

-RESEARCH ARTICLE-

## DOES SHADOW ECONOMY WIDENS OR NARROWS THE INCOME INEQUALITY IN MALAYSIA? SOME ROBUST RESULTS

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### —Abstract—

This study was undertaken to contribute further to the body of knowledge of Shadow Economy studies, by investigating how the scale of the shadow economy influences income inequality in the context of a developing country, with Malaysia serving as the case study. Utilizing annual data from 1980 to 2018, the analysis draws upon four distinct shadow economy estimations: (i) the Multiple Indicator-Multiple Cause (MIMIC) model-based figures presented by Medina and Schneider (2019); (ii) the estimates developed by [Elgin, Kose, Ohnsorge, and Yu \(2021\)](#), which include both (a) MIMIC-based and (b) Computable General Equilibrium (CGE) model approaches; and (iii) the Modified-Cash-Deposit-Ratio (MCDR) method estimates provided by [Habibullah, Din, Yusof-Saari and Baharom \(2016\)](#). Gini coefficient is employed as the measurement for income inequality. The empirical framework integrates real Gross Domestic Product (GDP), tax burden, and urbanization growth as control variables. To evaluate the nexus between the shadow economy and income inequality, the study employs three estimators namely: Ordinary Least Squares (OLS) with robust standard errors, Robust Least Squares (RLS) incorporating M-estimators, and Fully Modified OLS (FMOLS). The analysis conducted are quite robust and comprehensive taking into account both linear and nonlinear dynamics. The empirical evidence predominantly supports a nonlinear relationship, we could see the Kuznet effect, an inverted U-shaped pattern. Implication of the U-Shape is that income inequality initially increases with the expansion of the shadow economy but subsequently decreases once a specific threshold is exceeded. Furthermore, the macroeconomic controls indicate that greater levels of economic development mitigate inequality, whereas higher tax burdens and increased urbanization contribute to its intensification. The analysis also uncovers nonlinear effects in the relationships between inequality and both tax burden and urbanization.

**Keywords:** income inequality, shadow economy, nonlinear, robust regression, Malaysia.

### INTRODUCTION

The United Nations Development Programme ([UNDP, 1994](#)) emphasized in its Human Development Report that economic security is a foundational element of broader human security, which in turn fosters sustainable human development and long-term economic growth. A key aspect of economic security lies in ensuring individuals have access to

stable and adequate income, primarily derived from productive and gainful employment. In today's volatile economic landscape, marked by persistent uncertainties, obtaining and retaining decent employment—particularly among younger populations—has become increasingly challenging. For many, self-employment becomes the only viable path, despite its often-lower stability compared to traditional wage employment. Others may resort to participating in the shadow economy for financial survival. In Malaysia, the degree of income disparity is typically measured using the Gini coefficient. Although the coefficient decreased from 0.513 in 1970 to 0.407 by 2019, [Yau and Tan \(2022\)](#) argue that any value above 0.4 still signals a critically unequal distribution of income.

According to [Kuznets \(1955\)](#) seminal hypothesis, income inequality varies with different phases of economic development. Initial phase of development, inequality worsens, as individuals possessing capital benefit from new investment opportunities and wealth accumulation. Meanwhile, an influx of low-skilled labour into urban areas suppresses wages, thereby widening income gaps. However, as economies progress—such as transitioning from agrarian to industrial sectors—broader employment opportunities become available. This tends to reduce inequality once a specific income threshold is surpassed. This non-linear relationship nexus of development and inequality is known to exist due to the Kuznets effect.

Addressing income inequality poses a significant policy challenge, as governments strive to ensure equitable economic opportunities and enhance overall societal well-being ([UNDP, 2013](#)). Persistent inequality can exacerbate vulnerability among disadvantaged groups, potentially escalating into social unrest, ethnic and regional conflicts, and even political instability ([Alesina & Perotti, 1996](#); [Barro, 2000](#)). Moreover, excessive inequality can hinder economic progress by limiting access to healthcare and education, which are essential for human capital accumulation ([Aghion et al., 1999](#); [Galor & Moav, 2004](#)). When children from low-income families attend under-resourced schools and face barriers to higher education, overall labour productivity suffers, ultimately stalling economic growth.

Malaysia experienced the consequences of such inequality first-hand in 1969, when ethnic tensions fuelled by income disparity led to violent riots ([Banna et al., 2020](#); [Saari et al., 2015](#)). In response, Malaysia implemented the New Economic Policy (NEP) in 1971 to address income disparities between ethnic groups ([Shari, 2000](#)). While the income gap narrowed between the mid-1970s and 1990, a reversal in this trend began in the following decade ([Mahadevan, 2006](#)). Nonetheless, [Chakravorty \(1993\)](#) found evidence of Kuznets effect between growth and inequality in Malaysia during the 1950–1990 period, with a turning point identified between 1970 and 1976. More recently, [Goh et al. \(2023\)](#) reported a general decline in inequality, as reflected in the Gini coefficient, which dropped from 0.557 in 1976 to 0.411 in 2020.

This research seeks to evaluate the degree of which the shadow economy impacts income disparities in Malaysia. The presence of such a sizable informal sector has critical implications, notably in terms of foregone tax revenues, which in turn hinder Malaysia's capacity in infrastructure investment and provide essential public services. Moreover, the shadow economy is frequently associated with illicit and corrupt activities that escape formal regulatory frameworks. This study explores whether the shadow economy serves to intensify, mitigate, or exert a nonlinear effect on income inequality within the Malaysian context. Gini coefficient is employed as a measure of income inequality, alongside four alternative estimations of the size of shadow economy, the analysis further integrates real GDP, tax burden, and urbanization growth as additional explanatory variables.

Following section discussions on past literatures on the nexus of shadow economy and income inequality. Subsequent Section 3 details empirical framework employed while Section 4 interprets the empirical results. Finally, concluding Section 5 is a summary of key findings and potential policy implications.

## LITERATURE REVIEW

Two leading scholars in the field, [Schneider \(2005\)](#); [Schneider \(2011\)](#) and [Dell'Anno \(2007, 2018\)](#), examined the implications of the shadow economy on global economic activity. [Schneider \(2005\)](#) provides a concise definition, describing the shadow economy as encompassing all market-oriented goods and services produced legally, but intentionally hidden from authorities. The concealment occurs for reasons such as: (i) evading income, value-added, or other forms of taxation; (ii) avoiding contributions to social security systems; (iii) circumventing labour market regulations, including those related to working hours, minimum wages and occupational health and safety requirement; and (iv) avoiding administrative burdens such as completing surveys and/or official documentation.

Conversely, [Dell'Anno \(2007\)](#) characterizes the shadow economy as a specific subset of the broader "non-observable economy," which includes underground economy as well as informal production conducted for economic motives. Expanding upon this, [Dell'Anno \(2022\)](#) classifies shadow economy activity into three main forms: (a) self-employment, (owners, independent workers, and unpaid family members) operating in enterprises or firms which are not registered; (b) Under reporting of output to evade taxation or regulation (registered enterprises); and (c) informal wage employment lacking formal contracts, social protection, or employee benefits. Despite the many definitional attempts, [Dell'Anno \(2022\)](#) concludes that a universally informal economy is defined as—one that satisfies both statistical rigor and economic relevance—remains elusive. Consequently, terms such as "informal," "unofficial," "hidden," "black," and "underground" economies are often used interchangeably with "shadow economy" in academic discourse.

