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Investigating the effect of the shadow economy on Malaysia's economic growth: Insight from a nonlinear perspective

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ABSTRACT

Utilizing a nonlinear autoregressive distributed lag (NARDL) model, the goal of this study is to find out if the shadow economy's (SE) effect on Malaysia's economic growth is not linear from 1970 to 2022. This model uniquely identifies potential nonlinearities or asymmetries in the relationship between SE and growth. The results of the bounds tests show that there is a strong long-term link between economic growth and both good and bad changes in the SE, as well as variables like inflation, urban population growth in cities, financial development, and economic uncertainty. Furthermore, the results indicate that the SE's influence on growth is nonlinear, both in the short and long term. In particular, both growing and shrinking the SE have positive effects on growth, but growing the SE has a bigger long-term effect than shrinking it. Conversely, in the short term, reductions in the SE's size have a greater impact. Additionally, inflation, urban population growth, financial development, and economic uncertainties emerge as key determinants of growth across both time horizons. These findings suggest the need for policies that reduce the size of the shadow economy and encourage the shift from informal to formal economic activities to foster sustained economic growth.

Contribution/ Originality: The nonlinear autoregressive distributed lag (NARDL) method is used in this study to look at the uneven dynamics between Malaysia's shadow economy and formal economic growth in a new way. It stimulates renewed dialogue on the implications of shadow economies and also offers valuable insights for policymakers and researchers in Malaysia and across Southeast Asia.

1. INTRODUCTION

The increasing interest in understanding the dimensions and development of the shadow economy[1] (SE) is driven by its widespread presence across countries, though to varying extents. Recent estimates indicate that the SE's size, relative to gross domestic product (GDP), differs substantially between countries with varying levels of development.

[1] In this study, the term "shadow economy"—also referred to as the underground economy, informal economy, illegal economy, or black economy—encompasses transactions and production that are underdeclared, undeclared, under-registered, or unmeasured to deliberately evade taxes, safety regulations, minimum wage laws, maximum working hours, social security obligations, administrative processes, and legal labor standards (Gamal et al., 2024; Sakanko, David, Abu, & Gamal, 2024). This definition further includes unlawful activities linked to crime and corruption, along with lawful but non-market activities.

For example, Medina and Schneider (2019) estimate that the size of the global SE is around 40 percent of the official GDP in developing and transition economies, compared to less than 20 percent in high-income countries of the Organization for Economic Co-operation and Development (OECD). Evidence suggests that the SE is more prominent in low-income countries, where it constitutes over 70 percent of total employment and around one-third of national output (Elgin, Kose, Ohnsorge, & Yu, 2021; Medina & Schneider, 2019). In certain Sub-Saharan African countries, the shadow economy represents more than 90 percent of total employment and as much as 62 percent of official GDP (ILO, 2018; World Bank, 2019).

Because the shadow economy is so common around the world, researchers are looking into what makes it work. But it's still not clear how the growth of the formal economy affects the size of the shadow economy (Sakanko et al., 2024; Saunoris, 2018). Theoretically, the shadow economy could either promote or hinder growth in the official economy, depending on its relative costs and benefits. Some people say that the shadow economy slows down economic growth because it causes problems for the real economy, like less tax money coming in, unfair competition, wrong use of resources, and skewed government data (Feige, 1989; Nguyen & Duong, 2021; Sakanko et al., 2024; Saunoris, 2018). Conversely, the shadow sector is viewed as an efficient, competitive, and productive part of the economy that complements the formal sector and promotes growth (Saunoris, 2018). Moreover, it is suggested that the SE alleviates social pressure on the state by generating employment and creating profit opportunities and also serves as a buffer against economic volatility (Choi & Thum, 2005; Ishak & Farzanegan, 2022; Sakanko et al., 2024).

While numerous studies have addressed these theoretical ambiguities, the nature of the association between the growth of the formal economy and SE remains inconclusive. Both perspectives have received substantial empirical validation across different countries and regions (e.g., (Baklouti & Boujelbene, 2020a, 2020b; Camara, 2022; Goel, Saunoris, & Schneider, 2019; Hoinaru, Buda, Borlea, Văidean, & Achim, 2020; Nguyen & Duong, 2021; Nguyen, Bui, Thai, Nguyen, & Nguyen, 2022; Saunoris, 2018; Schneider & Hametner, 2014; Younas, Qureshi, & Al-Faryan, 2022; Zaman & Goschin, 2015)). However, most of the studies that have been done so far only look at a symmetrical relationship between the SE and the economy's performance, missing the chance of asymmetric dynamics. The possibility that there is a connection between the growth of the formal economy and the size of the SE has gained support, especially when considering time-specific interactions. For example, Goel et al. (2019) demonstrated that in the United States, the shadow economy slowed economic growth during the pre-World War II period (1870–1938) but contributed to growth in the post-World War II period (1946–2014). This reflects the potential variability in the shadow economy's influence over time. Also, reducing the shadow economy doesn't always lead to better formal growth. This is because informal businesses may find it hard to adapt to the higher standards of productivity expected in the formal sector, and formal firms may have trouble meeting the market needs that were previously met by people in the shadow economy.

