*, or the amount of money a region spent on infrastructure in the fiscal year. As for the independent variables, *Loan* is a dummy variable where 1 is if the region took out a PEN loan, and 0 is otherwise; *DLoanYear* is a dummy for if the PEN loan had been disbursed within the region's province at the year of observation, where 1 is if it's passed the year when a region in the province first took out a PEN loan, and 0 if PEN loan had not been disbursed within the province at the time the data was recorded. α in the model denotes the region fixed effect, δ is the year effect, while ϵ is the error term for a region i at time t . As for the control variables, *Fiscal Capacity Index* is an index developed by Indonesia's Ministry of Finance that evaluates a region's fiscal capacity on a value between 1 to 3; and *Revenue* represents the region's local government revenue during the respective fiscal year. These variables are meant to control for a region's fiscal capacity which is associated with its infrastructure spending as well as the likelihood of the region taking out a loan.

However, prior to conducting a DID analysis, the pre-treatment trend assumption must be proven. This assumption states that there is to be similarities between the outcome trend of the treatment and control group prior to the time of the intervention. Proving this assumption will allow the post-intervention difference between the outcomes of the treatment and control group to be attributed to the disbursement of the PEN loans. To prove this assumption, the following model is used:

$$\begin{aligned} \log(\text{CapitalSpending})_i = & \beta_0 + \delta_t + \beta_1 \text{Loan}_{it} + \beta_2 \text{TimeRescale}_{it} \\ & + \beta_3 \text{Loan}_{it} * \text{TimeRescale}_{it} + \alpha_i + \epsilon_i \end{aligned} \quad (2)$$

It should be noted that the model above is restricted to only include samples from time periods prior to the treatment. In other words, the parallel trends analysis only extends to years before the PEN loans were disbursed. The parallel trends analysis required a time rescale variable to be created where the value of 0 represents the year of treatment, positive values represents years following the treatment(e.g. 1, 2, 3, etc), and negative values representing years before the treatment (e.g. -1, -2, -3, etc). The most important coefficient from Equation (2) for the parallel trends assumption analysis is the β_3 coefficient that

represents the differences between the control and treatment groups pre-treatment. The acceptance of the null hypothesis of $\beta_3 = 0$ proves that, pre-intervention, the control and treatment groups are statically indistinguishable in terms of the infrastructure spending trend.

After the parallel trend assumption is fulfilled, this research then aims to estimate the impact of the PEN loan disbursement on the amount of money a regional government allocates towards infrastructure spending. The impacts of the PEN loans on infrastructure spending is then represented within the β_4 coefficient from Equation (1), where the null hypotheses of $\beta_4 = 0$ would mean that the disbursement of the PEN loans had no impact on regional infrastructure spending.

After estimating the causal effects of the PEN loans on regional infrastructure spending using the aforementioned DID model, this study then employs a fixed effects panel regression to research the association between capital spending and economic growth. The aim of conducting this analysis is to empirically construct a framework that can link economic growth to creative financing instruments like the PEN loans. The following model details how this relationship is tested:

$$\log(GDP/Local\ Revenue)_{it} = \beta_0 + \beta_1 \log(Capital\ Spending)_{it} + \beta_2 HDI_{it} + \beta_3 COVID + \alpha_i + \epsilon_i \quad (3)$$

