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Cash Demand Sensitivity: Post-Tax Amnesty Shadow Economy Estimation in Indonesia

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Abstract

Indonesia has consistently failed to meet its tax revenue targets in recent years, primarily due to extensive shadow economy activities aimed at tax evasion. This study seeks to measure the sensitivity of cash demand in estimating the shadow economy across Indonesia's 34 provinces during the post-tax amnesty period from 2016 to 2022 and to assess its impact on potential tax revenue losses. Utilizing a quantitative methodology, the research employs panel data regression with a Random Effects Model. The shadow economy is estimated using a monetary approach model based on cash demand sensitivity. The dependent variables include total currency demand and potential tax revenue, while the independent variables comprise tax burden, inflation rate, Gross Regional Domestic Product (GRDP), financial and technological innovation (represented by internet use for financial purposes), and the shadow economy. The findings reveal that the tax burden, inflation, and financial/technological innovations do not significantly influence cash demand, whereas income has a significant positive effect. Moreover, the shadow economy substantially affects potential tax revenue losses. On average, the shadow economy across the 34 provinces amounts to IDR 292.152 billion, with an average potential tax revenue loss of IDR 35.306 billion.

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INTRODUCTION

Taxes represent a critical source of state revenue, serving as the foundation for sustainable development and societal welfare (Rahman, 2022). Indonesia, tax revenues constitute approximately 75 percent of total state revenue (Kartiko, 2020).

Despite this, data from the Ministry of Finance reveals that tax revenues often fail to meet the established targets. The following graph illustrates the comparison between Indonesia's targeted and actual tax revenues from 2012 to 2022 respectively.

According to the Ministry of Finance, Indonesia's tax revenue realization has experienced considerable fluctuations in recent years. Before 2021, tax revenues often failed to meet targets, particularly in 2020, when the COVID-19 pandemic severely disrupted economic activity and public income. However, from 2021 to 2022, tax revenue realization began to meet or even exceed targets, indicating the implementation of more effective fiscal policies or structural changes

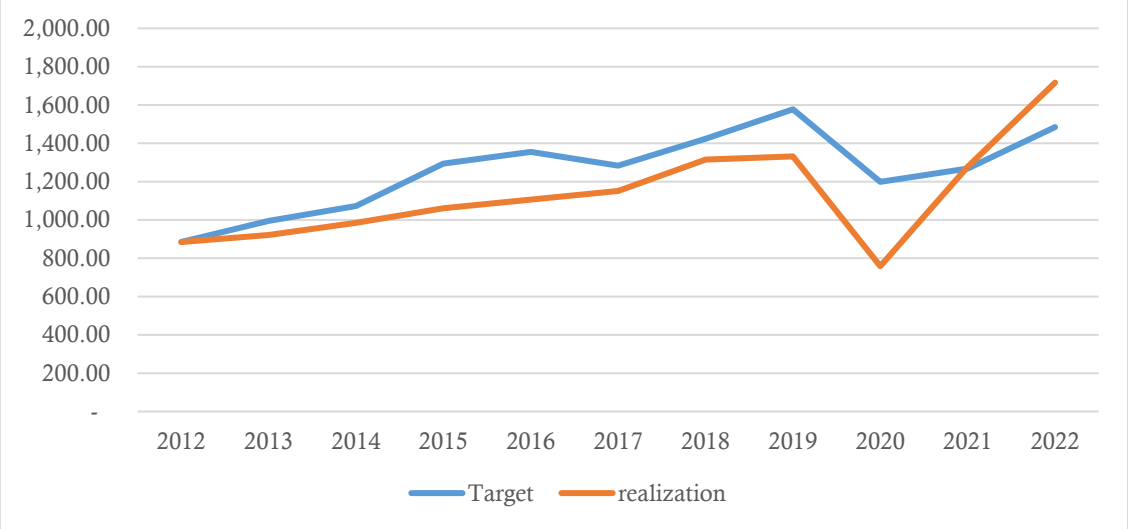

Figure 1. Revenue Realization and Revenue Target in Indonesia 2012-2022
Source: Secondary Data of Ministry of Finance, 2024 (processed)

The frequent shortfall in tax revenue targets is primarily attributed to the significant presence of the shadow economy in Indonesia. The shadow economy principle, encompassing unregistered and untaxed economic activities, is a major contributor to this issue. It includes both illegal and legal activities that go unreported, thereby excluding their income from GDP calculations (Bashlakova & Bashlakov, 2020). These activities impair the accuracy of economic data, reduce potential tax revenue, exacerbate the budget deficit, and prompt the government to consider raising tax rates (Schneider, 2021).

The shadow economy in Indonesia remains substantial (Ramadhan, 2019). According to Revenue Asian Statistic (2022), Indonesia's tax-to-GDP ratio is the lowest in Asia, at 11.9 percent, reflecting economic distortions and suboptimal development. The Global Economy reports that Indonesia's shadow economy averaged 22.59% of GDP between 2008 and 2015. The lowest value was recorded in 2014, at 21.05%, while the highest was in 2009, at 24.29%. In 2015, the shadow economy stood at 21.76%, below the global average of 27.78%. These data highlight notable fluctuations in These data highlight notable fluctuations in Indonesia's shadow economy during this period, with an increase in 2009, a decline until 2014, and a slight rise in 2015. Such trends provide a basis for assessing government performance and policies relative to global standards.

Estimating the magnitude of the shadow economy in Indonesia is a complex task due to

its elusive nature and conceptual intricacies (Central Bank of Malta, 2020). One widely adopted approach involves analyzing cash demand, specifically by examining its sensitivity to influencing factors such as tax burden, income, inflation, and financial and technological innovations. This method is selected because participants in the informal economy often prefer cash transactions to circumvent government oversight and tax liabilities (Indupurnahayu & Walujadi, 2019). The examination of cash demand rests on the premise that individuals participating in the shadow economy primarily utilize cash transactions to maintain anonymity and evade detection by governmental authoritie (Bundesbank, 2019).

