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# The Shadow Economy in Malaysia: Evidence from an ARDL Model

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## ABSTRACT

In this study we estimate the size of the shadow economy in Malaysia for the period 1972-2012, using the Tanzi-type currency demand approach (CDA). We employ the autoregressive distributed lag (ARDL) bounds testing approach popularized by Pesaran, Shin, and Smith (2001) to ascertain the validity of the CDA model. The bounds test suggests that there exists a stable long-run relationship between currency demand and its determinants. We then relate the estimated size of the shadow economy in Malaysia with its determinants - income, tax burden and unemployment. Our results suggest that income has negative effect on shadow economy while tax burden and unemployment have positive impact on shadow economy in Malaysia

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## INTRODUCTION

Shadow economy, also called underground, informal or black market economy[1] , exists in all countries in the world. As a result, every country appears to have dual economies - an official economy and a shadow economy. The only difference between the two economies is that the former refers to activities that are recorded in the national accounting systems (NAS) while the latter is related to those economic activities that are performed outside the purview of the government authorities. To date, there is no consensus on the definition of shadow economy (Bajada, 1999; Caridi & Passerini, 2001; Feige, 1990; Tanzi, 1983). In most cases, the definitions and concepts of the shadow economy, however, depend on the chosen estimation methods and measurements (Schneider & Enste, 2000). In fact there are a plethora of definitions employed by different authors (Feige, 1990). This has led to all these concepts far from being standard and the definitions often seem to overlap somewhat in intricate ways (Caridi & Passerini, 2001). Table 1 provides a brief definition with respect to monetary and non-monetary transactions as well as legal and illegal status activities (Mirus & Roger, 1997). Therefore, this study defines shadow economy as all legal economic activities that involve monetary transactions and those transactions have avoided the burden of tax payment[2] .

**Table 1** A taxonomy of types of underground economic activities

| Type of activity | Monetary transactions | | Non-monetary transactions | |
|---|---|---|---|---|
| Illegal activities | Trade with stolen goods; drug dealing and manufacturing; prostitution; gambling; smuggling; fraud; etc. | | Barter of drugs, stolen goods, smuggling, etc. Produce or growing drugs for own use. Theft for own use. | |
| | Tax evasion | Tax avoidance | Tax evasion | Tax avoidance |
| Legal activities | Unreported income from self-employment; Wages, salaries and assets from unreported work related to legal services and goods | Employee discounts, fringe benefits | Barter of legal services and goods | All do-it-yourself work and neighbour help |

Source: Mirus and Roger (1997, p.5) with additional remarks (Schneider & Enste, 2000)

Studies conducted around the world show that a large portion of economic activities remains hidden from the authorities and many workers are getting paid but with no record to validate the transactions. To take a closer look at the latest statistics by Schneider, Buehn, and Montenegro (2010), the average size of the shadow economy globally accounts for nearly 33% (of official GDP) over the sample period of 1999-2007. High income OECD countries

[1] These terms are used interchangeably as a standardized terminology in this study.
[2] This definition is based on the taxonomy provided by Mirus and Roger (1997) which is also similar to the definition used by Feige (1979) and Schneider and Lundager (1986).

reported a relatively low share of the shadow economy between 15%-20% (of official GDP) (Alm & Embaye, 2013; Schneider *et al*., 2010); while in some developing countries (low income countries) such as the Europe and Central Asia (ECA), the Latin America and the Caribbean (LAC) and the Sub-Saharan Africa (SSA) regions recorded approximately 40% of their economic activities are informal. That is roughly double the size of the shadow economy in high income countries.

The literature suggested that tax and social security contribution burdens, intensity of regulation, public sector services and the impact of international competition are some of the reasons for involving in the underground activities (Gërxhani, 2004; Schneider *et al*., 2010).[3] Of these, tax burden is often cited as the most prevalent factor behind the emergence of the shadow economic activities. Schneider (2000) asserted that the existence and growth of the shadow economy continued to be a problem for many countries for three major reasons. Firstly, if an increase in the tax burden leads to a rise in the size of the underground economy, this may cause further increase in the budget deficit due to a decrease in tax receipts. Secondly, it creates difficulty in measuring the official economic variables especially gross domestic product, consumption, income and unemployment. The unreliable official statistics can lead to incorrect information for policy making. Lastly, the underground economy phenomenon tends to encourage both the domestic and foreign labours to work more in the shadow economy and discourage them to participate in the official economy at the same time.