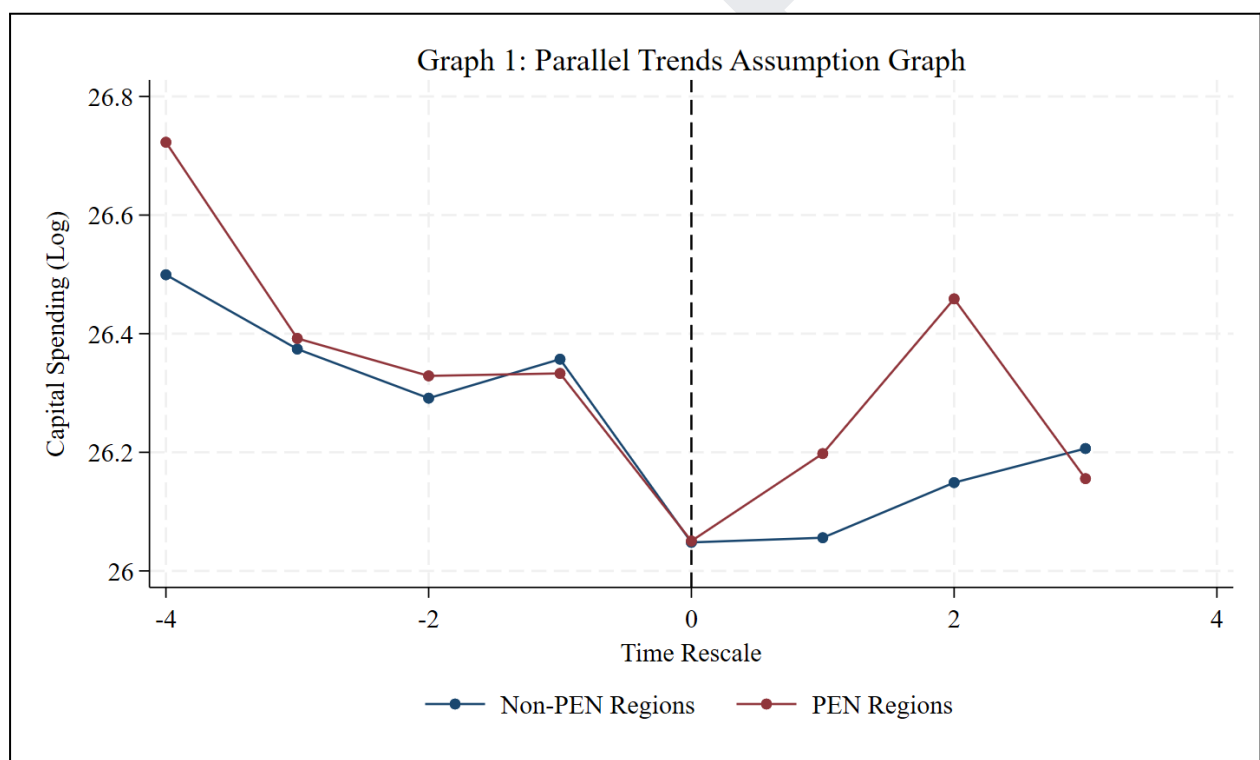
where the dependent variable is either GDP or the region's local revenue. It is then the case that the main independent variable is *Capital Spending*, which is each region's capital spending at a given period. The control, *HDI*, is the region's human development index value as a way to represent the average human capital. Lastly, similar Equation (1), α denotes the region fixed effect, δ is the year effect, while ϵ is the error term for a region i at time t . The idea behind Equation (3) is to recreate the augmented Solow model where output is a function of both physical capital and effective labor, where the quality of labor depends on health, education, and living standards (Engel and Chinn, 2020).

V. Results

Prior to analyzing the results of the main model, the results of the parallel trends assumption must first be proven to hold in this analysis. To reiterate, the parallel trends

assumption is proven to hold if the regional capital spending trend between the treatment and control regions are remarkably similar before the disbursement of the PEN loans. Empirically, this assumption would be fulfilled when the β_3 variable in Equation (2) is statistically indistinguishable from the null.

When the model in Equation (2) was ran, the resulting β_3 interaction term was indeed indistinguishable from zero. The β_3 coefficient in the Equation (2) came out to a value of -0.014, which was insignificant at the 10% level. These results prove that, statistically, there are no differences between the treatment and control groups prior to the disbursement of the PEN loans. Moreover, the results from the model in Equation (2) also indicate that the identification method used to identify the control group, i.e. regions that did not receive a PEN loan, is strongly defensible.



Another way to prove this parallel trends assumption is by utilizing a visual inspection of the regional capital spending trend in both treatment and control groups. To do so we will utilize Graph (1) above where the x-axis is the previously mentioned time rescale variable where 0 is the year when the PEN loans were first disbursed within a region's corresponding province, negative numbers being years prior to the disbursement, and positive

number being years following the disbursement. The y-axis is then a region's capital spending in the corresponding years in logarithmic form. Upon visual inspection, it is seen that logarithmic regional capital spending during the negative time rescale periods follow a strikingly similar trend. It is then the case that during the positive time rescale period, the trends between treatment and control group see a notable divergence. Specifically, regional capital spending in the treatment group saw a significant increase in period 2 before seeing a sharp downward correction while the control group only saw subtle logarithmic growth during the same period. Based on this, Graph (1) can be considered another strong case in proving that this paper successfully fulfilled the parallel trends assumption which serves as a basis on which the DID analysis will be conducted.