Various theories underpin the necessity of physical cash in daily economic activities. Classical approaches, such as those proposed by David Ricardo and Irving Fisher, link the quantity of money to price levels, with Fisher emphasizing its role as a medium of exchange. Keynes expanded this understanding by identifying transactional, precautionary, and speculative motives for holding money, which are influenced by real income, interest rates, and the velocity of money. The transaction theory highlights the critical role of money in facilitating economic exchanges. Friedman advanced the modern quantity theory, asserting that factors such as price levels, interest rates, and wealth determine the demand for money. Furthermore, the Baumol model introduces the concept of convenience in holding cash, suggesting that advancements in financial institutions can reduce the convenience costs associated with holding money, thereby influencing its demand (Mankiw, 2016).

Conflicting interests between the government and economic actors often hinder national progress by reducing tax revenues, leading to suboptimal development. While the government seeks to maximize tax revenue, economic actors may attempt to evade tax obligations to protect their interests. To address this challenge, the government implemented the Tax Amnesty policy, which aims to encourage individuals operating within the shadow economy to declare their taxes to the appropriate authorities.

Researching and assessing the shadow economy is critical, particularly in examining how economic indicators influence cash demand and its subsequent effects on tax potential following the implementation of the Tax Amnesty program. Such research will provide valuable insights into the development and patterns of the shadow economy, contributing to a better understanding of its dynamics and implications for policy-making.

Extensive research over recent decades has explored the measurement of the shadow economy using the monetary approach. For example, Mulyawan (2017) employed this method to estimate the shadow economy in Indonesia from 2011 to 2015, concluding that it amounted to IDR 536 trillion during this period. Similarly, Hariyanti *et al.* (2022) utilized the monetary approach to measure the shadow economy from 2000 to 2018, incorporating public consumption demand as a variable influencing cash demand. Further studies by Wirawan (2023) revealed annual fluctuations in the shadow economy. These findings highlight the existence of substantial unreported funds excluded from taxation, resulting in significant potential tax revenue losses.

This study builds on previous research by incorporating variables such as tax burden, inflation, income, financial innovation, and technology. In particular, it advances the field by introducing internet access usage for financial services as a critical factor, addressing a gap in understanding how technological advancements especially in information and communication technology (ICT) impact cash demand. As digital financial services become increasingly prevalent, it is essential to evaluate their effect on traditional monetary behavior. While prior studies have focused on cash demand within the context of economic and demographic factors, the role of ICT, particularly in promoting financial inclusion, remains underexplored.

By applying the Baumol-Tobin model, this research offers a robust theoretical framework to assess how the convenience and efficiency of

digital financial transactions may reduce the reliance on physical cash. The Baumol-Tobin model provides insights into how individuals balance the trade-off between holding cash and minimizing transaction costs. Technological advancements, which reduce these costs, are likely to decrease cash demand, supporting the hypothesis that access to internet-based financial services significantly influences monetary behavior. This approach offers fresh perspectives on the evolving nature of cash demand in a rapidly digitizing economy.

RESEARCH METHODS

This study employs a quantitative methodology, utilizing secondary data from 34 Indonesian provinces spanning 2018 to 2021, and conducts analysis using multiple linear regression with panel data. The analysis focuses on total currency demand and potential tax revenues as dependent variables, while the independent variables include tax burden, inflation rate, Gross Regional Domestic Product (GRDP), financial and technological innovations (indicated by internet usage for financial purposes), and the shadow economy. Data sources include Statistics Indonesia (BPS), Bank Indonesia, and the Ministry of Finance.

Prior to applying panel data regression using EViews to examine the effects of the independent variables on the dependent variables, classical assumption tests are performed to ensure the validity and reliability of the regression model. These tests include multicollinearity and heteroscedasticity tests. The normality test is omitted, as the central limit theorem posits that normality testing is unnecessary when the number of observations exceeds 30. Given the 238 observations in this study, the normality test is deemed unnecessary. Furthermore, autocorrelation testing is not conducted, aligning with Basuki (2018), who argues that autocorrelation testing on non-time series data—whether cross-sectional or panel data—holds limited significance.

The study applies various panel data regression models, including the Common Effect, Fixed Effect, and Random Effect Models. To determine the most appropriate model, the Chow test, Hausman test, and Lagrange Multiplier test are employed. The panel data regression equation utilized in this research is as follows:

$$\mathrm{Ln}C_{it} = \alpha_{it} + \beta_i T_{it} + \beta_2 LnI_{it} + \beta_3 LnY_{it} + \beta_4 F_{it} + e \quad \text{..... (1)}$$

Where, LnC is the demand for cash, α is constant, $\beta$is Regression Coefficient (1…5), T is Tax Burden, LnI is Inflation, LnY is Income, F is Financial and technological innovation, e is the error term.

After conducting the regression analysis for the cash demand equation, this study investigates the impact of the shadow economy on tax potential. The regression equation applied is as follows:

$$TP_{it} = \alpha_{it} + \beta_i SE_{it} + \mathrm{e} \quad \text{..... (2)}$$

Where, LnTP is Tax potential, α is Constant, β is Regression Coefficient, LnSE is Shadow Economy, and e is error term.

This research also incorporates several statistical tests, including the determination coefficient, F-statistic, and t-statistic. The R-squared (R^2) metric measures the degree to which the independent variables explain the variance in the dependent variable. Its value ranges from zero to one, where a higher R^2 signifies a stronger ability of the independent variables to explain the variations in the dependent variable (Ghozali, 2013).