Like any other developing countries, Malaysia also experienced large shadow economic activities. Large shadow economy implies higher tax evasion. While it is impossible to account for the total number of shadow economic activities in Malaysia, a study by Fatt and Ling (2008) reported that more than half of the survey respondents were of the opinion that the unreported business income and rental income, under declaring of business income and using false or fictitious invoice. All these evasions are perpetrated to reduce tax liabilities. In a regional context, Malaysia was placed fourth in the ASEAN-5, with a total of US$11.24 billion lost from tax evasion activities according to The Tax Justice Network (2011) report. While Thailand was ranked no.1 (approximately US$25.81 billion), followed by Indonesia and Philippines recorded revenue loss of almost US$17.76 billion and US$11.71 billion attributed to tax evasion, respectively. Singapore lost over US$4.08 billion, and among the lowest in the region.

Comparing the estimation of the shadow economy to official GNP, Kasipillai *et al*. (2000) estimated that on average the shadow economy in Malaysia is about 6.8% of its GNP between 1971 and 1994. However, based on panel data estimates, the average size of the shadow economy to GDP in Malaysia was estimated to be 30.4% (Alm & Embaye, 2013) and 30.9% (Schneider *et al*., 2010) for the period 1984-2006 and 1999-2007, respectively. Even though both studies were undertaken in the context of Malaysia, these studies involved a large panel of countries. However, in the case of developing countries, estimating the size of the shadow economy should be carried out country-by-country basis due to their distinct tax policies as well as diverse socio-economic characteristics. According to Khalilzadeh-Shirazi and Shah (1991), tax reforms in developing countries have varied in terms of substance, process, context and timing.

[3] Summary of the various causes driving the shadow economy using the MIMIC and the CDA methods are available in previous study (Feld & Schneider, 2010).

Thus, the purpose of the present study is to estimate the size of the shadow economy in Malaysia over the period 1972-2012. This exercise will give us a time series of 41 observations of measured shadow economic activities in Malaysia. To estimate the magnitude of the Malaysian shadow economy we employed the popular autoregressive distributed lag (ARDL) procedure proposed by Pesaran *et al*. (2001). Our estimates of the shadow economic activities coincide with several episodes of economic crises throughout the years 1972-2012. We further ascertain the determinants of shadow economy in Malaysia and our empirical results suggest that income is negatively related to the shadow economy, while tax burden and unemployment are positively related to shadow economy in Malaysia.

The paper is organized as follows. In the next section, the related literature on the size of the shadow economic activities in some parts of the world are reviewed. Subsequently, section 3 presents the model and method used to estimate the shadow economy in Malaysia. Section 4 discusses the empirical results and the last section concludes with the reiteration of the key findings.

## LITERATURE REVIEW

There have been increasing empirical literature estimating the size of the shadow economy using the currency demand approach (CDA) method. Basically, CDA is based on the idea of Cagan (1958) and later extended by Tanzi (1983) who incorporated an econometric estimation on currency demand equation for the United States from 1930-1980. Two equations with different tax rate variables are used - the average tax rate on interest income, and the other is the ratio of total income tax to adjusted gross income. The remaining determinants are income per capita, the proportion of wages and salaries in national income and interest rate on saving deposits; while currency in circulation to money supply ratio is the dependent variable. On average, the size of the US underground economy is estimated to be 2.8% and 4.2% (of GNP) corresponding to the average tax rate and weighted average tax rate equations, respectively. Thereafter, numerous studies have been conducted to estimate the size of the shadow economy all around the world.

More recently, studies by Dell'Anno and Halicioglu (2010) on Turkey (1987-2007) and Kiani *et al*. (2015) on Pakistan (1975-2010) used the autoregressive distributive lags (ARDL) model to study the long-run relationship between currency holdings and other explanatory variables such as tax rate, interest rate, income, inflation rate and exchange rate. Their findings confirmed the existence of a larger underground economy averaged about 26.9% in Pakistan whereas in Turkey, the shadow economy ranged between 10.7% and 18.9% over the period studied.

More recent studies by Alm and Embaye (2013) and Ardizzi *et al*. (2014) have taken another step forward using relatively large datasets. Alm and Embaye (2013) estimated the size of the shadow economy for 111 countries for the period 1984-2006 using the generalized method of moments (GMM) approach. They further included inflation rate, degree of urbanization and enforcement strength of the administration as explanatory variables along with conventional variables such as tax rate, real capita income and interest rate. The dependent variable is proxy by currency to M2 ratio, similar to Tanzi (1983). Their findings suggest that the higher the tax rate (economic return from underreporting), the weaker the enforcement of the tax administration and a higher inflation rate increases the currency to M2 ratio. Apart from this, the other explanatory variables included, namely income per capita, interest rate and the degree of urbanization, were found to be statistically significant in affecting the currency to M2 ratio. On average, the size of the shadow economy was approximately 31.7%. The share of the shadow economy varies greatly according to the country's income groups whereby lower income countries are associated with larger shadow economy. For example, the mean shadow economy (of GDP) was 16.9%, 24.3%, 33.4%, 37.2% and 38.2% for OECD countries, high income non OECD countries, upper middle income countries, lower middle income countries and low income countries, respectively.