Despite definitional inconsistencies, numerous empirical studies have tried to quantify the size of the shadow economy across countries. Key contributions include those by [Alm and Embaye \(2013\)](#), [Elgin and Oztunali \(2012\)](#), [Tan et al. \(2017\)](#), [Medina and Schneider \(2019\)](#), and [Elgin and Elveren \(2019\)](#). Variations in estimates stem from differences in methodology, time periods, and country samples. Nevertheless, a general decline in the shadow economy shares or size has been observed over time globally.

Shadow economy estimation is vital due to its well documented implications for fiscal policy and public service delivery. A larger shadow sector diminishes a government's tax base, undermining its ability to fund infrastructure, public utilities, and income redistribution programs. Additionally, the shadow economy distorts labour and product markets by diverting resources from formal to informal activities, and it compromises the accuracy of national statistics critical for macroeconomic policymaking. Moreover, shadow economy operations often enable corruption and foster linkages with illicit or criminal behavior ([Dell'Anno, 2018](#); [Dell'Anno, 2016](#); [Eilat & Zinnes, 2002](#); [Naylor, 1995](#); [Saha et al., 2021](#)). However, [Schneider and Enste \(2000\)](#) argue that a substantial portion of income generated within the shadow economy is promptly spent in the formal sector. [Smith \(2002\)](#) further suggests that the shadow economy can help alleviate unemployment by providing alternative income-generating opportunities.

### **Nexus between Income Inequality and Shadow Economy**

The relationship between the shadow economy and income inequality remains complex and context-dependent. [Eilat and Zinnes \(2002\)](#) propose that informal activities can either exacerbate inequality if they primarily benefit capital owners or reduce it, if they create income and employment opportunities for low-income individuals and small enterprises. Looking from this angle, the shadow economy serves as a parallel avenue for marginalized groups to earn livelihoods, especially when formal employment is inaccessible ([Mukhtar et al., 2021](#)). However, participation in informal markets also entails tax evasion, which erodes the government's capacity in implementing the right redistributive policies, resulting widening income inequality ([Dell'Anno, 2016](#); [Rosser et al., 2000](#)).

Past studies are ambiguous on the nexus between the shadow economy and income inequality and remains inconclusive. [Gutiérrez-Romero \(2021\)](#) observes that the direction of this relationship appears to depend on the development level of the economy—being positively correlated in advanced economies but negatively so in developing contexts. In the case of Pakistan, identify a positive association between the size of the informal sector and income inequality for the period spanning 1975 to 2016. Likewise, [Esaku \(2021\)](#) reports that a growing shadow economy in Nigeria significantly amplifies inequality, a finding supported by [Adegboyega et al. \(2022\)](#), who also confirm a direct link between informality and inequality in the Nigerian context.

Conversely, [Huynh and Nguyen \(2019\)](#), in their study encompassing 19 Asian countries from 1990 to 2015, report that an expanding shadow economy contributes to a decline in income inequality. In Africa, [David et al. \(2023\)](#) find that a more limited informal sector slightly contributes to lower inequality, with evidence pointing to an expected, nonlinear, inverted U-shaped relationship between informality and inequality.

[Elgin et al. \(2021\)](#), analysing a panel of 86 countries from 1960 to 2016, detect a generally positive link between the shadow economy and income inequality. However, their findings underscore a nuanced pattern, where the effect tends to be negative in high-income economies and positive in lower-income ones. In a broader cross-country study, [Elgin and Elveren \(2019\)](#), using data from 125 countries between 1963 and 2016, similarly conclude that informal activity tends to reduce inequality in more affluent nations while exacerbating it in less developed economies.

Other studies have affirmed a direct relationship. [Ahmed et al. \(2007\)](#), using cross-sectional data for 67 countries, identify a positive linkage between unobserved economic activity and income inequality. [Ariza and Rojas \(2017\)](#), focusing on 13 Colombian cities, find that a 1% marginal increase in shadow economy size increases the Gini coefficient by roughly 0.07 units. [Krstić and Sanfey \(2011\)](#), analysing Serbian labour markets with data from 2002 and 2007, show that informal employment contributes to widening income inequality. In a comparable vein, [Yap et al. \(2018\)](#) analyse data from 154 countries over the 2000–2017 period using both nonparametric and semiparametric methods. Their findings reveal that in developed economies, informal sector and income inequality assumes an inverted N-shaped form. In contrast, developing countries generally exhibit an inverted U-shaped relationship, indicating that the effect of informality on inequality evolves differently across development levels.

## METHODOLOGY

### The Estimating Model

Building on prior empirical studies such as [Huynh and Nguyen \(2019\)](#), [Berdiev and Saunoris \(2019\)](#), and [Esaku \(2021\)](#), this study adopts the following baseline econometric specification to investigate the relationship between the shadow economy and income inequality:

$$inequality_t = \alpha_0 + \theta_1 shadow_{jt} + \gamma_k X_{kt} + \varepsilon_t \quad (1)$$

In this model specification, the response variable  $inequality_t$  captures income inequality, proxied by the Gini coefficient. The principal explanatory variable,  $shadow_{jt}$ , represents the shadow economy's size as a percentage of gross domestic product (GDP), where the subscript  $j$  denotes the estimation method applied. Specifically, shadow economy estimates are sourced from three key studies: (i) [Medina](#)

and Schneider (2019), employing the Multiple Indicator-Multiple Cause (MIMIC) framework; (ii) Elgin et al. (2021), utilizing both (a) the MIMIC approach and (b) the Computable General Equilibrium (CGE) model; and (iii) Habibullah et al. (2016) applying the Modified-Cash-Deposit-Ratio (MCDR) methodology. The vector  $X_{kt}$  includes macroeconomic control variables such as real GDP, tax burden, and urbanization growth. The parameters  $\alpha_0$  and  $\varepsilon_t$  correspond to the constant term and the stochastic error term, respectively. The error term follows a distribution with zero mean and homoscedastic variance. All variables are transformed using natural logarithms to allow coefficient interpretation in terms of elasticities.

The impact that the shadow economy has on income inequality is captured by the sign and magnitude of the coefficient  $\theta_j$ . A positive value implies that an expanding shadow economy worsens income inequality, whilst a negative value indicates a mitigating effect. At lower levels of informality, the shadow economy might not offer sufficient employment opportunities, thereby increasing inequality. However, as and when the shadow economy grows, it may begin to absorb a larger share of the unemployed or underemployed population, potentially alleviating income inequality through informal job creation and alternative income sources.

The nature of the nexus between the shadow economy and income inequality depends on the sign of  $\theta_j$ . A positive coefficient implies that a greater shadow economy exacerbates income inequality, whereas a negative coefficient suggests that the shadow economy mitigates inequality. At lower levels of informality, the shadow economy may offer limited employment opportunities, thus worsening inequality. However, as the informal sector expands, it may increasingly absorb unemployed or underemployed individuals, reducing inequality through job creation and income generation.