The F-statistic test determines if the independent variables, when considered together, significantly affect the dependent variable, thereby evaluating the overall explanatory power of the regression model (Ghozali, 2013).

The t-statistic test measures the individual effect of each independent variable on the dependent variable in a regression model, determining the significance of each coefficient while holding other variables constant (Basuki & Prawoto, 2017).

To estimate the size of the shadow economy, a monetary approach is applied to

analyze how cash demand varies with different influencing factors. The estimation process begins with calculating cash demand, influenced by factors such as tax burden, inflation, income, and preferences for cash. The total cash demand in the formal economy is calculated without considering the tax burden. The assumption is that individuals are motivated to enter the shadow economy in response to high tax burdens. The velocity of money in the shadow economy is estimated by comparing it with the formal economy and subtracting the cash circulating within the shadow economy from this comparison. The extent of the shadow economy is quantified by multiplying the velocity of money circulating in it by the corresponding cash demand.

RESULTS AND DISCUSSION

The first step in conducting panel data regression analysis involves performing classical assumption tests. These include the multicollinearity test and the heteroscedasticity test. The multicollinearity test aims to identify linear correlations between independent variables within the regression equation. The results of the multicollinearity test are evaluated by examining the VIF (Variance Inflation Factor) values.

Table 1. Multicollinearity test results

Variable	VIF
CM	NA
T	1.264306
LNINF	1.074894
LNY	1.277365
F	1.633103
SE	1.000000

Source: Data Processed, 2024

As shown in Table 1, each independent variable has a Variance Inflation Factor (VIF) value below 10, suggesting that multicollinearity does not affect the data.

The heteroscedasticity test is used to verify whether the variance of the residuals remains constant. The findings from the Glejser test are presented as follows.

Table 2. Heteroscedasticity test results

F-statistic	0.337786	Prob. F(4,233)	0.8523
Obs*R-squared	1.372182	**Prob. Chi-Square(4)**	**0.8490**
Scaled explained SS	2.391982	Prob. Chi-Square(4)	0.6641

Source: Data Processed, 2024

Table 2 shows a probability value of 0.8490, above the significance threshold of $\alpha = 0.05$. Consequently, it can be inferred that the model does not display heteroscedasticity.

Model selection for the panel data regression is conducted using the Chow Test, Hausman Test, and Lagrange Multiplier Test. The results identify the Random Effect Model as the most appropriate for this analysis

Table 3. Results of Cash Demand Equation Estimation with Random Effect Model

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.171715	2.213051	-0.077592	0.9382
T	0.625938	0.942405	0.664192	0.5072
LNI	-0.265625	0.302949	-0.876798	0.3815
LNY	0.897649	0.120328	7.460013	0.0000
F	-3.866589	2.075283	-1.863162	0.0637
R-squared	0.205794		F-statistic	15.09367
Adjusted R-squared	0.192159		Prob(F-statistic)	0.000000

Source: Data Processed, 2024

Based on the estimation results using the Random Effect Model (REM), the panel data regression equation is:

$$LnC_{it} = -0{,}171_{it} + 0{,}625\,T_{it} - 0{,}265LnI_{it} + 0{,}897LnY_{it} - 3{,}866F_{it} + e \quad \text{.....(3)}$$

Based on the estimation results using the Random Effect Model presented in Table 3, the coefficient of determination for the cash demand regression equation is 0.2057. This suggests that tax burden, inflation, income, and financial and technological innovations explain 20.5% of the variance in cash demand, while 79.5% is attributed to other unaccounted variables. Furthermore, the F-value for the cash demand regression model is 15.09367, with a probability value of 0.0000. The F-table value is derived from the formula F (α; df1; df2) = F (α; k-1; n-k), where k denotes the combined number of dependent and independent variables, and n indicates the sample size. From the F-table, the value for the cash demand regression equation is 2.4103. The calculated F-value being higher than the F-table value and the p-value being under 0.05 suggests that tax burden, inflation, income, and financial and technological innovations significantly influence cash demand.

Additionally, the calculated t-values and probabilities for each variable were obtained. These t-values were compared with the critical t-table values using the formula t (α; n-k). From the t-table, the value for the cash demand regression equation is 1.651420. The t-test results indicate that the variables for tax burden, inflation, and financial and technological innovations do not significantly influence cash demand across the 34 provinces of Indonesia, as their t-statistic values are below the critical t-table values, and their significance levels exceed 0.05. However, the income variable significantly influences cash demand, as indicated by t-statistic values that exceed the critical t-table values, and their significance levels are below 0.05.

The positive but statistically insignificant relationship between the tax burden and cash demand suggests complex underlying dynamics. Schneider (2021) highlights that higher tax burdens are often associated with increased shadow economy activities in developing countries, where cash is predominantly used to evade taxes due to anonymity. However, the lack of statistical significance indicates the presence of additional intervening factors influencing this relationship.

One key factor is the effectiveness of tax systems and enforcement mechanisms. While tax burdens may increase in many developing countries, inefficiencies or weak enforcement within the tax system can hinder the intended regulatory impact. Gunarto and Adi (2023) argue that high regulatory intensity and weak institutional capacity foster uncertainty and distrust. Taxpayers may question whether compliance costs, including administrative and legal expenses, outweigh the benefits of participating in the formal economy. This uncertainty often leads individuals to avoid formal financial systems, such as banking services, opting for cash transactions to minimize scrutiny.

The shadow economy is also crucial in shaping the relationship between tax burdens and cash demand. As Kristiaji (2023) emphasizes, the shadow economy expands during economic downturns or periods of uncertainty. Many businesses within the informal sector operate beyond the reach of tax authorities, rendering the tax burden on the formal economy largely irrelevant to them. These entities predominantly rely on cash transactions to evade detection, which sustains cash demand within the informal economy regardless of changes in formal tax policies.