Ardizzi *et al*. (2014) also focused on large panel data sets on 91 Italian provinces. They proposed a reinterpretation of the traditional Tanzi-type CDA using random effects Tobit model accounting for unobserved residual heterogeneity across provinces for the years 2005-2008. The major findings can be divided into two groups: (a) the mean of the shadow economy was about 17.5% (of GDP) after controlling for the role of crime; and (b) on average, the estimated size was approximately 26.1% (of GDP) without accounting for the role of criminal transactions.

## RESEARCH METHODOLOGY

### Estimating the shadow economy with the currency demand model

There are many techniques used to estimate the size of the shadow economy. The CDA is considered as one of the most well-recognized and popular methods in estimating the size of the shadow economy. The idea behind this approach assumes that shadow economic transactions are undertaken in the form of cash which leave no trace or trail. Transactions involve cash are difficult to trace as compared to those activities using other assets or registered in any financial institutions. A rise in the tax burden implies stronger incentive to engage in cash-intensive underground economic activities, and hence increase the demand for cash. In other words, the CDA provides an indirect measure of the shadow economy by estimating how much cash used for shadow transactions with assumption about the equality of velocity between the cash used in the unofficial and the official economy (Tanzi, 2002). Like Schneider and Lundager (1986) and Schneider (1986), we selected the CDA method due to the following reasons: (a) it consists of reliable and comparable time series data; (b) it is one of the most widely used methods for purpose of comparison with other countries; and (c) development of the shadow economy over time can be examined as its economic determinants contain the relevant information.

Since currency in circulation is a subset of the money demand, thus, the currency demand is modeled as a function of a scale variable (real income) to account for transactions demand, the opportunity cost of holding currency (interest rate), and additional variables that might influence the behavior of currency holdings. Following Tanzi (1983) and other subsequent studies (Alm & Embaye, 2013; Bajada, 1999; Carolina & Pau, 2007; Dell'Anno & Halicioglu, 2010; Dobre & Davidescu, 2013; Faal, 2003; Hill & Kabir, 2000; Kiani *et al*., 2015; Klovland, 1984; Maurin, Sookram, & Watson, 2006), the general specification for long-run currency demand function is as follows:

$$LCM_t = \theta_0 + \theta_1 LTAX_t + \theta_2 LR_t + \theta_3 LY_t + \theta_4 L\pi_t + e_t \tag{1}$$

where t = 1, ..., T, L is natural logarithm, CM is the ratio of currency in circulation to broad money supply ($M_2$), TAX is the tax rate (the ratio of total indirect tax revenue to GDP)[4], R is the interest paid on saving deposits, Y is nominal income per capita, $\pi$ is the inflation rate (growth in the GDP deflator) and ee is the error term. The estimated coefficients for $\theta_1$ and $\theta_4$ are expected to be positive, while the parameter estimates for interest rate ($\theta_2$) and income per capita ($\theta_3$) are expected to be negatively related with currency holdings.

## Method of estimation - ARDL cointegration bounds test

In this study, we rely on the ARDL method to estimate the size of the shadow economy in Malaysia as the ARDL bounds testing approach to cointegration (Pesaran *et al*., 2001) has some credits over conventional cointegration testing. Firstly, the ARDL does not require all variables in Equation (1) to be integrated of the same order. Simply saying, it allows a mixture of I(0) and I(1) variables in one model which avoids the needs for pre-testing for unit root tests. Secondly, unlike other cointegration techniques, the ARDL approach has better properties for smaller sample size. Thirdly, the endogeneity issue is less of a potential problem in ARDL technique if the regression residuals are serially uncorrelated (Baharumshah, Mohd, & Masih, 2009).