Inclusion of real GDP as a control variable act as a measurement for the level of economic development or growth. Theoretical relationship between economic growth and income inequality is well documented in the literature, most notably in Kuznets (1955).

It is also known as the Kuznets effect, whereby inequality increases in the early phases of development and decline thereafter. This pattern has been supported by studies such as Ahluwalia (1976), Robinson (1976), and Gupta and Singh (1984).

While some studies report a negative relationship—where economic growth reduces inequality by enhancing redistributive capacity (Brueckner et al., 2015; Kakwani et al., 2003; Panizza, 2002)—others find a positive or inconclusive effect (Rubin & Segal, 2015; Scully, 2003). Recent studies on Malaysia present similarly divergent results. Goh et al. (2023) and Banna et al. (2020) report that economic growth has reduced inequality, while Banna et al. (2020) identifies a U-shaped curve, and Yau and Tan

(2022) observe an S-shaped relationship between income inequality and economic development.

Taxation is another critical variable that influences income inequality. Its effect depends heavily on the structure and progressivity of the tax system. A tax system that leans more on direct taxation tends to be more progressive, transferring resources from high-income to low-income groups, while systems reliant on indirect taxes are typically regressive (Martinez-Vazquez et al., 2012). Progressive taxes, particularly income taxes, are designed to reduce inequality by increasing rates with income (Odusola, 2017). In contrast, value-added taxes, sales taxes, excise duties, and customs tariffs (indirect taxes) disproportionately affect lower-income groups. Empirical evidence on the effect of taxation on inequality is, however, inconclusive. Iosifidi and Mylonidis (2017) find that increasing the burden of labour or consumption taxes relative to capital taxes raises inequality, though a higher reliance on labour taxes (as opposed to consumption taxes) improves income distribution. In South Asia, Khan and Padda (2021) report that both direct and indirect taxes help reduce inequality. Similarly, Martorano (2018) documents a negative association between taxation and inequality in Latin America. Conversely, Ouedraogo et al. (2022) find that taxation worsens inequality in Sub-Saharan Africa, although they note an inverted U-shaped relationship with indirect taxes. In Indonesia, Sari and Qibthiyah (2022) also observe a positive relationship between taxation and inequality. A study by Alves and Afonso (2019) in OECD countries finds an inverted U-shaped relationship between inequality and taxes on income, profits, and individual capital gains, as well as on goods and services, but a U-shaped relationship with corporate income taxes, payroll taxes, and property taxes.

Urbanization is the third control variable, and its relationship with income inequality is equally nuanced. As argued by Sulemana et al. (2019) individuals who migrate to urban areas without adequate skills or education may struggle to find employment that matches their needs, often accepting low-wage jobs or facing unemployment, thereby widening the income gap. However, if migration results in productive employment, urbanization may help reduce inequality. This dual possibility supports (Kuznets, 1955) inverted U-shaped hypothesis. Empirical findings vary by region and context. Sulemana et al. (2019) find that urbanization increases inequality in Sub-Saharan Africa. Kanbur and Zhuang (2013) show that urbanization exacerbated inequality in countries such as the Philippines, Indonesia, and India, but reduced it in China. In contrast, Topcu and Altınöz (2023) find that urbanization leads to reductions in both rural and urban inequality across Latin America. Dossou (2023) reports a positive effect of urbanization on inequality in Africa, while Chen et al. (2016) find that urbanization had a short-term negative effect on inequality but a lagged positive effect in post-reform China. Similar positive effects have been reported by Kawsar (2012) for Bangladesh and Adams and Klobodu (2019) for Sub-Saharan Africa. Meanwhile, support for the Kuznets curve has been found in Zhou and Qin (2012) for China, Cali (2008) for India, Ha et al. (2019) for Vietnam, and Chakravorty (1993) for Malaysia during the 1970s.

## Incorporating Nonlinear into Shadow Economy Model

Baseline model described in Equation (1) assumes a linear association between the explanatory variable which is the size of the shadow economy and the explained variable which is the income inequality. To evaluate the possibility of a nonlinear relationship (if any), the model is extended by incorporating a squared term of the shadow economy variable, resulting in the following specification:

$$inequality_t = \alpha_0 + \theta_1 shadow_{jt} + \theta_2 shadow_{jt}^2 + \gamma_k X_{kt} + \epsilon_t \quad (2)$$

In this formulation, the hypothesized or estimated shadow economy size appears in both linear and quadratic forms, allowing us to examine whether its impact on inequality changes with scale. If the estimated coefficients satisfy the condition  $\theta_1 > 0$  and  $\theta_2 < 0$ , and both are statistically significant, the relationship is nonlinear and follows an inverted U-shaped curve. This implies that income inequality initially increases as the shadow economy expands, but beyond a certain threshold, further growth in the shadow economy contributes to a reduction in inequality. Conversely, if  $\theta_1 < 0$  and  $\theta_2 > 0$ , the model also indicates a nonlinear relationship, but in the form of a U-shaped curve. In this case, inequality declines at lower levels of informality but begins to worsen once the shadow economy surpasses a minimum size.

The inverted U-shaped (Kuznets effect) relationship reflects a scenario in which the early growth of informal economic activity may fail to soak up a significant portion of the labour force, thereby worsening income distribution. However, as the informal sector matures and expands, it can increasingly serve as a safety net by providing employment opportunities to low-income groups, leading to improved income equality. In contrast, the U-shaped relationship suggests that while limited informality may initially help reduce inequality by creating flexible employment, an excessively large shadow economy may undermine state capacity, reduce public investment, and compromise income redistribution, ultimately worsening inequality.

### Data Sources

This analysis utilizes yearly data (1980 – 2018) to examine the nexus between disparities in income (income inequality) and the extent of the shadow economy in Malaysia. The analytical time frame is constrained by the availability of data especially the shadow economy estimates, particularly those provided by [Medina and Schneider \(2019\)](#) and [Elgin and Elveren \(2019\)](#), which do not extend beyond 2018.

[Medina and Schneider \(2019\)](#) and [Elgin and Elveren \(2019\)](#) estimate the size of the shadow economy using the Multiple Indicator-Multiple Cause (MIMIC) model. This approach comprises two stages: the first involves specifying a measurement model that links the latent shadow economy variable to its observed causes and indicators; the second involves estimating the structural coefficients associated with these causes and

indicators. Medina and Schneider (2019) present a comprehensive global dataset covering 157 countries over the period from 1991 to 2017, which forms one of the primary sources for shadow economy estimation in this study.

Elgin and Elveren (2019) also employ a Computable General Equilibrium (CGE) model to estimate the informal economy. This model captures the dynamic behaviour of households optimizing their labour allocation over time between formal and informal sectors. The CGE framework is grounded on two critical equilibrium conditions: one linking the labour market between formal and informal segments, and the other reflecting intertemporal substitution behaviour. The outcome is an estimate of informal output as a share of official GDP. Their database spans more than 160 countries and covers the years from 1990 to 2018.