Infrastructural constraints further influence the extent to which tax burdens affect economic behavior. Futselaar and Ying-Hui (2021) note that limited access to digital financial services and inadequate business registration and tax compliance infrastructure create significant barriers, particularly in rural or underdeveloped regions. Many individuals or businesses in these areas may wish to operate legally and pay taxes but face logistical challenges. These constraints hinder their integration into the formal economy, limiting the effectiveness of tax incentives or penalties.

Financial inclusion and access to financial technologies also significantly affect tax burdens and cash demand dynamics. In many developing countries, financial systems are not fully integrated into the daily economic activities of the population, especially within the shadow economy. The absence of robust digital infrastructure—such as online banking, mobile payment systems, or efficient business registration processes—prevents a transition from cash-based transactions to formal financial systems. Syed et al. (2021) identify inadequate digital finance infrastructure as a major factor sustaining the shadow economy in South Asian countries. Similarly, Hassan (2024) finds that limited access to mobile financial services in Southern Africa correlates with the persistence of the shadow economy, underscoring the critical need for improved financial inclusion. The digital divide prevents the government from achieving the intended impact of increased tax burdens, as structural barriers hinder a shift towards formal financial systems.

Another significant aspect is the behavioral dimension of tax evasion and avoidance. For many businesses and individuals, avoiding taxes is not solely a rational economic decision based on cost-benefit analysis but also a function of cultural and social norms. As Ameyaw et al. (2016) observed, tax compliance behavior is shaped by a complex interplay of economic, psychological, and social factors. In contexts where tax evasion is prevalent and socially accepted, increasing the tax burden may not necessarily result in greater compliance but encourage more sophisticated forms of tax avoidance, such as continued reliance on cash for transactions. This entrenched behavior diminishes the influence of the tax burden on cash demand as actors within the informal economy find ways to persist outside formal regulatory frameworks.

Additionally, a mismatch between economic sectors regarding tax compliance exacerbates the issue. Brumby (2019) highlighted that sectors experiencing rapid economic growth often do not correspond to those contributing significantly to tax revenues. For instance, emerging sectors such as technology or informal services may be harder to tax than traditional industries like manufacturing or extractive activities. This sectoral disparity complicates the relationship between tax burden and cash demand, as individuals and businesses in high-growth sectors may engage in tax avoidance strategies, thereby sustaining or increasing their reliance on cash transactions.

The negative and statistically insignificant relationship between inflation and cash demand reveals a nuanced dynamic warranting further investigation. While it may seem intuitive that rising inflation leads to higher cash holdings as people attempt to hedge against increasing prices, this finding challenges such assumptions. Research by Eileen and Jusoh (2010), Manik et al. (2023), Safitri and Militina (2018), Noviyanti (2022), and Polontalo et al. (2018) supports the notion that although individuals may initially increase cash holdings during inflationary periods, this does not necessarily result in a significant or sustained rise in cash demand.

A primary explanation is that inflation erodes the purchasing power of money. As prices rise, the value of cash diminishes, prompting individuals and businesses to seek alternative assets that offer better value protection, such as gold, real estate, or financial instruments. These assets provide security and potential appreciation, making them more attractive during inflationary pressures. For example, Salisu, Raheem, and Ndako (2020) conducted a comparative analysis of inflation-hedging properties in the United States, finding that while real estate and stocks effectively hedge against inflation, gold does not align with the Fisher hypothesis. Similarly, Almeida et al. (2024) examined the relationship between housing prices, stock prices, gold, and inflation over seven decades, concluding that housing and equities act as effective hedges, offering stability and growth during inflation shocks. These findings emphasize the importance of diversifying investment portfolios to include resilient assets like real estate and equities.

Furthermore, high inflation is often accompanied by heightened economic

uncertainty. During such periods, individuals are less likely to hold cash, which fails to protect against inflation, and are more inclined to invest in stable assets that preserve wealth. Pallotti, Paz-Pardo, and Slacalek (2024) argue that inflation drives a behavioral shift in financial decision-making, leading individuals to prioritize resilient investments over liquid assets like cash. As a result, rising inflation reduces cash holdings as people gravitate towards assets that maintain their value over time.

Finally, inflation rarely operates in isolation and is typically accompanied by other macroeconomic variables influencing cash demand. For instance, rising inflation often leads to higher interest rates as central banks attempt to curb inflationary pressures. Higher interest rates diminish the appeal of holding cash, as individuals can achieve better returns through interest-bearing accounts or other financial products. This interplay between inflation and interest rates underscores the multifaceted relationship between inflation and cash demand, highlighting the need for a holistic approach to understanding these dynamics.

It is important to consider that individuals typically hold cash only up to a certain limit during periods of stable inflation. However, when inflation becomes volatile and unpredictable, the preference for cash diminishes further. High inflation encourages individuals to minimize their cash holdings in favor of assets that provide a hedge against inflationary risks. This dynamic explains the generally negative relationship between inflation and cash demand: inflation not only erodes the purchasing power of money but also incentivizes shifts in financial behavior toward safer and more profitable alternatives.

This pattern aligns with Friedman's Quantity Theory of Money, which posits that individuals demand less cash as the value of money decreases. As inflation rises, the opportunity cost of holding cash increases, making it more financially advantageous to invest in higher-yielding assets. Nonetheless, the theory also suggests that during periods of stable inflation, individuals may still hold cash because its value remains predictable. Consequently, the statistically insignificant relationship between inflation and cash demand observed in this study may indicate that inflation's influence on cash behavior becomes pronounced only after surpassing a specific threshold.