In Malaysia, the interplay between the SE and the performance of the formal economy has shown unique patterns. Although studies have highlighted both positive and adverse consequences of the SE, Malaysia's SE has often mirrored the formal economy's growth trends (Gamal et al., 2024; Gamal, Rambeli, Jalil, & Viswanathan, 2019). Consequently, reductions in the shadow economy may yield unconventional outcomes. For instance, while reductions are generally anticipated to either boost or hinder formal growth depending on the context, their effects can sometimes resemble those of an increase in the shadow economy, albeit with lower intensity, or they may even produce adverse outcomes during certain periods.

Against this background, the study seeks to investigate whether the shadow economy's impact on formal economic growth in Malaysia exhibits asymmetry. This research makes a significant contribution to the literature by addressing several critical gaps. First, it is among the first to specifically analyze the shadow economy's influence on Malaysia's formal economy, a context that has seen considerable shifts in the shadow economy's scale and nature. Previous research has primarily emphasized a linear relationship (e.g., (Gamal et al., 2022; Hoinaru et al., 2020; Nguyen et al., 2022; Nguyen & Luong, 2020)). However, empirical studies exploring asymmetric relationships remain scarce for Malaysia and other regions. Second, researchers use the nonlinear autoregressive distributed lag (NARDL) method to identify potential imbalances in the relationship. This approach is based on the well-known ARDL bounds-testing method and is a good way to understand effects that aren't linear or even in the short and long term (Abu, Abd Karim, et al., 2022; Gamal et al., 2024). Finally, by employing this rigorous method, the study provides valuable insights for policymakers and researchers, contributing to a better understanding of the SE in Malaysia and other Southeast Asian economies. The findings aim to encourage policies that support the transition from informal to formal economic activities.

The paper is arranged as follows: the next section reviews relevant literature, the third section outlines the methods, the fourth section presents and discusses the findings, and the study is concluded in the fifth section.

2. LITERATURE REVIEW

Over the years, a wealth of research has investigated the interplay between the SE and the performance of the economy, employing both country-level and group-level analyses. While many studies have explored this relationship through a linear lens, the findings often differ, reflecting the complexity and variability of the phenomenon. A number of studies report an adverse connection between the SE and performance of the economy. For instance, Schneider and Hametner (2014) used ordinary least squares (OLS) estimators to look at data from 1980 to 2012 in Colombia and found that an increase in the SE happened at the same time as slower economic growth. This result supports the notion that shadow economies can erode tax revenues, thereby restricting public investment in critical infrastructure and social services needed for sustained development. Nevertheless, the focus on Colombia limits the applicability of these findings to other nations, given the diverse institutional frameworks, economic policies, and enforcement practices worldwide.

Similarly, Borlea, Achim, and Miron (2017) studied the connection between the growth of the economy and the size of SE in 28 EU countries, concluding that shadow economy expansion significantly hinders growth within this region. Although their findings align with Schneider and Hametner (2014) results, the broader regional focus highlights the consistent adverse implication of the development of the shadow economy in developed economies with strong regulatory frameworks and established fiscal systems. However, these results may not apply to less developed countries, where informal activities play a more central role in livelihood and social stability, and economies are less formalized. Further comparative studies focusing on specific regions, including Asia, ECOWAS, OECD, and MENA, have likewise underscored the adverse influence of shadow economies on growth (e.g., (Baklouti & Boujelbene, 2020a; Camara, 2022; Hoinaru et al., 2020; Nguyen et al., 2022; Nguyen & Luong, 2020; Younas et al., 2022)). However, these studies primarily rely on panel data estimations, which may overlook country-specific nuances and potentially obscure the distinct implication of the development of the shadow economy on the economy across different institutional and socioeconomic settings.

Contrastingly, some studies suggest that shadow economies can foster economic growth, particularly in developing countries with limited formal employment opportunities. Schneider and Hametner (2007) for example, found a proportional link between the growth of the formal economy and the size of SE in Colombia from 1976 to 2002. They said this because informal activities bring in money and boost demand in formal sectors that aren't doing well yet. Similarly, Zaman and Goschin (2015) using an autoregressive (AR (1)) approach, reached similar conclusions for Romania, where shadow economy expansion from 1999 to 2012 was associated with economic growth. These studies suggest that informal economic activity can serve as a “safety net” during economic transitions. But both studies are mostly about economies that are changing. In these types of economies, people may have to work in the shadow economy because of inefficient institutions and rigidities in the formal sector. This makes the shadow economy a temporary stabilizer. This "positive" view may not extend to more developed or regulated economies, where the benefits may diminish as formal employment becomes more accessible or policies actively support marginalized groups.

Broadening the scope, Saunoris (2018) applied instrumental variables (IV) and two-stage least squares (2SLS) estimators to examine 108 countries, discovering a positive long-term connection between the growth of the economy and SE in both developed and developing regions. While these findings highlight overarching trends, inconsistencies in data and methods of measuring informal sectors raise questions about their robustness. Similarly, Nguyen and Duong (2021) employing Bayesian linear regression models, observed that the relationship between growth of the economy and the size of SE is proportionate in BRICS nations (Brazil, Russia, India, China, and South Africa) from 1991 to 2017. Even though Bayesian methods are reliable, the results may be affected by what people already think, especially in places where illegal activities are very important for making money and creating jobs. These studies show that the shadow economy's effect on growth depends on things like the quality of regulations, the flexibility of the labor market, and the level of social protection, all of which are very different from one place to another.