In contrast, Habibullah et al. (2016) apply the Modified-Cash-Deposit-Ratio (MCDR) technique, originally developed by Pickhardt and Sarda (2011); Pickhardt and Sardà (2015), to estimate the shadow economy. This approach calculates the share of shadow to official income using the formula:  $\left\{ \left[ \frac{(CC_t - CC_0)}{(CC_0 + DD_t)} \right] = \left( \frac{Y_{Ut}}{Y_{Lt}} \right) \right\}$  where  $CC_t$  is the currency in circulation at year-end  $t$ ,  $CC_0$  is currency in circulation during the base year, and  $DD_t$  denotes demand deposits at year-end  $t$ .  $Y_{Lt}$  and  $Y_{Ut}$  represent the legit and shadow economies, respectively. The ratio  $\left( \frac{Y_{Ut}}{Y_{Lt}} \right)$  indicates the relative size of the shadow economy in relation to the official GDP. This study incorporates the MCDR estimates over the full 1980–2018 period.

Disparities in income is proxied the by Gini coefficient, obtained from Standardized World Income Inequality Database (SWIID). Higher values of Gini indicating greater disparity. The SWIID dataset, developed by Solt (2020), employs a Bayesian standardization approach to harmonize inequality data collected from diverse sources. One of the key advantages of the SWIID database is its broad coverage, providing comparable Gini estimates for 198 countries between 1960 and 2018.

Data for the macroeconomic control variables real GDP and urbanization were obtained from the World Development Indicators (WDI). The tax burden variable, defined as the ratio of tax revenue to GDP, was sourced from the Key Indicators for Asia and the Pacific. Descriptions of all variables and data sources are provided in Table 1 of the study.

**Table 1: Data sources and description of the variables**

Variables (Name)	Definition (Description)	Unit	Data sources
Dependent variable:			

inequality	Equals to income inequality. Proxy using Gini index of inequality	Index ranging from 0 to 100, higher the value higher is the inequality	Standardized World Income Inequality Database. URL: <a href="https://fsolt.org/swiid/">https://fsolt.org/swiid/</a>
Independent variables:			
A.Size of shadow economy (four specifications);			
i).shadow_Medina-Schneider-MIMIC	Size of the shadow economy estimated by Medina and Schneider (2019) using MIMIC model.	Expressed as shadow economy's GDP as a share of total GDP (%)	Media and Schneider (2019)
ii).shadow_Habibullah-MCDR	Size of the shadow economy estimated by Habibullah et al. (2016) using the Modified-Cash-Deposit-Ratio model.	Expressed as shadow economy's GDP as a share of total GDP (%)	Monthly Highlights & Statistics, Bank Negara Malaysia. URL: <a href="https://www.bnm.gov.my/publications">https://www.bnm.gov.my/publications</a>
iii).shadow_Elgin-MIMIC	Size of the shadow economy estimated by Elgin et al. (2021) using MIMIC model.	Expressed as shadow economy's GDP as a share of total GDP (%)	Elgin et al. (2021)
iv).shadow_Elgin-CGE	Size of the shadow economy estimated by Elgin et al. (2021) using CGE model.	Expressed as shadow economy's GDP as a share of total GDP (%)	Elgin et al. (2021)
B.Control variables:			
Real GDP	Proxy for the level of economic development or economic growth	Real Gross Domestic Product in RM Millions (2015=100)	World Development Indicators, World Bank Database. URL: <a href="https://databank.worldbank.org/source/world-development-indicators">https://databank.worldbank.org/source/world-development-indicators</a>
Tax burden	Total taxation	Tax revenue as a share to GDP (%)	Key Indicators (KI) for Asia and the Pacific Series, Asian Development Bank. URL: <a href="https://www.adb.org/publications/series/key-indicators-for-asia-and-the-pacific">https://www.adb.org/publications/series/key-indicators-for-asia-and-the-pacific</a>
Urbanisation	Growth in urbanisation	Expressed in the percentage growth in urbanization. Urbanisation is computed as urban population as a share to total population (%)	World Development Indicators, World Bank Database. URL: <a href="https://databank.worldbank.org/source/world-development-indicators">https://databank.worldbank.org/source/world-development-indicators</a>

## EMPIRICAL RESULTS

### Preliminary Descriptive Results

The summary statistics for all the variables employed in the analysis are reported in Table 2. The mean of the Gini coefficient, which serves as a proxy for income inequality in Malaysia, is 45.5, with values ranging from a minimum of 42.5 to a maximum of 48.7. Regarding the shadow economy, the average size estimated via four distinct methodologies varies notably. Specifically, the Medina-Schneider MIMIC method yields a mean estimate of 30.9% of GDP, while the Habibullah-MCDR approach reports a substantially higher average of 40.9%. The estimates based on the Elgin-MIMIC and Elgin-CGE models are 31.5% and 30.8% of GDP, respectively. For the macroeconomic control variables, the mean real GDP stands at RM606.0 billion, the average tax burden is 16.8% of GDP, and the annual average urbanization growth rate is 3.8%.

**Table 2: Descriptive statistics**

Variables	Unit	Mean	Max	Min	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Obs
inequality	%	45.46	48.70	42.50	1.89	-0.01	1.87	2.09	39
shadow_Medina-Schneider-MIMIC	%	30.98	37.20	26.90	2.67	0.64	2.63	2.01	27
shadow_Habibullah-MCDR	%	40.93	65.00	23.30	14.45	0.42	1.55	4.54	39
shadow_Elgin-MIMIC	%	31.47	33.80	29.30	1.04	0.08	2.79	0.08	26
shadow_Elgin-CGE	%	30.78	37.80	26.50	2.90	0.86	3.08	3.57	29
real GDP	RM	606x10 <sup>9</sup>	136x10 <sup>9</sup>	163x10 <sup>9</sup>	356x10 <sup>9</sup>	0.52	2.15	2.91	39
tax burden	%	16.81	22.22	12.02	2.77	0.31	1.87	2.67	39
urbanisation	%	3.76	4.99	2.13	0.96	-0.45	1.80	3.69	39

**Notes:** All variables are in absolute values.

With respect to variability, the standard deviations of income inequality, tax burden, urbanization, as well as for the shadow economy estimates, they are derived from the Medina-Schneider, Elgin-MIMIC, and Elgin-CGE models display relatively low dispersion, indicating consistent values across the sample period. In contrast, greater variability is observed in the Habibullah-MCDR shadow economy estimate and real GDP, reflecting more fluctuation over time in these two variables.

Income inequality and urbanization growth both exhibit negative skewness, suggesting distributions that are left-skewed with longer or heavier left tails. Conversely, positive skewness is observed for all shadow economy estimates, as well as for real GDP and tax burden, indicating skewed to the right distributions with longer right tails. Positive kurtosis are also observed for all the variables, indicating that their distributions are

more peaked than the normal distribution. Notably, the Elgin-MIMIC variable has a kurtosis value exceeding 3, suggesting a leptokurtic distribution. Despite these characteristics, the Jarque-Bera normality test results indicate that the data reasonably satisfy the assumption of normality.

Correlation matrix for all variables could be observed from [Table 3](#). The correlation between income inequality and most explanatory variables is positive, with coefficients generally exceeding 0.80. An exception is the tax burden, which shows a slightly lower but still strong correlation of 0.75. In contrast, the nexus between income inequality and real GDP is found to be negative, consistent with the findings discussed earlier in the methodology.