Table 2 below represents results of the DID analysis conducted based on Equation (1). These results are based on 503 regions with observations made from 2017 to 2023 totalling to 3,563 observations. The outcome variable represents a region's capital spending; thus, the coefficient tied to the interaction variable quantifies this percentage change in said region's capital spending. As seen below, the results of the DID analysis show that treatment regions experienced an increase of around 15.5% in capital spending as compared to control regions after receiving the PEN loan. These results were highly significant at the 1% level. Furthermore, when a region's fiscal capacity index value is taken into consideration as a control variable, the amount the PEN loan impacts regional capital spending in treatment regions rises to an increase of 16.2%; this also being significant at the 1% level. Based on these results, it is safe to draw the conclusion that creative financing schemes such as the PEN loans have a relatively sizable impact on capital spending especially during economic downturns, which in this case was the COVID-19 pandemic. These results corroborate previous research that found similar types of loans from State Infrastructure Banks in the United States had a significant impact in increasing capital spending in the transportation sector (Chen, 2016).

Table 1

The impact of PEN loans on regional capital spending: OLS Estimates

Dependent variable: Regional Capital Spending	(1)	(2)
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<i>Loan Region x Loan Year</i>	0.155 *** (0.029)	0.162 *** (0.028)
Loan Year	-0.073 *** (0.021)	-0.077 *** (0.021)
Fiscal Capacity Index		0.049 *** (0.009)
Observations	3,563	3,563
Number of Regions	509	509
R2	0.028	0.008

Standard errors are reported in parentheses.

Confidence intervals are denoted as follows: 99% (***), 95% (**), 90% (*).

Coefficients for the variable Loan Regions are left out due to collinearity.

The only control variable this model utilizes is a variable that represents a region's fiscal capacity index value. Using this variable in the model reflects how previous literature has found that not only do regional governments in Indonesia make the decision to borrow money based on fiscal capacity (Lewis, 2003), but also that the amount of regional capital expenditure relies on regional fiscal indicators such as regional revenue, general allocation fund, special allocation fund, etc (Kuntari et al., 2019). These findings are reinforced in the results for Equation (1) that estimated a one index-point increase in the fiscal capacity will result in a 4.9% increase in capital spending; this result being significant at the 1% level. The high significance suggests that the control variable is appropriate for the model as well as being impactful to the dependent variable. Despite this, the main interaction variable remained positively significant at the 1% indicating that the PEN loans had an impact on regional capital spending regardless of a region's overall fiscal capacity.

Following these results, this paper then attempts to estimate the association between capital spending and economic growth. Table 2 shows the results from the individual fixed-effects regression in Equation (3). As seen below, the estimations reveal that there is an association between capital spending and GDP and regional revenue. According to the results, a 1% increase in capital spending is associated with a 0.129% increase in regional revenue and a 0.016% increase in GDP. Both of these results are significant at the 1% level.

The results are in line with growth models, e.g. the Solow growth model, where growth is modeled to be driven by capital accumulation which in this case is represented by regional capital spending (Engel & Chinn, 2022). Furthermore, results from Equation (3) help to further literature in an otherwise ambiguous relationship as pointed by Herrera (2007). Although causality cannot be inferred from this model, the strong positive correlation supports literature that found empirical evidence that developing countries displayed a positive relationship between capital spending and economic growth (Abdullateef et al., 2011; Nyarko-Asomani et al., 2019).

Equation (3) also includes control variables for a region's human development index (HDI) and a dummy for COVID-19. The results estimated that a region's human development index was significantly correlated with both regional revenue and GDP growth at a 1% level. Estimates in Table 2 show that a one index-point increase in HDI resulted in a 5.2% increase in regional revenue and a 6.9% increase in regional GDP. These results also reflect the assumptions made in the widely accepted Solow growth model as previously discussed. On the other hand, the dummy variable for Covid-19 had a weaker correlation with regional revenue and GDP in terms of the model. Overall, these results not only confirm previous theoretical framework, but also provide some evidence into how creative financing schemes such as the PEN loans may have an indirect correlation with economic growth through stimulating capital spending.

Table 2

The relationship between capital spending and economic growth: OLS Estimates

	(1)	(2)
Dependent Variable:	log(Revenue)	log(GDP)
log (Capital Spending)	0.129 *** (0.015)	0.016 *** (0.004)
Human Development Index	0.052 *** (0.004)	0.0687 *** (0.001)
COVID-19	0.018 *	-0.003

	(0.010)	(0.002)
Observations	3,563	3,563
Number of Regions	503	503
R2	0.058	0.555

Standard errors are reported in parentheses.

Confidence intervals are denoted as follows: 99% (***), 95% (**), 90% (*).