Temporal factors also shape the direction of connection between the growth of the economy and SE. For instance, Goel, Saunoris (2018) employed autoregressive distributed lag (ARDL) bounds-testing, IV, and generalized method of moments (GMM) techniques to analyse U.S. data from 1870 to 2015. Their study revealed that the shadow economy impeded growth during the pre-World War II period (1870–1938) but supported it in the post-WWII era (1946–2014). This divergence may reflect changes in the economic environment, with the shadow economy serving as a buffer during economic transitions. The change also suggests that as the U.S. formal economy grew older, the shadow economy changed too, possibly working together with the formal sector to make it stronger. Such temporal variation underscores the importance of exploring whether similar dynamics exist in other countries, such as Malaysia, particularly across extended periods of structural change and economic transformation.

Despite the breadth of research, most studies assume a straightforward linear connection between the shadow economy and growth, often neglecting non-linear or asymmetric influences. Given the mixed findings, the shadow economy's impact on growth may vary depending on economic and social contexts. For example, in contexts where the shadow economy hinders growth, policymakers might assume that reducing its size would benefit the formal economy. However, without adequate social and economic support, reducing the shadow economy could exacerbate poverty and unemployment and worsen social conditions. To fully grasp the complicated link between the shadow economy and growth, we need to look at possible imbalances or non-linear dynamics, especially in places like Malaysia where the shadow economy has persisted. This study seeks to address this gap by analyzing whether the shadow economy's influence on Malaysia's growth trajectory from 1970 to 2022 follows a non-linear path. This is different from previous research that mostly assumed a linear relationship and didn't look at how the shadow economy might affect growth in different economic stages and social settings in a more complex, possibly asymmetric way.

3. RESEARCH METHODOLOGY

Building on previous studies that explored the linear connection between the growth of the economy and the size of the SE (e.g., (Gamal et al., 2022; Goel et al., 2019; Nguyen et al., 2022; Schneider & Hametner, 2014)), this study specifies an econometric model to illustrate a nonlinear relationship between growth and the negative and positive adjustments in the size of the SE, as follows:

$$rgdp_t = \alpha_0 + \omega_1 se_t^+ + \omega_2 se_t^- + \varphi' Z_t + \mu_t \quad (1)$$

where $t = 1,2, \dots, T$ denotes time. $rgdp$ represents real GDP, a measure of economic growth. se^+ and se^+ indicate the negative and positive adjustment in the size of SE (expressed relative to the nominal GDP), respectively[2]. Z represents vector of control variables (urban population growth, financial development, inflation rate, and monetary uncertainty). The choice of these variables as controls is determined by existing empirical studies on the shadow economy (see, for example, (Aanak Impin & Kok, 2021; Akalpler & Duhok, 2018; Choong & Lim, 2009; Nguyen &

[2] The process of decomposing or generating the negative and positive components of the SE is presented in Equations 4 and 5 in sub-section 3.1.

Nguyen, 2018; Wen, Khalid, Mahmood, & Yang, 2022; Zhang, 2003)). α_0 is the intercept, and ω_i and φ are the parameters of the explanatory variables. μ_t is the residual. Real GDP is log-transformed to address skewness.

3.1. NARDL Estimation Technique

Shin, Yu, and Greenwood-Nimmo (2014) came up with the NARDL bounds-testing method, which is used in this study to look at how the SE affects the growth of the economy in a way that isn't linear. This method builds upon the well-known (Pesaran, Shin, & Smith, 2001) ARDL bounds-testing framework, incorporating asymmetry. The selection of this approach is based on several factors. First, the NARDL bounds-testing method is a good way to find nonlinearity or asymmetry in the link between the shadow economy and economic growth (Abu, et al., 2022; Abu, David, Sakanko, & Amaechi, 2022; David, Sakanko, & Obilikwu, 2020; Gamal et al., 2024). The nonlinear ARDL approach is easy to understand and can capture asymmetric transitions between short- and long-term effects. It also has the benefits of the ARDL technique, such as being able to handle cointegration in small samples regardless of the integration order of the series.

Typically, a bivariate NARDL(p, q) model is represented as:

$$y_t = c + \beta^+ x_t^+ + \beta^- x_t^- + \chi' Z + \upsilon_t \qquad (2)$$

β^+ and β^- represent the coefficients of the partial sums of x_t, the asymmetric variable. Z denotes the vector of the explanatory variables that are included in the model symmetrically, and υ_t is the residual.

x_t denote a $k \times 1$ vector of predictors defined as:

$$x = x_0 + x_t^+ + x_t^- \qquad (3)$$

x_t^+ and x_t^- represent the partial sum process of the negative and positive adjustments in x_t. They are generated by computing:

$$x_t^+ = \sum_{i=1}^{t} \Delta x_i^+ = \sum_{i=1}^{t} \max(\Delta x_i, 0) \qquad (4)$$

$$x_t^- = \sum_{i=1}^{t} \Delta x_i^- = \sum_{i=1}^{t} \min(\Delta x_i, 0) \qquad (5)$$