**Table 3: Correlation matrix**

Variables	inequality	shadow_Medina-Schneider-MIMIC	shadow_Habibullah-MCDR	shadow_Elgin-MIMIC	shadow_Elgin-CGE	real GDP	tax burden	urbanisation
inequality	1							
shadow_Medina-Schneider-MIMIC	0.83	1						
shadow_Habibullah-MCDR	0.81		1					
shadow_Elgin-MIMIC	0.80			1				
shadow_Elgin-CGE	0.95				1			
real GDP	-0.99	-0.86	-0.78	-0.84	-0.97	1		
tax burden	0.75	0.65	0.49	0.72	0.77	-0.75	1	
urbanisation	0.98	0.78	0.82	0.73	0.92	-0.97	0.69	1

**Notes:** All variables are in logarithm.

## Results of Unit Root Tests

Prior to estimating either Equation (1) or Equation (2), it is necessary to establish the integration order for each variable included in the analysis. This study employs the Kwiatkowski-Phillips-Schmidt-Shin ([Kwiatkowski et al., 1992](#)) test to assess the stationarity properties of the data series. The KPSS test is formulated with the null hypothesis of stationarity, in contrast to the alternative hypothesis that the series contains a unit root. The outcomes of the unit root tests are presented in [Table 4](#). The test is conducted in two stages: first, at the level of each series and, second, at their first differences. Each stage includes two specifications—one with an intercept only, and another with both an intercept and a deterministic trend. Columns 2 and 3 in [Table 4](#) report the results for the level series, while Columns 4 and 5 display the test results for the first-differenced series. The KPSS test results for the level series indicate that the null hypothesis of stationarity is rejected at the 5% significance level or better in most

cases, suggesting that the series are non-stationary in levels. However, for the first-differenced series, the null hypothesis of stationarity cannot be rejected, implying that these transformed series are stationary. Results clearly shows that all variables in the study are non-stationary in their levels but become stationary after first differencing, satisfying the condition for subsequent cointegration analysis and long-run modelling.

**Table 4: Results of KPSS unit root tests**

Series	Level:		First-difference	
	Intercept	Intercept+trend	Intercept	Intercept+trend
inequality	0.9134** (5)	0.1597** (3)	0.2926 (5)	0.1425 (6)
shadow Elgin-CGE	0.6743** (4)	0.1566** (3)	0.2996 (4)	0.1434 (6)
shadow Elgin-CGE <sup>2</sup>	0.6715** (4)	0.1596** (3)	0.3171 (4)	0.1437 (6)
shadow Habibullah-MCDR	0.6947** (5)	0.1565** (12)	0.0758 (1)	0.0703 (2)
shadow Habibullah-MCDR <sup>2</sup>	0.6933** (5)	0.1553** (12)	0.0759 (1)	0.0722 (1)
shadow_Medina-Schneider-MIMIC	0.6899** (3)	0.1684** (8)	0.1518 (3)	0.0991 (5)
shadow_Medina-Schneider-MIMIC <sup>2</sup>	0.6884** (3)	0.1696** (8)	0.1577 (3)	0.0727 (4)
shadow Elgin-MIMIC	0.6830** (3)	0.1729** (8)	0.0973 (3)	0.0972 (3)
shadow Elgin-MIMIC <sup>2</sup>	0.6829** (3)	0.1736** (8)	0.0969 (3)	0.0970 (3)
real GDP	0.9719*** (6)	0.2204*** (5)	0.2754 (2)	0.0496 (1)
tax burden	0.5592** (5)	0.1958** (5)	0.3127 (1)	0.0820 (8)
urbanisation	0.7690*** (6)	0.2642*** (4)	0.2976 (3)	0.0918 (3)

**Notes:** Asterisks \*\*\* and \*\* denote statistically significant at 1% and 5% level. The KPSS (Kwiatkowski et al., 1992). Unit root test procedure tests the null hypothesis of stationarity versus the alternative hypothesis of a unit root. The numbers in parentheses indicate the lag length in the KPSS procedures. All variables are in logarithm.

### Long-run model and cointegration tests

Following the confirmation that all variables are integrated of order one, I (1), we proceed to estimate both Equation (1) and Equation (2) and assess the existence of cointegration. The presence of cointegration would validate these equations as long-run models. Table 5 presents the regression results estimated using the OLS method bundled with robust standard errors to account for potential autocorrelation and heteroscedasticity. Model 1 represents the linear specification, whereas Model 2 reflects the nonlinear model that includes a squared term of the shadow economy. The table is divided into four parts: Part A utilizes the shadow economy estimates derived from Elgin-CGE; Part B uses the Habibullah-MCDR method; Part C applies the Medina-Schneider-MIMIC approach; and Part D employs the Elgin-MIMIC estimates.

The existence of cointegration is evaluated through the DF-statistics. In all four models across both linear and nonlinear specifications the DF-statistics are significant statistically at least at the 5% level indicating cointegration in each case, confirming that both Equation (1) and Equation (2) can be interpreted as valid long-run models for the Malaysian context.

**Table 5: Results using OLS-robust standard error**

Models	constant	shadow	shadow <sup>2</sup>	real GDP	tax burden	urbanisation
Part A: Shadow economy using Elgin-CGE						
Model 1	5.7782*** (11.8420)	-0.0983** (-2.3699)		-0.0645*** (-5.3085)	0.0141*** (3.9816)	0.0384*** (6.7699)
	R <sup>2</sup> =0.9966	DF=-4.0092***				
Model 2	5.3449*** (6.0056)	0.1474 (-0.0347)	-0.0347 (-0.5132)	-0.0643*** (-5.3117)	0.0133*** (3.3666)	0.0370*** (5.1908)
	R <sup>2</sup> =0.9966	DF=-3.8939***				
Part B: Shadow economy using Habibullah-MCDR						
Model 1	4.9833*** (17.450)	0.0056 (-0.1964)		-0.0480*** (-11.5278)	0.0236*** (3.1036)	0.0318*** (4.9635)
	R <sup>2</sup> =0.9916	DF=-2.0442**				
Model 2	4.7419*** (31.2779)	0.2806*** (3.4423)	-0.0387*** (-3.3305)	-0.0562*** (-8.1853)	0.0180** (2.4339)	0.0167* (1.9557)
	R <sup>2</sup> =0.9935	DF=-2.7543***	Optimal=37.5			
Part C: Shadow economy using Medina-Schneider-MIMIC						
Model 1	4.6261*** (18.5442)	0.0056 (0.2663)		-0.0361*** (-5.2487)	0.0131*** (3.7201)	0.0515*** (11.036)
	R <sup>2</sup> =0.9942	DF=-2.6361**				
Model 2	1.3453 (1.0807)	2.3803** (2.7918)	-0.3491** (-2.8031)	-0.0617*** (-5.8968)	0.0122*** (3.4708)	0.0232* (2.0333)
	R <sup>2</sup> =0.9964	DF=-3.9117***	Optimal=30.2			
Part D: Shadow economy using Elgin-MIMIC						
Model 1	5.1101*** (7.6535)	-0.0340 (-0.5736)		-0.0479** (-2.8268)	0.0115** (2.5420)	0.0416** (2.4610)
	R <sup>2</sup> =0.9949	DF=-2.4736**				
Model 2	2.1831 (0.3554)	1.7367 (0.4790)	-0.2582 (-0.4902)	-0.0516*** (-3.0640)	0.0112** (2.4301)	0.0379** (2.2140)
	R <sup>2</sup> =0.9950	DF=-2.1522**				

**Notes:** Asterisk \*\*\*, \*\* and \* denote statistically significant at 1%, 5% and 10% level, respectively. DF denotes Dickey-Fuller t-statistic for the testing of a unit root of the residuals of cointegrated regressions between income inequality and its regressors using the Engle-Granger two-step procedure. Figures in the brackets are t-statistics. All variables are in logarithm. The optimal point for the shadow economy is calculated as  $-\hat{\theta}_1/2\hat{\theta}_2$ .