Thus, the insignificant statistical relationship between inflation and cash demand can be attributed to the tendency of inflation to drive individuals toward other asset classes. When inflation is stable or low, people feel more comfortable holding cash. Conversely, in periods of high and unstable inflation, the rising opportunity cost of holding cash compels individuals to invest in inflation-hedging assets, weakening the direct impact of inflation on cash demand. These findings align with broader theoretical perspectives on how inflation shapes asset preferences and financial behavior.

This nuanced understanding underscores the importance of examining inflation's effects on cash demand through a broader lens of financial behavior and the availability of alternative assets rather than assuming a straightforward, linear relationship.

The relationship between income and cash demand, on the other hand, is found to be significantly positive, corroborating findings from various studies, including those by Nakorji and Asuzu (2019), Personal and Archive (2021), Mahmood and Alkhateeb (2018), Mulyawan (2017), Wirawan (2023), Hariyanti et al., (2022), and Afdi and Purnomo (2015). This positive relationship suggests that as individuals or households experience an increase in income, their demand for cash also rises.

Understanding this phenomenon more comprehensively requires examining the theoretical framework underpinning it. Keynes' theory of money demand provides a foundational perspective. According to Keynes, the demand for money is driven by three primary motives: the transaction motive, the precautionary motive, and the speculative motive.

The transaction motive implies that as income increases, individuals are likely to engage in more transactions, such as purchasing goods and services. In such cases, cash is a convenient

medium for daily transactions, particularly for small-scale purchases or routine expenditures. This trend is especially evident in economies where cash remains the preferred payment method despite the growing adoption of digital payment systems.

Additionally, the precautionary motive suggests that with increased income, individuals tend to hold more cash to safeguard against unexpected expenses. This behavior aligns with Keynes' liquidity preference theory, which posits that higher income levels lead individuals to allocate a portion of their wealth to liquid assets, such as cash, to address potential risks and uncertainties. These could include emergencies, sudden market volatility, or unplanned expenditures. As a result, income growth directly correlates with higher cash holdings, driven by the need to ensure financial preparedness for unforeseen circumstances in daily life or business operations.

The speculative motive, while often more applicable to investments, also suggests that individuals may choose to hold more cash during periods of economic uncertainty or when expectations of favorable investment opportunities arise. In this case, higher income gives individuals the flexibility to hold onto more cash, allowing them to respond swiftly to market changes or profit from future opportunities. These motives align with the quantity theory of money, which indicates that the demand for money is directly proportional to economic activity. As income grows, economic activity expands, leading to more transactions requiring cash as a medium of exchange. This is particularly significant in contexts where physical cash remains an essential form of liquidity, such as in informal economies or developing countries.

Furthermore, Mankiw (2016) explains that money demand is highly responsive to income fluctuations. When income rises, so does the ability to save and spend. Individuals with higher incomes are more capable of meeting their basic needs and tend to engage in more discretionary spending, increasing the overall demand for cash. Additionally, businesses demand more cash to facilitate the rising number of transactions as the economy grows and consumer spending increases.

In conclusion, the positive and significant relationship between income and cash demand can be attributed to the heightened need for cash in response to increased economic activity, the desire for liquidity to handle unexpected expenses, and the necessity of cash to manage daily transactions. This connection highlights the broader economic implications of rising income levels, reinforcing that cash remains a vital financial asset, especially in economies where digital transactions have not fully replaced cash. Therefore, understanding this relationship provides valuable insights into how economic growth can drive changes in monetary behavior and cash demand.

The relationship between financial and technological innovation and cash demand is negatively insignificant, a finding consistent with studies by Manuel (2020), Dunne and Kasekende (2018), and Lukito, Firdaus, and Adi (2023). These studies suggest that despite the proliferation of financial innovations, such advancements have not yet significantly influenced the demand for cash. Exploring the underlying factors at play is essential to provide a more comprehensive understanding of this phenomenon.

One key explanation lies in the Baumol-Tobin theory of cash demand, which posits that advancements in banking technology, such as online banking and mobile payment systems, should theoretically reduce the need for cash. With easier and faster access to digital payment systems, individuals may not feel the need to hold as much physical cash for transactions. However, the effect of this substitution between cash and digital payments is not uniform across different regions and economic sectors. In areas where digital infrastructure is not fully developed or widely adopted, the expected reduction in cash demand due to technological innovation does not materialize significantly.

This is particularly relevant in developing countries, where traditional cash transactions remain dominant, and the adoption of financial

technologies is often uneven. Financial inclusion, the degree to which individuals can access and use financial services, is still challenging in many regions. In communities lacking digital infrastructure, trust in digital financial systems may not be fully established, leading to continued reliance on cash as the primary medium of exchange. Furthermore, certain population segments, such as older adults or individuals in rural areas, may resist adopting new technologies due to a lack of familiarity or distrust in the security of digital financial platforms. Demirgüç-Kunt et al. (2020) highlight that approximately 30% of adults in developing countries still lack access to formal financial services, with exclusion rates particularly high among women, low-income individuals, and rural residents.

Moreover, cultural factors and habits related to cash usage influence cash demand significantly. In some societies, cash is viewed as a tangible and secure means of conducting transactions, making the shift to digital alternatives slower than expected. Even with financial innovations like e-wallets and contactless payments, people may still prefer using cash for small or routine purchases, especially in regions with low digital literacy or limited access to banking services.

Additionally, trust in digital financial systems remains a critical factor. As long as concerns about the security and reliability of digital transactions persist, especially in regions prone to fraud or where cyber-security measures are not robust, individuals may be reluctant to transition from cash to digital forms of payment fully. This lack of confidence in digital systems can mitigate the potential impact of financial and technological innovations on reducing cash demand.