In line with Shin et al. (2014) Equation 2 is re-written as an unrestricted $NARDL(p,q)$ model to illustrate an asymmetric relationship between series x_i and y_i and expressed as:

$$y_t = c + \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \gamma' Z + \sum_{i=1}^{p-1} \delta_i \Delta y_{t-i} + \sum_{i=0}^{q} (\pi_i^+ \Delta x_{t-i}^+ + \pi_i^- \Delta x_{t-i}^- + \vartheta' \Delta Z_{t-1}) + \upsilon_t \qquad (6)$$

Δ is the first difference operator, with $\theta^+ = -\rho\beta^+$, and $\theta^- = -\rho\beta^-$. ρ is the coefficient of the one-period lagged dependent variable. π_i^+ and π_i^- correspond to the short-run coefficient in the model. γ is the vector of the lagged regressors included symmetrically, while ϑ represents the coefficient of the differenced symmetric regressors. The optimal lag lengths (p, q) are determined using the Akaike Information Criterion (AIC).

In accordance with the NARDL framework proposed by Shin et al. (2014) the nonlinear cointegrating relationship between y_t and x_t is assessed using the well-established bounds-testing procedure outlined by Pesaran et al. (2001). To test for the presence of a cointegrating relationship between y_t and x_t, the null hypothesis of no cointegration $(H_0: \rho = \theta^+ = \theta^- = \gamma = 0)$ is contrasted with the alternative hypothesis $(H_1: \rho \neq \theta^+ \neq \theta^- \neq \gamma \neq 0)$, which posits the existence of cointegration. By setting the upper critical bound for the F-statistic from the standard Wald test higher than what Pesaran et al. (2001) say should happen, the null hypothesis is rejected. This proves that the two sets are indeed connected. If the F-statistic falls between the upper and lower bounds, the results are considered inconclusive. Once cointegration is established, both short-run and long-run relationships can be estimated. Additionally, the standard Wald test is employed to examine symmetry in both the short and long run. Long-run asymmetry is tested using $-\theta^+/\rho = -\theta^-/\rho$, while short-run asymmetry is assessed with the null hypothesis $\sum_{i=0}^{q} \pi_i^+ = \sum_{i=0}^{q} \pi_i^-$.

3.2. Data

This study relies on annual time series data spanning 1970 to 2022. The selected timeframe reflects data availability and incorporates major economic events in Malaysia's history, such as the Asian financial crisis, the global economic recession, and the COVID-19 pandemic, among others. These events triggered notable changes in both the formal and shadow economies. These are the numbers from the World Development Indicators (WDI) for real GDP, inflation rate, financial development (shown by the ratio of credit to the private sector to GDP), and urban population growth (shown by the annual growth rate of the urban population). Data on the shadow economy (SE) was obtained from Gamal et al. (2024). Bahmani-Oskooee, Kutan, and Xi (2013) explained the generalized autoregressive conditional heteroscedasticity (GARCH) method, which we also used to measure economic and monetary uncertainty.

4. RESULTS AND DISCUSSION

4.1. Preliminary Data Analysis

Before examining the asymmetric effects of the SE on the growth of the Malaysian economy, descriptive statistics, correlation analysis, and the stationarity properties of the variables were computed. Table 1 presents the summary statistics and correlation analysis results. During the period from 1970 to 2022, Malaysia's average real GDP was RM573, 882.11 billion (equivalent to US$131,023.31 billion), with a range from RM73, 752.09 billion (US$16,838.38 billion) to RM1, 510,940.00 trillion (US$344,963.47 billion). The standard deviation indicates that the distribution of real GDP is not normal. Additionally, the mean size of the SE as a percentage of GDP is 24.22 percent, fluctuating between 22.44 percent and 25.74 percent. The low standard deviation reflects that the shadow economy's size has remained relatively stable over time. Other averages during this period include an inflation rate of 3.32 percent, financial development (measured as credit to the private sector as a percentage of GDP) at 93.77 percent, urban population growth at 3.94 percent, economic uncertainty at 0.0009, and monetary uncertainty at 0.0085. However, the standard deviations reveal considerable variability in inflation, urban population growth, financial development, economic uncertainty, and monetary uncertainty over time.

The correlation analysis shows a strong, positive, and statistically significant relationship between real GDP and both the shadow economy (r=0.9958) and financial development (r=0.8436), significant at the 1 percent level. On the other hand, urban population growth has a strong, negative, and statistically significant correlation with real GDP (r=−0.7973) at the 1 percent level, while inflation exhibits a moderate, negative correlation with real GDP (r=−0.4251). Additionally, economic uncertainty (r=0.2249) and monetary uncertainty (r=−0.0908) have weak and statistically insignificant correlations with real GDP.

Table 1. Descriptive statistics and correlation matrix.

	$rgdp$	se	π	fd	urb	eu	mu
Mean	574	24.2	3.32	93.8	3.94	0.001	0.009
SD	436	0.985	2.87	38.219	1.07	0.001	0.033
Min.	74.1	22.4	-1.14	21.3	1.74	0.000	0.000
Max.	1,51	25.7	17.4	159	5.25	0.004	0.221
se	0.996***	1.000					
π	-0.425***	-0.397***	1.000				
fd	0.844***	0.826***	-0.451***	1.000			
urb	-0.797***	-0.811***	0.328**	-0.423**	1.000		
eu	-0.225*	-0.245*	0.016	-0.190	0.106	1.000	
mu	-0.091	-0.077	0.095	-0.092	0.173	-0.102	1.000

Note: Asterisks (***), (**) and (*) denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variables are defined as follows: $rgdp$ represents real GDP; se refers to the shadow economy (% GDP); π\pi$\pi$ denotes the inflation rate (%); fd is credit to the private sector as a percentage of GDP; urb indicates the urban population growth rate; eu represents economic uncertainty; and mu corresponds to monetary uncertainty.