Several notable findings are derived from the results presented in Table 5. First, within the linear model specification (Model 1), only the shadow economy estimates based on the Elgin-CGE approach is significant statistically at the 1% significance level and

exhibits a negative coefficient. This indicates that, during the study period, an increase in the size of the shadow economy is associated with a decline in income inequality in Malaysia. Second, in the nonlinear specification (Model 2), both the linear and squared terms of the shadow economy variable are statistically significant when using the Habibullah-MCDR and Medina-Schneider-MIMIC estimates. The coefficient signs—positive for the linear term ( $\theta_1$ ) and negative for the squared term ( $\theta_2$ ) confirm an inverted U-shaped association. This relationship suggests that income inequality initially worsens as the shadow economy expands, but once it surpasses a certain threshold, further increases lead to reductions in inequality. The calculated turning points for the shadow economy representing the level at which income inequality begins to decline are approximately 37.5% of GDP for the Habibullah-MCDR estimate and 30.2% for the Medina-Schneider-MIMIC estimate.

Third, all the control variables tax burden, real GDP, and urbanization growth are statistically significant at conventional levels (at least 10%). Real GDP is negatively associated with income inequality, indicating that greater economic output tends to reduce inequality. In contrast, both the urbanization growth and tax burden show positive correlations with income inequality, implying that these factors contribute to a widening income gap.

The models were re-estimated using robust regression techniques based on M-estimators, which are less sensitive to outliers. Table 6 presents these findings. The DF-statistics confirm cointegration across all model specifications. In Part A, the linear model using Elgin-CGE estimates again yields a statistically significant and negative coefficient for the shadow economy, reaffirming the earlier conclusion that informality, in this case, mitigates income inequality. However, in the linear models of Parts B through D, the shadow economy variable is not statistically significant.

**Table 6: Results using Robust (RLS) regression**

Models	constant	shadow	shadow <sup>2</sup>	real GDP	tax burden	urbanisation
Part A: Shadow economy using Elgin-CGE						
Model 1	6.2507*** (25.0324)	-0.1409*** (-6.4704)		-0.0760*** (-12.0276)	0.0113*** (3.0492)	0.0357*** (9.1041)
	R <sup>2</sup> =0.7659	DF=-4.3910***				
Model 2	4.9996*** (9.1804)	0.5313* (1.8548)	-0.0940** (-2.3272)	-0.0738*** (-14.1629)	0.0115*** (3.6205)	0.0321*** (8.7658)
	R <sup>2</sup> =0.7582	DF=-4.1191***	Optimal=16.8			
Part B: Shadow economy using Habibullah-MCDR						
Model 1	4.9660*** (32.1950)	-0.0005 (-0.0826)		-0.0475*** (-10.8827)	0.0241*** (3.0093)	0.0324*** (7.3622)
	R <sup>2</sup> =0.9048	DF=-2.0593**				
Model 2	4.7339*** (29.9814)	0.2845*** (3.0413)	-0.0392*** (-3.0595)	-0.0562*** (-11.9241)	0.0179** (2.4537)	0.0174*** (2.7532)
	R <sup>2</sup> =0.8829	DF=-2.7571***	Optimal=37.6			

Part C: Shadow economy using Medina-Schneider-MIMIC						
Model 1	4.5951***	0.0146		-0.0361***	0.0136**	0.0511***
	(18.3711)	(0.9230)		(-5.2120)	(2.1994)	(8.1015)
	R <sup>2</sup> =0.7998	DF=-2.5189**				
Model 2	1.3415	2.3564***	-0.3453***	-0.0603***	0.0124**	0.0244**
	(1.2908)	(3.2039)	(-3.1937)	(-6.0490)	(2.2997)	(2.3554)
	R <sup>2</sup> =0.8888	DF=-4.0442***	Optimal=30.3			
Part D: Shadow economy using Elgin-MIMIC						
Model 1	5.1389***	-0.0383		-0.0485***	0.0120*	0.0413***
	(9.3534)	(-0.7843)		(-3.5321)	(1.8215)	(3.0542)
	R <sup>2</sup> =0.8465	DF=-2.4473**				
Model 2	-0.1843	3.1223	-0.4593	-0.0524***	0.0122*	0.0372***
	(-0.0418)	(1.1779)	(-1.1884)	(-3.5938)	(1.8745)	(2.5813)
	R <sup>2</sup> =0.8517	DF=-1.6769*				

**Notes:** Asterisk \*\*\*, \*\* and \* denote statistically significant at 1%, 5% and 10% level, respectively. DF denotes Dickey-Fuller t-statistic for the testing of a unit root of the residuals of cointegrated regressions between income inequality and its regressors using the Engle-Granger two-step procedure. Figures in the brackets are z-statistics. All variables are in logarithm. The optimal point for the shadow economy is calculated as  $-\hat{\theta}_1/2\hat{\theta}_2$ .

On the contrary, the nonlinear results presented in Model 2 (Parts A, B, and C) show that both the linear and squared shadow economy terms remain significant, again displaying the expected signs positive for the linear term and negative for the quadratic term thus reinforcing the inverted U-shaped relationship. The turning points for the shadow economy associated with reduced income inequality are estimated at 16.8% of GDP for Elgin-CGE, 37.6% for Habibullah-MCDR, and 30.3% for Medina-Schneider-MIMIC. As before, all control variables remain statistically significant at the 10% level, with real GDP negatively correlated with inequality, while tax burden and urbanization exert positive effects.

Further robustness checks were conducted using the Fully Modified Ordinary Least Squares (FMOLS) technique to address potential small-sample bias and endogeneity concerns. Table 7 summarizes these results. In alignment with previous findings from both the OLS and robust regression models, the linear nexus between the shadow economy and income inequality in Part A (based on Elgin-CGE estimates) remains significantly negative. For the nonlinear specifications in Parts A, B, and C, both the shadow economy and its squared term are significant statistically at the 5% level, once again reflecting an inverted U-shaped curve. These outcomes reinforce the conclusion that the nexus between the size of the shadow economy and income inequality in Malaysia is nonlinear characterized by an initial rise in inequality, followed by a decline as informality continues to grow.