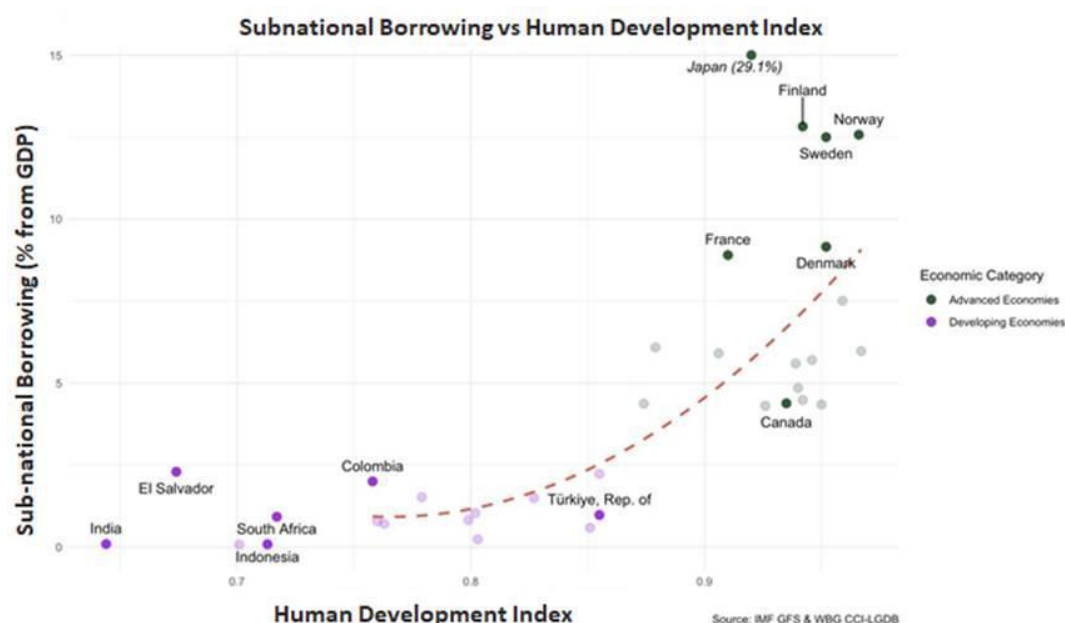
Coefficients for the variable Loan Regions are left out due to collinearity.

V. Policy Implication

The findings of this study have significant implications for Indonesia’s infrastructure financing strategy, particularly amid recent fiscal reforms under the UU HKPD, PP HKFN, and the 2025–2029 RPJMN. Through these reforms, the government aims to enhance the efficiency, equity, effectiveness, and accountability of intergovernmental fiscal transfers. It also seeks to encourage regional governments to optimize their fiscal capacity and explore alternative, creative financing mechanisms. Within this evolving policy landscape, there is an urgent need for robust, policy-relevant evidence to guide the scaling, targeting, and governance of creative infrastructure financing instruments. The following are some policy implications based on the empirical evidence this paper discovered.

1. Institutionalizing creative financing to close Indonesia’s infrastructure gap

The empirical evidence presented in this study demonstrates that creative financing had a significant and positive impact on regional capital spending, increasing investment by an estimated 16.2%. This result highlights the potential of subnational lending to complement fiscal transfers and stimulate much-needed infrastructure development, particularly during periods of fiscal stress or economic downturns. Importantly, despite this potential, the current level of subnational debt in Indonesia remains extremely low. Over the past few years, Indonesia’s sub-national debt has accounted for less than 1% of GDP (World Bank, 2024). A recent World Bank analysis of 34 countries further supports the potential effect of sub-national loans, finding a positive correlation between the share of subnational loans and the Human Development Index (HDI). This suggests that higher levels of well-managed subnational borrowing are often associated with better development outcomes.



To fully leverage the potential of subnational borrowing, relevant ministries and institutions should initiate the development of a permanent, rule based regional loan framework aimed at providing concessional financing with clear eligibility criteria. One practical example already underway is PT SMI's adoption of a cluster-based financing approach, in which regions are grouped according to their fiscal capacity and socio-economic conditions. Under this model, areas with more limited development indicators and lower fiscal strength are eligible for more concessional loan terms—such as lower interest rates and longer tenors—to ensure more equitable access to financing. As efforts toward formalization and implementation continue, it will be important to improve stronger policy alignment between central and local governments, strengthen coordination among ministries, and streamline regulatory procedures to accelerate decision making and execution.