To evaluate the unit root properties of the variables, the Phillips-Perron (PP), Augmented Dickey-Fuller (ADF), and Zivot-Andrews (ZA) tests were conducted. The results, displayed in Table 2, indicate that real GDP, the shadow economy, financial development, and urban population growth achieve stationarity after first differencing, suggesting these variables are integrated in order I(1) at the 1 percent significance level. In contrast, all three tests strongly reject the null hypothesis of non-stationarity for the inflation rate at the 1 percent significance level. However, the results for economic and monetary uncertainty are inconsistent. The ADF and PP tests show that economic and monetary uncertainty stay the same at the 5% significance level. However, the ZA test shows that these variables only stay the same after being differentiated once, also at the 5% significance level. Despite the discrepancies in the integration order for economic and monetary uncertainty, the overall results point to a mix of stationary and non-stationary variables, thus justifying the use of the NARDL bounds-testing approach, which accommodates variables with varying integration orders.

Table 2. Results of unit root tests.

		$lrgdp$	se	π	fd	urb	eu	mu
ADF	Level	-2.82*	-0.97	-4.25***	-1.88	1.25	-6.05***	-3.44**
	1st diff.	-5.78***	-7.99***	–	-5.80***	-5.83***	–	–
PP	Level	-2.82*	-1.12	-4.34***	-1.87	1.08	-6.01***	-6.78***
	1st diff.	-5.78***	-8.10***	–	-5.79***	-5.83***	–	–
ZA	Level	-3.04	-3.86	-5.40***	-3.65	-2.79	-4.34	-4.39
	T_b	1988	1998	1983	1991	1985	1993	1991
	1st diff.	-6.81***	-8.23***	–	-4.53***	-7.11***	-4.90*	-16.1***
	T_b	1998	1998	–	1999	1995	1985	1992

Note: $I(d)$ denotes the order of integration of variables, while T_b indicates the structural break date. Asterisks (***), (**) and (*) signify significance levels of 1%, 5%, and 10%, respectively. The ADF test refers to the augmented Dickey and Fuller (1979) PP corresponds to the Phillips-Perron test, and ZA represents the Zivot and Andrews (2002) which accounts for a single structural break. The PP and ADF test exams the null of non-stationarity against stationarity. Conversely, the ZA test evaluates the 'null hypothesis of a unit root against' a trend-stationary process with a structural break occurring at an unknown point. The ZA test (Model A) focuses on shifts in the level or intercept. The optimal lag-length for the ADF and ZA tests is determined by SIC as proposed by Schwarz (1978) with a maximum lag of 6. The PP test employs the Bartlett kernel spectral estimation method, with the bandwidth automatically determined using the Newey-West procedure. MacKinnon (1996) critical values for the PP and ADF tests (Constant only) are -3.560, -2.918, and -2.597 at the 1%, 5%, and 10% levels, respectively. For the ZA test with a structural level shift, the critical values are -5.34 (1%), -4.93 (5%), and -4.58 (10%).

4.2. NARDL Bounds-Testing Cointegration Test

The NARDL bounds-testing method is used to check if there is a nonlinear cointegrating link between the SE and Malaysia's economic growth. The bounds-testing results based on a lag length of (1, 2, 3, 3, 3, 3, 3), as determined by the AIC, are shown in Table 3. The results show that the F-statistic value of 7.104 is higher than the upper critical bound of 4.73 at the 1% significance level. This enables the rejection of the null hypothesis, which suggests no cointegrating relationship between the variables. So, we can say that there is a strong asymmetric cointegrating link between Malaysia's economic growth and the size of SE. This link includes inflation, financial development, urban population growth, economic uncertainty, and monetary uncertainty.

Table 3. The bounds-testing result.

Model	Lag length		F-statistic
$lrgdp = f(se^+, se^-, \pi, fd, urb, eu, mu)$	1,2,3,3,3,3,3		7.104***
	$K = 7$		$N = 49$
Critical values	10%	5%	1%
I(0)	2.099	2.46	3.28
I(1)	3.181	3.65	4.73

Note: K refers to the number of regressors variables, while N indicates the size of the sample. *** is significance at the 1% level. This is according to Pesaran et al. (2001) critical values. The appropriate lag-size is selected using the AIC.

4.3. Estimation Result and Discussion

Because the variables have a long-term cointegrating relationship, the AIC recommended that the best lag length be (1, 2, 3, 3, 3, 3, and 3). This was used to estimate both the long-run and short-run NARDL models. The long-run and short-run estimates, along with the results of the post-estimation diagnostic tests for autocorrelation, heteroscedasticity, normality, and stability, are presented in panels A, B, and C of Table 4. Furthermore, following the approach of Shin et al. (2014) the tests for long- and short-run symmetry relationships, conducted via the Wald test, are reported in panel B of Table 4. The test statistics for short-run (W_{SR}) and long-run (W_{LR}) symmetry test indicate that the null hypothesis of symmetry between the negative and positive components of the shadow economy is rejected at the 10% and 5% significance levels, respectively. These results imply that the effects of the positive and negative components of the shadow economy on Malaysia's economic growth differ significantly in both the short and long run.