**Table 7: Results using FMOLS for the long-run model**

Models	constant	shadow	shadow <sup>2</sup>	real GDP	tax burden	urbanisation
Part A: Shadow economy using Elgin-CGE						
Model 1	6.0682*** (21.700)	-0.1221*** (-5.0253)		-0.0717*** (-10.043)	0.0109** (2.5248)	0.0375*** (7.9818)
	R <sup>2</sup> =0.9956					
Model 2	4.4199*** (6.5567)	0.7331** (2.0866)	-0.1205** (-2.4275)	-0.0667*** (-10.541)	0.0122*** (3.1218)	0.0346*** (7.7087)
	R <sup>2</sup> =0.9959		Optimal=20.9			
Part B: Shadow economy using Habibullah-MCDR						
Model 1	4.9139*** (21.810)	0.0007 (0.0777)		-0.0477*** (-7.4777)	0.0461*** (3.9398)	0.0284*** (4.4258)
	R <sup>2</sup> =0.9836					
Model 2	4.6421*** (28.956)	0.3276*** (3.4491)	-0.0450*** (-3.4565)	-0.0567*** (-11.854)	0.0300*** (4.0376)	0.0140*** (2.1784)
	R <sup>2</sup> =0.8829		Optimal=38.0			
Part C: Shadow economy using Medina-Schneider-MIMIC						
Model 1	4.3738*** (10.045)	0.0142 (0.6382)		-0.0288** (-2.2760)	0.0163* (1.8917)	0.0597*** (4.8611)
	R <sup>2</sup> =0.9936					
Model 2	-1.0686 (-1.0473)	3.9164*** (5.5059)	-0.5733*** (-5.4830)	-0.0689*** (-6.2876)	0.0115** (2.1475)	0.0148 (1.2983)
	R <sup>2</sup> =0.9953		Optimal=30.4			
Part D: Shadow economy using Elgin-MIMIC						
Model 1	5.2551*** (7.2121)	-0.0392 (-0.6254)		-0.0530*** (-2.8547)	0.0174* (2.0273)	0.0389** (2.1245)
	R <sup>2</sup> =0.9932					
Model 2	3.8655 (0.5178)	0.7988 (0.1810)	-0.1237 (-0.1923)	-0.0544** (-2.7628)	0.0236** (2.6692)	0.0358* (1.8369)
	R <sup>2</sup> =0.9919					

**Notes:** Asterisk \*\*\*, \*\* and \* denote statistically significant at 1%, 5% and 10% level, respectively. Figures in the brackets are t-statistics. All variables are in logarithm. The optimal point for the shadow economy is calculated as  $-\hat{\theta}_1/2\hat{\theta}_2$ . The prewhitening lag length=1.

### Further Analysis on Non-linear Effects of Other Independent Variables

Empirical literature suggests that the relationships between income inequality and factors such as economic growth, taxation, and urbanization may be inherently nonlinear. To investigate this hypothesis, we estimate a set of nonlinear models for each independent variable, formulated as follows:

$$inequality_t = \alpha_0 + \theta_1 shadow_{jt} + \theta_2 shadow_{jt}^2 + \beta_1 realGDP_t + \beta_2 realGDP_t^2 + \gamma_k X_{kt} + \varepsilon_t \quad (3)$$

$$inequality_t = \alpha_0 + \theta_1 shadow_{jt} + \theta_2 shadow_{jt}^2 + \delta_1 taxburden_t + \delta_2 taxburden_t^2 + \gamma_k X_{kt} + \mu_t \quad (4)$$

$$inequality_t = \alpha_0 + \theta_1 shadow_{jt} + \theta_2 shadow_{jt}^2 + \varphi_1 urbanisation_t + \varphi_2 urbanisation_t^2 + \gamma_k X_{kt} + \omega_t \quad (5)$$

A nonlinear association between income inequality and real GDP is confirmed when both coefficients  $\beta_1$  and  $\beta_2$  are statistically significant, with  $\beta_1 > 0$  and  $\beta_2 < 0$  indicating an inverted U-shaped curve, or  $\beta_1 < 0$  and  $\beta_2 > 0$  suggesting a U-shaped curve. Similarly, for tax burden,  $\delta_1 > 0$  and  $\delta_2 < 0$  represent an inverted U-shaped relationship, whereas  $\delta_1 < 0$  and  $\delta_1 > 0$  imply a U-shaped pattern. Regarding urbanization,  $\varphi_1 > 0$  and  $\varphi_2 < 0$  denote an inverted U-shape, while  $\varphi_1 < 0$  and  $\varphi_2 > 0$  suggest a U-shaped association.

The estimation results for the nonlinear impacts of real GDP, tax burden, and urbanization on income inequality are displayed in Table 8. Table 8 is structured into three parts: the first examines the nonlinear effect of real GDP, followed by the effect of tax burden, and lastly, the effect of urbanization.

**Table 8: Results of non-linear effects of real GDP, tax burden and urbanisation**

Models	constant	shadow	shadow <sup>2</sup>	real GDP	real GDP <sup>2</sup>	tax burden	urbanisation
Part A: non-linear real GDP							
(i) Elgin-CGE							
	-1.9695	-1.8174	0.2510	0.7186	-0.0143	0.0157***	0.0383***
	(-0.2055)	(-0.7312)	(0.6918)	(0.7171)	(-0.7840)	(3.2565)	(5.2582)
	R <sup>2</sup> =0.9959						
(ii) Habibullah-MCDR							
	7.8843***	0.2807***	-0.0388***	-0.2937*	0.004463	0.0177**	0.0256**
	(3.6052)	(3.0729)	(-3.0173)	(-1.7599)	(1.4106)	(2.7340)	(2.3686)
	R <sup>2</sup> =0.9959		Optimal=37.2				
(iii) Medina-Schneider-MIMIC							
	-2.1651	1.4470*	-0.2116	0.3056	-0.0066	0.0132***	0.0276**
	(-0.6053)	(1.7267)	(-1.6970)	(1.0217)	(-1.2250)	(3.4141)	(2.2199)
	R <sup>2</sup> =0.9957						
(iv) Elgin-MIMIC							
	4.2685	-5.5592	0.7991	0.7134	-0.0139	0.0148***	0.0401**
	(0.8015)	(-1.0825)	(1.0702)	(1.5138)	(-1.6291)	(3.4690)	(2.0281)
	R <sup>2</sup> =0.9945						
Models	constant	shadow	shadow <sup>2</sup>	real GDP	tax burden	tax burden <sup>2</sup>	urbanisation
Part B: non-linear tax burden							
(i) Elgin-CGE							
	3.7764***	1.6842**	-0.2571***	-0.0744***	-0.5464***	0.1004***	0.0204***
	(3.8463)	(2.5935)	(-2.8067)	(-10.448)	(-3.0417)	(3.1124)	(3.9272)
	R <sup>2</sup> =0.9970		Optimal=26.5			Minimal=1.2 1	