The insignificant relationship between financial innovation and cash demand may also be tied to economic disparities within and between countries. While wealthier individuals or those living in urban areas might quickly adopt new financial technologies, a significant portion of the population may still lack access to the necessary infrastructure or resources to participate in this digital shift. Consequently, the reduction in cash demand may only be observed in select, more affluent regions while broader populations rely heavily on cash.

In conclusion, although financial and technological innovations can reduce cash demand, their impact is limited by factors such as underdeveloped digital infrastructure, cultural preferences for cash, economic inequality, and varying levels of trust in digital financial systems. As such, the negative and insignificant relationship between these innovations and cash demand highlights the complexity of transitioning from a cash-based economy to one that relies more heavily on digital financial solutions. This finding underscores the need for more inclusive policies and investments in digital infrastructure to ensure that the benefits of financial innovations are more broadly distributed across all segments of society.

After conducting regression analysis on the sensitivity of cash demand and tax potential, the magnitude of the shadow economy can be assessed using a monetary approach that focuses on the utilization of cash. The estimation process begins with calculating cash demand, influenced by tax burden, inflation, income, and societal preferences for cash. Total cash demand in the formal economy is calculated by excluding the tax burden from the model, assuming high taxes drive shadow economy participation. The velocity of money circulation in the shadow economy is then estimated by comparing it to the formal economy and subtracting the amount of cash in the shadow economy. The magnitude of the shadow economy is calculated by multiplying the velocity of money circulation in the shadow economy by the cash demand within it. The subsequent section outlines the estimated size of the shadow economy across 34 provinces in Indonesia, derived from the monetary approach.

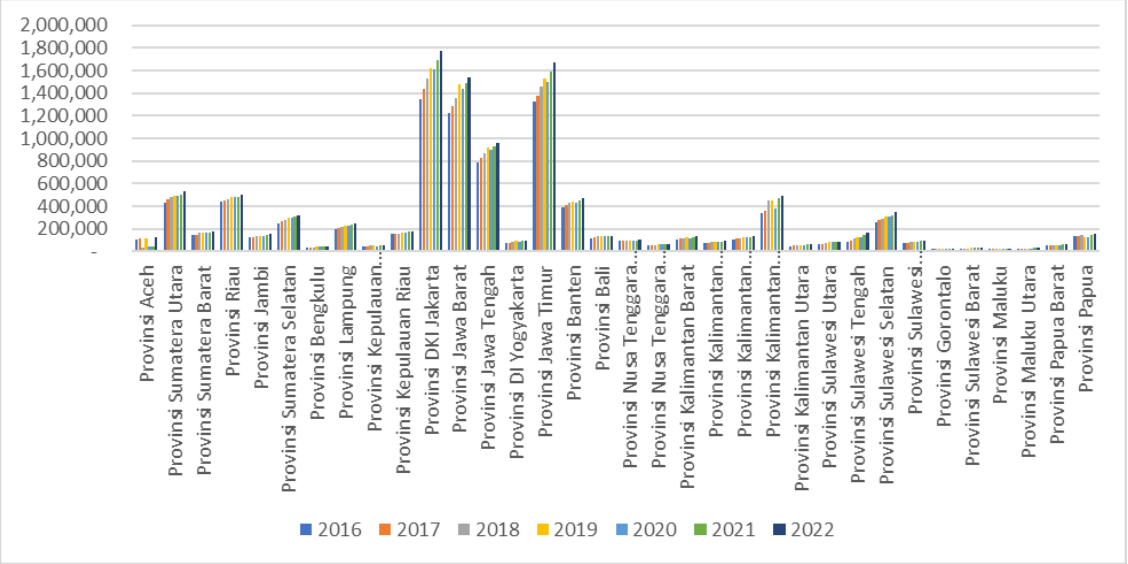

Figure 2. Shadow economy of 34 provinces in Indonesia 2016-2022
Source: Data Processed, 2024

Based on the results obtained from the monetary approach for calculating the shadow economy, as illustrated in Figure 3, the shadow economy across 34 provinces in Indonesia experienced significant fluctuations between 2016 and 2022. Provinces such as North Sumatra, West Java, and East Java exhibited a steady increase in the size of their shadow economies, indicating a growth in informal economic activities. In contrast, provinces like Aceh and East Kalimantan showed marked fluctuations. DKI Jakarta and East Java reported the highest figures for the shadow economy, with DKI Jakarta exceeding IDR 1.7 trillion in 2022. The average estimated size of the shadow economy across these 34 provinces was IDR 292.152 billion.

The potential tax revenue lost due to shadow economy activities can be estimated by multiplying the shadow economy's size by each province's tax burden. The following section presents the potential tax revenue losses from the shadow economies of the 34 provinces in Indonesia