In Table 4, the long-run (panel A) and short-run (panel B) estimation results show that changes in the SE, whether positive or negative, have a big effect on the economy's performance at the 1% significance level, both in the short and long term. Precisely, a 1% increase in the negative and positive components of the SE results in a long-term growth increase of 0.284 and 0.445 percentage points, respectively. Similarly, a 1% change in the size of the SE, whether positive or negative, generates an immediate short-term positive impact on economic growth of 0.088 and 0.197 percentage points, respectively. These results show that both increases and decreases in the shadow economy's size have positive consequences for the short-term and long-term growth of the economy. However, the magnitude of these effects differs significantly between the negative and positive mechanisms. For example, the short-term effect of negative changes in the shadow economy is greater than that of positive changes, while the long-term effect of positive changes is notably larger than the effect of negative changes.

These findings are consistent with previous empirical studies on the connection between the SE and the growth of the economy in emerging economies, including Malaysia, which have found that the shadow economy significantly contributes to the 'short-term and long-term' growth of the formal economy (e.g., (Gamal et al., 2022; Nguyen & Duong, 2021; Saunoris, 2018)). In the past, researchers have mostly looked at this relationship as a straight line. However, these results show that the growth of the SE generally helps the growth and development of the economy across both time horizons, even though the positive and negative effects are not always as strong. This indicates that the emergence of the shadow economy may not be inherently harmful to economic growth and could, in fact, promote it. Considering that the shadow economy has represented around one-third of Malaysia's GDP between 1970 and 2022, this finding is perhaps not surprising. The positive impact of the shadow economy may arise from its roles in job creation, poverty alleviation, reducing income inequality, and serving as a buffer against economic fluctuations, thus easing social pressures on the government and stimulating the broader economy (David, 2024; Sakanko et al., 2024).

This effect is especially important because, even though Malaysia's economy is growing and per capita income is going up, income inequality is still there. More than half of the people, including about 78% of the rural population, earn less than one-ninth of the national per capita income. This is partly because of the country's ethnic diversity (Ab Hamid et al., 2020; Yap, Sarmidi, Nor, & Said, 2017). For many individuals facing poverty and inequality, employment in the shadow economy indirectly supports the formal sector, as income generated in the informal sector is often spent on formal goods and services. Additionally, the shadow economy provides goods and services at lower prices, benefiting lower-income groups and producing positive distributional effects. But even though the shadow economy helps growth, it also starts a "destructive cycle" that causes bad things to happen, like less tax revenue, ineffective public policy, wasted resources, and an environment that's good for crimes like money laundering, kidnapping for ransom, and tax evasion. These negative aspects can ultimately outweigh the positive contributions of the shadow economy (Aljassmi, Gamal, Abdul Jalil, David, & Viswanathan, 2024; Sakanko et al., 2024). Therefore, while the results indicate a positive relationship, caution is necessary to avoid triggering such destructive cycles.

Regarding the control variables, Table 4 shows that inflation rate, urbanization, and economic uncertainty all have a significant direct influence on the long-term and short-term growth of the Malaysian economy at the 5% significance level. Specifically, a 1% change in the inflation rate, urban population growth, and economic uncertainty results in the growth of the economy in the long-term horizon by 0.007 percentage points, 0.070 percentage points, and 44.934 points, respectively. Furthermore, changes in these variables are linked to an increase in the growth of the economy in the short run by 0.001 percentage points, 0.033 percentage points, and 2.448 percentage points, respectively.

Table 4 NARDL estimation results.

Panel A: ARDL (1,2,3,3,3,3,3) LR estimates – response variable: $lrgdp$							
$cons$	se^{+}	se^{-}	π	fd	urb	eu	mu
10.519 (16.04) ***	0.445 (14.14) ***	0.284 (3.97) ***	0.007 (3.18) ***	-0.001 (-2.33) **	0.070 (5.56) ***	44.934 (3.90) ***	-0.554 (-2.39) **

Panel B: ARDL (1,2,3,3,3,3,3) SR estimates – response variable: $\Delta lrgdp$			
Regressors	Lag order		
	0	1	2
Δse^{+}	0.088 (5.496) ***	-0.074 (-3.388) ***	-0.052 (-2.617) **
Δse^{-}	0.197 (13.567) ***	-0.057 (-3.784) ***	-0.005 (-0.327)
$\Delta\pi$	0.001 (3.624) ***	-0.001 (-4.865) ***	
Δfd	-0.0005 (-4.982) ***	-0.00004 (-0.287)	-0.0005 (-3.567) ***
Δurb	0.033 (4.057) ***	0.024 (3.241) ***	0.029 (3.699) ***
Δeu	2.448 (1.916) *	-11.817 (-6.904) ***	-5.522 (-4.950) ***
Δmu	0.088 (2.949) ***	0.319 (6.504) ***	0.128 (3.067) ***
W_{LR}	5.769 [0.026] **		
W_{SR}	2.931 [0.102] *		