2. Strengthening evidence-based and contextualized planning

While expanding infrastructure financing is crucial, its effectiveness largely depends on how well investments are tailored to the specific economic, social, and political context of each region. Infrastructure that responds to local needs and priorities—such as improving connectivity, basic services, and local economic hubs—tends to yield higher returns and broader development impact. (Estache, A., 2007; Calderón, C. & Servén, L., 2010)

To ensure this alignment, regional borrowing should be integrated into a comprehensive planning framework that reflects both national priorities and local

development strategies. This includes embedding financing decisions within regional infrastructure investment maps in RPJMN and RPJMD, regional spatial planning document (*Rencana Tata Ruang Wilayah*-RTRW), and performance-based budgeting mechanisms. Conducting systematic regional diagnostics is also essential to identify context-specific infrastructure needs, local capacity constraints, and sectoral opportunities. Such evidence-based planning ensures that creative financing does not follow a one-size-fits-all model, but instead contributes meaningfully to inclusive growth, regional competitiveness, and the broader goals of economic convergence and spatial justice outlined in the RPJMN 2025–2029.

3. Enhancing Local Capacity and Project Readiness

The success of creative financing mechanisms hinges not only on the availability of capital but also on the readiness and capacity of local governments to manage it effectively. Without adequate institutional readiness, financing may fail to translate into timely and impactful infrastructure outcomes. Project development facilities -such as such as support for feasibility studies, Detailed Engineering Designs (DED), and Environmental Impact Assessments (EIA)- and technical assistance initiative like the World Bank's *City Creditworthiness Initiative* have shown potential in improving project preparation, enhancing institutional quality, and increasing the bankability of infrastructure proposals.

However, such support remains limited in scale and uneven in its distribution. The adoption of a tiered support model, in which regions with weaker fiscal and technical capacity receive more targeted and intensive assistance during the project preparation phase should be considered. Scaling up grant-based assistance for pre-investment activities and embedding them into the lending process would help mitigate project delays, enhance disbursement efficiency, and ensure that infrastructure investments deliver measurable development outcomes.

VI. Conclusion

This study has provided credible empirical evidence on the transformative potential of creative financing mechanisms, specifically through subnational loans, to enhance regional capital spending and stimulate economic growth in Indonesia. Utilizing a staggered difference-in-differences (DID) analytical framework, this paper demonstrates that the National Economic Recovery (PEN) program loans had a substantial and statistically

significant positive impact, increasing regional capital expenditure by approximately 16.2%. This finding highlights the crucial role that innovative financing instruments, such as concessional subnational loans, can play in sustaining infrastructure investment, especially during periods of fiscal stress, such as the COVID-19 pandemic.

Furthermore, a fixed-effects panel regression model analysis provided evidence that increased capital spending positively correlates with regional economic performance, manifesting as higher regional GDP and revenue. Specifically, a 1% increase in capital spending corresponds to a 0.129% increase in regional revenue and a 0.016% increase in GDP. These results affirm the critical link between capital spending and economic development, aligning with the theoretical predictions of growth models, such as the augmented Solow model, and addressing previously ambiguous relationships identified in existing literature.

The findings hold significant policy implications, especially within the context of Indonesia's ongoing fiscal reforms outlined in UU HKPD and PP HKFN, and in alignment with the goals articulated in the RPJMN 2025–2029. Given that Indonesia's subnational borrowing remains substantially low (less than 1% of GDP), there exists significant untapped potential for leveraging creative financing instruments to address infrastructure gaps and drive inclusive economic growth. One of the ways to maximize these benefits, policymakers could institutionalize creative financing through a clear, rule-based subnational lending framework.

Moreover, the effectiveness of infrastructure financing relies heavily on evidence-based and context-specific planning. Policymakers should integrate regional borrowing decisions into comprehensive regional infrastructure planning frameworks, ensuring alignment with both national priorities and localized developmental strategies. This integration should be supported by systematic regional diagnostics to accurately assess infrastructure needs, capacity constraints, and investment opportunities, thus promoting investments that maximize regional competitiveness and spatial equity.

Finally, enhancing local government capacity and project readiness remains vital. Expanded technical assistance through structured facilities will significantly improve the implementation efficiency and impact of financed infrastructure projects. By strengthening

institutional capacities and ensuring credible project pipelines, creative financing instruments can better translate into tangible, sustainable regional development outcomes.

In conclusion, Indonesia's experience with the PEN loans underscores the potential and importance of innovative subnational financing mechanisms as essential complements to traditional fiscal instruments. Future research and policy development should focus on optimizing these instruments, ensuring sustainable implementation frameworks, and continuously monitoring impacts to ensure inclusive and sustainable economic growth across all regions of Indonesia.

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