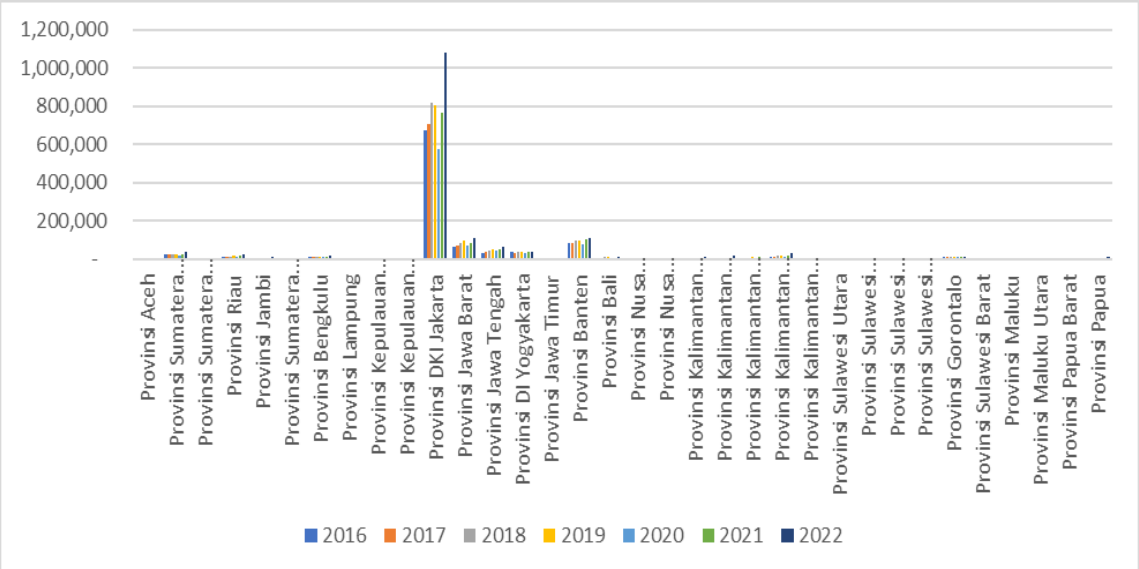

Figure 3. Lost tax potential of 34 provinces in Indonesia 2016-2022
Source: Data Processed, 2024

The potential tax revenue from the 34 provinces in Indonesia during 2016-2022 exhibited significant variation. Aceh recorded the lowest potential tax revenue, with IDR 1.255 billion in 2020 and the highest at IDR 5.461 billion in 2022. DKI Jakarta had the highest potential tax revenue, increasing from IDR 672.611 billion in 2016 to IDR 1.078.311 billion in 2022. Several provinces demonstrated substantial increases, such as North Sumatra, which rose from IDR 21.889 billion in 2016 to IDR 35.387 billion in 2022, and Riau, which increased from IDR 12.733 billion in 2016 to IDR 21.735 billion in 2022. Conversely, North Kalimantan experienced a decline from IDR 1.819 billion in 2016 to IDR 1.411 billion in 2022. The average potential tax revenue lost due to the shadow economy in these 34 provinces during this period was approximately IDR 35.306 billion per year, highlighting the need for enhanced tax enforcement to reduce the shadow economy and increase national revenue.

This figure highlights the persistent nature of the shadow economy, which has remained substantial post-policy despite the government's efforts. Compared to the average IDR 161.9 billion observed before the tax amnesty from 2007 to 2017, it becomes clear that the policy may not have achieved its intended outcomes. According to Mandala and Khoirunurrofik (2021), the tax amnesty policy fell short of its goals, indicating that a deeper examination is required to understand why the shadow economy remained so large.

Several factors could have contributed to the ineffectiveness of the tax amnesty in reducing the shadow economy. Public skepticism towards repeated tax amnesty programs is one significant factor. When tax amnesty policies are implemented frequently, they can unintentionally encourage tax avoidance rather than compliance. The public may view tax amnesty as a recurring opportunity to evade taxes without long-term consequences. This cycle weakens the credibility of tax authorities and erodes public trust, which is essential for achieving sustained compliance. Tax evasion practices may increase as individuals and businesses anticipate future amnesty programs, leading to more frequent engagement in shadow economy activities.

The introduction of the 2016 tax amnesty was more structured than its predecessors, with efforts made by the Directorate General of Taxes to improve fiscal performance. The program succeeded in immediate results, collecting taxpayer asset declarations worth IDR 4,884 trillion and generating approximately IDR 114 trillion in short-term revenue from penalty payments. However, these achievements mask deeper issues. One of the most pressing challenges faced by the program was the limited repatriation of assets from abroad. This suggests that while many taxpayers declared their assets, they chose not to return them to the formal economy. As a result, a significant portion of the nation's wealth continues to exist outside the regulated tax framework, contributing to the ongoing shadow economy problem.

Another challenge was the minimal engagement of micro, small, and medium enterprises (MSMEs). This is particularly concerning because MSMEs are often a major component of the shadow economy. Many small businesses operate informally and do not comply with tax regulations because of a lack of awareness or inability to bear formalization's administrative and financial burdens. The limited participation of MSMEs in the tax amnesty program reveals a critical gap in the policy's design: it failed to address the sectors most vulnerable to shadow economy activities adequately. Consequently, this sector continues to contribute to the persistence of the shadow economy, further limiting the policy's impact.

The potential tax revenue lost due to the shadow economy in these 34 provinces during this period was estimated to be approximately IDR 35.306 billion annually. This figure highlights the substantial financial cost of the shadow economy to the national budget. The shadow economy, characterized by unreported economic activities, results in significant tax revenue losses because these activities are hidden from tax authorities. Tax evasion is the primary mechanism driving these losses, with shadow

economy participants often engaging in cash transactions to avoid generating taxable records. This method allows businesses and individuals to conceal their true income, further complicating efforts to assess and collect the taxes owed.

In conclusion, while the 2016 tax amnesty brought immediate fiscal benefits, its long-term effectiveness in addressing the shadow economy remains questionable. The persistent size of the shadow economy post-policy suggests that deeper structural issues, such as public distrust of repeated amnesty programs and the limited engagement of key economic sectors like MSMEs, need to be addressed for more lasting results. Moving forward, the government may need to develop comprehensive, long-term strategies that focus not only on immediate tax collection but also on fostering a tax compliance culture and reducing the prevalence of the shadow economy through better enforcement and targeted support for formalizing small businesses.

Following the estimation of the shadow economy's size using the monetary approach, regression analysis was conducted to evaluate its effect on tax potential. Based on the Chow, Hausman, and Lagrange Multiplier Test results, the study identified the Random Effects Model (REM) as the most appropriate for panel data regression analysis in assessing tax potential.