Panel C: Diagnostic statistics tests					
ECT_{t-1}	$\chi^2_{SC}(3)$	$\chi^2_{FF}(1)$	χ^2_{HET}	χ^2_{NORM}	$Adj.R^2$
-0.511 (-9.461) ***	0.012 [0.911]	1.982 [0.175]	19.567 [0.879]	0.301 [0.860]	0.955

Note: 'The choice of the ideal lag-length is based on the AIC. Δ signifies the first differencing. *, **, *** is significance at the 1%, 5%, and 10% levels, respectively. Values in parentheses (.) indicate standard errors. Values in square brackets [.] are p-values for the LM test statistics. "−" and "+" refer to the negative and positive partial sums, respectively. The term (ECT_{t-1}) *represents the error correction term lagged by a year, reflecting the adjustment speed back to long-term equilibrium following short-term deviations.* W_{LR} *is the Wald test statistic for long-run symmetry, defined by* $-\hat{\theta}^{+}/\hat{\rho} = -\hat{\theta}^{-}/\hat{\rho}$, while *W_SR represents the short-run symmetry test, defined* by $\sum_{i=0}^{q}\pi_i^{+} = \sum_{i=0}^{q}\pi_i^{-}$. χ^2_{HET}, χ^2_{SC}, χ^2_{JB} and χ^2_{FF} the Breusch-Pagan-Godfrey, Breusch-Godfrey, Jarque-Bera, and Ramsey RESET test statistics, respectively'.

The positive influence of inflation rate and urban population growth on economic growth aligns with previous empirical research in Malaysia (e.g., (Aanak Impin & Kok, 2021; Akalpler & Duhok, 2018; Nguyen & Nguyen, 2018)). However, the positive impact of economic uncertainty on growth contradicts earlier studies, which suggest that it typically worsens the investment climate, slows both current and future investments, and impedes economic growth (Bhagat, Ghosh, & Rangan, 2016; Fatima & Waheed, 2014; Wen et al., 2022).

Conversely, the findings reveal a significant inverse connection between financial development and the growth of the formal economy, whether in the long- or short term, at the 5 percent level. A 1% change in financial development leads to a decrease in the growth of the economy by 0.001 percentage points in the long term and 0.0005 percentage points in the short term. This negative effect of financial development on growth is consistent with previous studies in Malaysia (e.g., (Choong & Lim, 2009; Zhang, 2003)), suggesting that changes or expansions in financial development may disrupt the country's growth trajectory. Additionally, long-run estimates show that monetary uncertainty negatively affects growth at the 5% significance level, while its immediate short-term impact is significant and positive at the 1% level. A 1% change in monetary uncertainty results in a decrease in long-term growth by 0.554 percentage points and an increase in the growth of the economy in the short-term by 0.088 percentage points.

Overall, these results suggest that increases in inflation, urban population growth, and economic uncertainty are positively associated with the growth of the Malaysian economy. On the other hand, financial development (as measured by credit to the private sector) and monetary uncertainty have a negative long-term effect on growth. While these findings align with previous research, the negative impact of financial development may be explained by the adverse outcomes observed during the global and Asian financial crises, both of which had severe consequences for Malaysia's economy. According to some theories, urbanization may boost growth through its ripple effects. On the other hand, inflation and economic uncertainty are good for long-term growth because they make people more likely to invest in physical and liquid assets as a defense against inflationary pressures, which boosts growth in those areas.

Finally, the convergence coefficient is negative, less than 1, and significant at the 1% level. This parameter's magnitude suggests a correction of approximately 51.1% of the short-run disequilibrium in economic growth within a year.

4.4. Diagnostics

To assess the suitability of the NARDL model for policy applications, a series of post-estimation diagnostic tests were conducted. These tests included the Breusch-Godfrey test, the Jarque-Bera test, the Breusch-Pagan-Godfrey test, and the Ramsey RESET test for serial correlation, normality, heteroscedasticity, and model specification. During each test, the model is checked to see if it follows the basic rules of classical regression. These rules confirm that the residuals should have a normal distribution, there should be no serial correlation, and the model should be correctly specified. The results, presented in Table 4, panel C, and indicate an absence of methodology problems associated with heteroscedasticity, serial correlation, or misspecification in the model. Furthermore, the error terms are distributed normally. The stability of the model's parameters over time is confirmed by the plots of the 'cumulative sum of squared recursive residuals (CUSUMSQ) and cumulative sum of recursive residuals (CUSUM),' illustrated in Figure 1.