(ii) Habibullah-MCDR							
	5.2180***	0.2245**	-0.0312**	-0.0545***	-0.2871**	0.0541**	0.0231**
	(23.238)	(2.1554)	(-2.1477)	(-8.0533)	(-2.4230)	(2.5169)	(2.4566)
	R <sup>2</sup> =0.9932		Optimal=36.5			Minimal=1.21	
(iii) Medina-Schneider-MIMIC							
	1.1819	2.6318***	-0.3862***	-0.0649***	-0.1063	0.0212	0.0194
	(0.9411)	(2.9288)	(-2.9328)	(-5.5385)	(-0.4717)	(0.5256)	(1.5317)
	R <sup>2</sup> =0.9953		Optimal=30.2				
(iv) Elgin-MIMIC							
	-6.9042	7.7291**	-1.1286**	-0.0697***	-0.4851*	0.0889**	0.0169
	(-1.0920)	(2.0315)	(-2.0553)	(-8.2975)	(-1.9967)	(2.0570)	(1.6788)
	R <sup>2</sup> =0.9944		Optimal=30.7			Minimal=1.22	
Models	constant	shadow	shadow <sup>2</sup>	real GDP	tax burden	urbanisation	urbanisation <sup>2</sup>
Part C: non-linear urbanisation							
(i) Elgin-CGE							
	5.9660	-0.3102	0.0319	-0.0602***	0.0164***	0.0795	-0.0099
	(6.0879)	(-0.4833)	(0.3417)	(-4.6899)	(3.1707)	(1.5484)	(-0.8525)
	R <sup>2</sup> =0.9959						
(ii) Habibullah-MCDR							
	4.6139***	0.2517***	-0.0342***	-0.0530***	0.0216***	0.0984***	-0.0209**
	(36.022)	(3.2857)	(-3.1785)	-8.5613	(2.8262)	(2.7617)	(-2.2673)
	R <sup>2</sup> =0.9931		Optimal=39.6				Optimal=10.5
(iii) Medina-Schneider-MIMIC							
	2.0106**	1.8485**	-0.2710**	-0.0553***	0.0157***	0.0761**	-0.0121
	(2.2197)	(2.6543)	(-2.6256)	(-4.5965)	(3.6652)	(2.0333)	(-1.4482)
	R <sup>2</sup> =0.9959		Optimal=30.3				
(iv) Elgin-MIMIC							
	6.9687	-1.0674	0.1457	-0.0512***	0.0158***	0.0996*	-0.0160
	(1.0975)	(-0.2828)	(0.2654)	(-2.7248)	(3.4742)	(1.9649)	(-1.3924)
	R <sup>2</sup> =0.9942						

**Notes:** Asterisk \*\*\*, \*\* and \* denote statistically significant at 1%, 5% and 10% level, respectively. Figures in the brackets are t-statistics. All variables are in logarithm. All regressions were estimated using OLS with robust standard error due to Newey-West procedure. The optimal/minimal point is calculated as  $-\hat{\theta}_1/2\hat{\theta}_2$  for shadow economy;  $-\hat{\delta}_1/2\hat{\delta}_2$  for tax burden; and  $-\hat{\varphi}_1/2\hat{\varphi}_2$  for urbanization.

In the case of real GDP, the only statistically significant model is based on the shadow economy measure derived from Habibullah-MCDR. In this specification, all estimated parameters are significant at least at the 10% level. The shadow economy follows an inverted U-shaped nexus with income inequality, with the turning point estimated at 37.2% of GDP. Real GDP appears to affect income inequality in a linear fashion, as only the linear term is significant statistically, while the squared term is not. Meanwhile,

both tax burden and urbanization are found to have a positive effect on income inequality.

Turning to the nonlinear effect of tax burden, [Table 8](#) shows that across all four specifications, nearly all variables are significant statistically at the 10% level, with the exception of tax burden and its squared term in the Medina-Schneider-MIMIC model, and urbanization in the Medina-Schneider-MIMIC and Elgin-MIMIC models. In all models, the shadow economy exhibits a nonlinear influence on income inequality, with turning points at 26.5%, 36.5%, 30.2%, and 30.7% of GDP for the Elgin-CGE, Habibullah-MCDR, Medina-Schneider-MIMIC, and Elgin-MIMIC measures, respectively. Real GDP continues to demonstrate a negative association with income inequality, while urbanization consistently shows a positive relationship. Regarding the tax burden, a U-shaped pattern is indicated by the significance of both linear and squared terms, with a negative coefficient on the linear term and a positive coefficient on the squared term. This implies that initially, increases in tax burden are associated with a decrease in income inequality, but beyond a certain threshold, further increases contribute to greater inequality.

Finally, the nonlinear nexus between urbanization and income inequality is assessed. The only model exhibiting a nonlinear effect of urbanization is the one utilizing the shadow economy estimate by Habibullah-MCDR. In this case, all regressors are statistically significant at the 5% level. Both shadow economy and urbanization are associated with an inverted U-shaped curve with respect to income inequality. The optimal urbanization rate (as a share of total population) is 10.5%. At lower levels of urbanization growth, income inequality tends to increase; however, once urbanization surpasses this threshold, additional growth contributes to a reduction in inequality. In contrast, the models based on Medina-Schneider-MIMIC and Elgin-MIMIC estimates suggest a linear impact of urbanization on income inequality. As for the other control variables, real GDP generally shows a negative effect, whereas tax burden tends to increase income inequality.

## CONCLUSION

This study contributes to the body of knowledge by examining the effect of the shadow economy on income inequality for Malaysia, a developing nation employing annual data spanning from 1980 to 2018. A unique feature of this paper lies in the use of four alternative estimates of the shadow economy: (i) the MIMIC-based estimate by [Medina and Schneider \(2019\)](#); (ii) two estimates from [Elgin and Elveren \(2019\)](#) derived from (a) the MIMIC approach and (b) the Computable General Equilibrium (CGE) model; and (iii) the Modified-Cash-Deposit-Ratio (MCDR) estimate by Habibullah et al. (2016). The analysis also incorporates macroeconomic control variables: tax burden, real GDP, and urbanization growth.

To assess the relationships, we employed three econometric techniques: OLS bundled with robust standard errors, Robust Least Squares (RLS) using the M-estimator, and the Fully Modified OLS (FMOLS) estimator. The analysis considered both linear as well as nonlinear effects of the shadow economy, as well as of the other variables albeit, macroeconomic variables, on income inequality.

The empirical findings consistently support the existence of a nonlinear, inverted U-shaped nexus between the size of the shadow economy and income inequality in Malaysia, consistent with the inequality-shadow economy Kuznets hypothesis. This pattern suggests that income inequality initially rises with the expansion of the shadow economy, but after reaching a certain threshold, further increases in the shadow economy size led to reductions in inequality. Regarding macroeconomic variables, the results reveal that rising levels of economic development (real GDP) are associated with lower income inequality, whereas increases in tax burden and urbanization are linked to wider income disparities. Furthermore, the study uncovers nonlinear effects of both tax burden and urbanization: tax burden demonstrates a U-shaped relationship with inequality, while urbanization shows an inverted U-shaped curve.

From a policy perspective, the results imply that effective strategies to address income inequality must consider the dynamics of the shadow economy. While the shadow economy may offer employment and entrepreneurial opportunities that help reduce income disparities, especially among low-income groups, its unchecked expansion can eventually exacerbate inequality. This aligns with previous findings, such as the N-shaped pattern suggested by [Yap et al. \(2018\)](#) and the S-shaped relationship observed by [Yau and Tan \(2022\)](#). Hence, in the long term, managing and ultimately mitigating the size of the shadow economy should remain a key objective for policymakers. This is especially critical given the association of large shadow economies with illicit and harmful activities, including corruption, tax evasion, smuggling, human trafficking, terrorism, and other forms of organized crime that pose threats to national governance and stability.

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