Table 4. Results of Tax Potential Equation Estimation with Random Effect Model

Variabel	Koefisien	Std. Error	t-Statistic	Prob.
C	-31734.68	20269.95	-1.565602	0.1188
SE	0.229471	0.029843	7.689234	0.0000
R-squared	0.200117	F-statistic		59.04310
Adjusted R-squared	0.196728	Prob(F-statistic)		0.000000

Source: Data Processed, 2024

The panel regression equation derived from the estimation using the Random Effects Model (REM) is as follows:

$$TP_{it} = -31734{,}68_{it} + 0.2294SE_{it} + e \quad \text{.....(4)}$$

The estimation results from the Random Effects Model indicate that the coefficient of determination (R^2) for the tax potential regression equation is 0.2001. This suggests that the shadow economy accounts for 20.0 percent of the variation in tax potential, while the remaining 80.0 percent is due to other factors not incorporated into the model.

Additionally, the F-value for the tax potential regression equation is 59.04310, compared to an F-table value of 3.03375, with a p-value of 0.0000. Given that the F-value surpasses the F-table value and the p-value is below 0.05, it can be concluded that the shadow economy significantly impacts tax potential. Additionally, the t-test results reveal that the t-statistic for the shadow economy variable exceeds the critical t-table value of 1.651336, and its significance level is below 0.05. Therefore, it can be inferred that the shadow economy significantly affects tax potential.

The relationship between the shadow economy and tax potential is significantly positive, implying that the complexity and magnitude of potential tax losses also increase as the shadow economy grows. This finding is consistent with studies by Mazhar and Méon (2017), highlighting the substantial tax revenue losses governments face due to economic activities outside official regulation. However, a deeper explanation is needed to grasp the mechanisms driving this relationship fully.

One of the primary issues related to the shadow economy is that it encompasses a wide range of economic activities that escape government oversight. This includes unreported employment, cash-only businesses, and untaxed informal transactions. As a result, a significant portion of the income generated within the economy is not reflected in official financial records, meaning that the government cannot collect taxes on it. Therefore, the size of the shadow economy directly impacts tax revenue collection, as the larger the shadow economy, the

greater the amount of income that goes untaxed. This dynamic creates a tax gap, the difference between the taxes that should have been collected and those that were collected, directly affecting the government's ability to finance public services and support economic development.

Moreover, expanding the shadow economy reduces the official tax base, as a significant portion of economic activities remains unrecorded. This not only results in lower tax revenues but also distorts the official economic figures, which typically understate the actual size of the economy. When a considerable amount of economic activity occurs outside of official channels, the government cannot accurately assess the true scale of the economy. This presents a significant challenge in national financial planning, as fiscal policies are often based on reported economic data. With a reduced tax base, the government may be forced to impose higher taxes on the formal sector to compensate for the revenue shortfall, which could further drive businesses and individuals into the informal sector, creating a vicious cycle of tax evasion and economic informality.

Additionally, the complexity of the shadow economy complicates efforts to estimate tax potential accurately. Many shadow economy activities are intertwined with legitimate businesses, making it difficult for authorities to distinguish between formal and informal income sources. This lack of transparency further hampers tax collection efforts. Businesses operating partially in the shadow economy may underreport their income or inflate expenses to reduce their tax liabilities. Such practices undermine tax compliance and exacerbate revenue losses, making it harder for the government to predict actual tax potential accurately.

The implications for economic development are significant. A government with a reduced capacity to collect taxes due to the shadow economy faces limitations in funding infrastructure projects, healthcare, education, and other essential public services. This can have long-term consequences for economic growth and social welfare. Furthermore, tax revenue losses reduce the government's ability to invest in programs that could bring informal economic activities into the formal sector, creating a cycle where the shadow economy persists and erodes the tax base.

In conclusion, the positive and significant relationship between the shadow economy and tax potential highlights the substantial tax losses that can occur when economic activities remain outside the formal regulatory framework. The expansion of the shadow economy not only decreases the official tax base but creates challenges for accurate revenue estimation and national financial planning. As governments struggle to address the complexities of the shadow economy, it becomes increasingly difficult to promote economic growth and development effectively. Therefore, understanding this relationship is crucial for policymakers aiming to reduce tax losses and strengthen the formal economy through tax reforms and better enforcement strategies

CONCLUSION

This study finds that tax burden and inflation do not significantly influence cash demand across 34 provinces in Indonesia from 2016 to 2022. However, income shows a significant positive impact on cash demand, indicating that increases consistently follow increases in income in cash demand. Conversely, financial and technological innovations have no significant effect on cash demand. On the other hand, the shadow economy significantly affects tax potential, with its size experiencing significant fluctuations in response to changes in tax amnesty policies. The potential tax revenue lost due to the shadow economy is substantial, indicating a considerable impact on state revenue, especially taxes. The average size of the shadow economy in the 34 provinces of Indonesia during the 2016-2022 period was IDR 292.152 billion, while the average potential tax revenue lost due to shadow economy activities was IDR 35.306 billion. To address the growth of the shadow economy, the government needs to strengthen policies that support and protect informal business operators, encouraging them to

transition to the formal sector by developing easily accessible business registration facilities. Tax abolition and amnesty policies can also be effective strategies to reduce excessive tax burdens, motivating economic actors to choose legal and registered pathways, thereby increasing tax revenue and strengthening the formal economy. However, this study has limitations in the variables analyzed and data access, which restrict the depth of analysis regarding factors that may influence the study's outcomes. These include imperfections in cash demand data, which need to be addressed with appropriate methods to enhance the accuracy and validity of the analysis results.

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