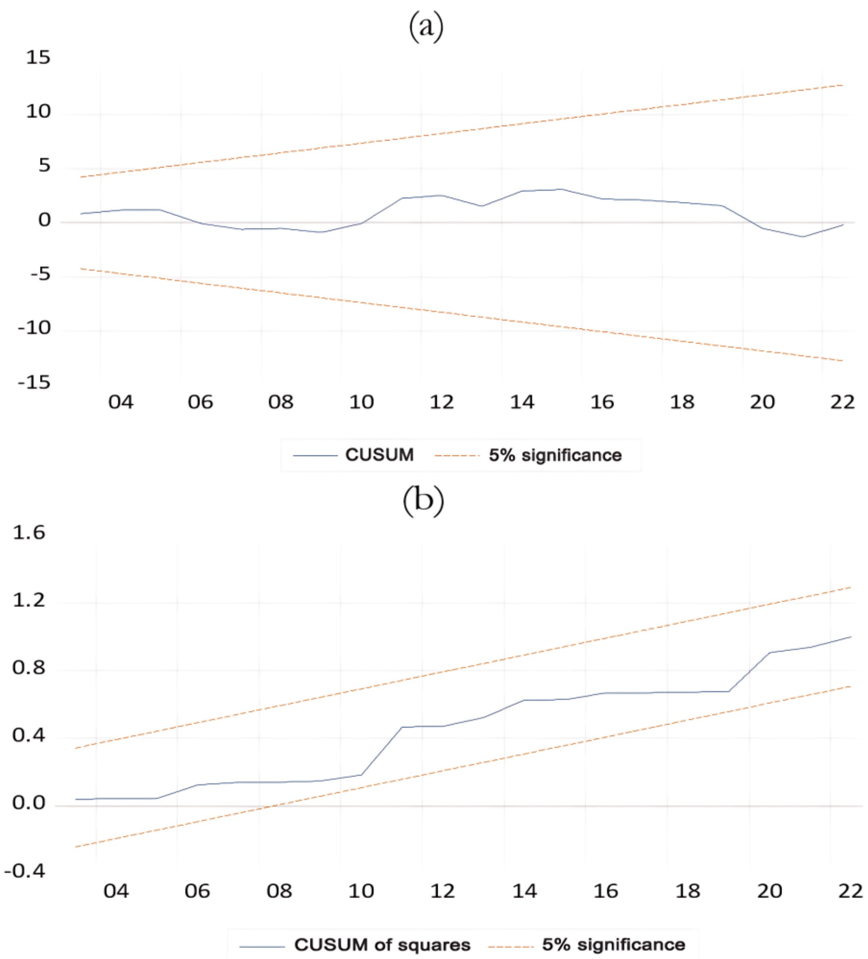

Figure 1. Plots of CUSUM (a) and CUSUMSQ (b).

5. CONCLUSION

The study investigates whether the influence of negative and positive adjustments in the SE on the growth of Malaysia's economy differs over the period 1970 to 2022, employing the NARDL bounds-testing technique. The results confirm a long-term (cointegrating) connection between the growth of the economy and the partial sums of the SE, along with control variables. The analysis reveals a nonlinear relationship in both the short and long term.

Specifically, negative and positive adjustments in the size of the SE positively influence the 'long-term and short-term' growth and development of the formal economy. However, the long-term impact of positive adjustments in the shadow economy is greater than that of negative changes. Conversely, in the short term, negative changes in the shadow economy exert a stronger influence on growth than positive changes. The findings further indicate that inflation, urban population growth, and economic uncertainty contribute positively to growth in both the short and long term, while financial development negatively affects growth in both time horizons.

The study underscores that the SE's size has a substantial influence on the growth of the economy, characterized by a nonlinear relationship in the Malaysian context. No matter what happens, these results should tell all levels of government that they need to come up with practical ways to slow down the growth of the informal sector and make it easier for people and businesses to move into the formal sector. Despite some positive implications of the SE for the economy, the findings suggest an urgent need to curb its expansion and enable individuals and businesses to shift to the formal economy. Sustained growth in the shadow economy, while potentially boosting short-term economic activity, undermines public revenue and leads to far-reaching economic, political, and social consequences. The shadow economy's expansion also creates avenues for illegal and criminal activities such as money laundering, arms trafficking, human trafficking, smuggling, kidnapping-for-ransom, and prostitution. Reducing the size of the SE or slowing its development requires several targeted strategies. First, policymakers should address the underlying factors that compel individuals and firms to operate informally, thereby supporting their transition to the formal economy. Streamlining bureaucratic procedures, eliminating red tape and corruption, and simplifying tax regulations can achieve this. These measures would remove key barriers that encourage participation in the shadow economy. Second, the government should introduce policies and programs aimed at reducing poverty, income inequality, and social and economic exclusion. Many individuals are pushed into the shadow economy due to limited opportunities in the formal sector. Initiatives promoting education, alleviating poverty, reducing inequality, and creating job opportunities would significantly diminish the labor supply to the shadow economy, reducing its overall size.

While this study makes a novel contribution by exploring the asymmetric connection between the SE and the growth of the Malaysian economy, it is not without limitations. One primary limitation is the measurement of the shadow economy. The data, derived from Gamal et al. (2024) relies on the Pickhardt-Sardà currency demand approach (CDA) and is limited to the period from 1970 to 2022. Additionally, the analysis focuses exclusively on Malaysia, which may limit the broader applicability of the findings. Nonetheless, these limitations do not detract from the study's policy relevance or its unique contributions. Future research could expand this work by utilizing broader datasets with alternative shadow economy measures and their impacts across multiple countries and extending the analysis period. Moreover, future studies could examine the connection between the SE and corruption. Because corruption and the shadow economy are linked in a cycle, spectral analysis could be used in future studies to look into these interactions. This would give us a better understanding of how the informal economy works in Malaysia.

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