The first step of bounds testing is formulating an unrestricted error correction model (UECM) as follows:

$$\begin{aligned}\Delta LCM_t = \alpha_0 &+ \sum_{i=1}^{p-1} \alpha_{1i} \Delta LCM_{t-i} + \sum_{i=0}^{q-1} \alpha_{2i} \Delta LTAX_{t-i} + \sum_{i=0}^{r-1} \alpha_{3i} \Delta LR_{t-i} \\ &+ \sum_{i=0}^{s-1} \alpha_{4i} \Delta LY_{t-i} + \sum_{i=0}^{v-1} \alpha_{5i} \Delta L\pi_{t-i} + \beta_1 LCM_{t-1} \\ &+ \beta_2 LTAX_{t-1} + \beta_3 LR_{t-1} + \beta_4 LY_{t-1} + \beta_5 L\pi_{t-1} + e_t\end{aligned} \tag{2}$$

where the long-run parameter $\theta_0$ is given by $\theta_0 = 1/\beta_1$ and the long-run parameters $\theta_1 = -\sum_1^q \alpha_{2i}/\beta_1$, $\theta_2 = -\sum_1^r \alpha_{3i}/\beta_1$, $\theta_3 = -\sum_1^s \alpha_{4i}/\beta$ and $\theta_4 = -\sum_1^v \alpha_{5i}/\beta_1$ .

The validity of Equation (1) as the long-run model is tested using the bounds test for cointegration. By employing the bounds test, the existence of a long-run cointegrating relationship between variables is examined using the Wald-statistics (*F*-statistics). The Wald-test is a joint test where the null hypothesis for all coefficients of all the lagged level variables in Equation (2) is jointly equal to zero, that is:

[4] We also used other tax rates measures including total tax burden (total nominal tax revenue to nominal GDP ratio and direct tax rate (direct total nominal tax revenue to GDP ratio). However, the results are not very supportive. Direct tax refers to taxes on income, profits, and capital gains whereas taxes on goods and services are the measure for indirect tax (See Table A1 in Appendix A).

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

$H_0 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$

The long-run cointegrating relationship is identified when the computed *F*-statistic is compared with the bound critical value tabulated by Narayan (2005) for small sample size. Following Pesaran *et al*. (2001), the null hypothesis of no cointegration is rejected when the computed *F*-statistic exceeds the upper bounds of critical value that the variables are cointegrated. On the other hand, the variables are not cointegrated if the null hypothesis of no cointegration is not rejected where the estimated *F*-statistic below the lower bound critical value. If the calculated *F*-statistic falls between the upper and lower bound critical values, the decision is inconclusive. The optimal lag lengths for ARDL specification are selected using AIC or SBC as well as diagnostics checking for residuals.

## Estimating long-run and short-run models

Once cointegration is established, in order to estimate the long-run model as per Equation (1), we employ the ARDL model approach. Assuming ARDL(1,1,1,1,1) model, we have:

$$\begin{aligned} LCM_t = \gamma_0 + \gamma_1 LCM_{t-1} + \gamma_2\, LTAX_t + \gamma_3\, LTAX_{t-1} + \gamma_4\, LR_t \\ + \gamma_5\, LR_{t-1} + \gamma_6 LY_t + \gamma_7 LY_{t-1} + \gamma_8 L\pi_t + \gamma_9 L\pi_{t-1} + e_t \end{aligned} \quad (3)$$

The long-run coefficients computed from Equation (3)are $\theta_0 = \frac{\gamma_0}{1-\gamma_1}, \theta_1 = \frac{\gamma_2+\gamma_3}{1-\gamma_1}$, $\theta_2 = \frac{\gamma_4+\gamma_5}{1-\gamma_1}, \theta_3 = \frac{\gamma_6+\gamma_7}{1-\gamma_1}, \theta_4 = \frac{\gamma_8+\gamma_9}{1-\gamma_1}$. On the other hand, the short-run error correction model (ECM) can then be estimated as follows:

$$\Delta LCM_t = \alpha_0 - \varphi ECT_{t-1} + \gamma_2\, \Delta LTAX_t + \gamma_4\, \Delta LR_t + \gamma_6 \Delta LY_t + \gamma_8 \Delta L\pi_t + e_t \quad (4)$$

where

$ECT_{t-1} = [LCM_{t-1} - \theta_0 - \theta_1 LTAX_{t-1} - \theta_2 LR_{t-1} - \theta_3 LY_{t-1} - \theta_4 L\pi_{t-1}]$, $\varphi = 1 - \gamma_1$ , is the coefficient representing the speed of adjustment, indicating that the annual percentage correction of a deviation from the long-run equilibrium the year before.

Lastly, the estimated long-run Equation (1) is used to calculate the illegal currency in circulation. Again, Equation (1) is estimated by setting the tax rate and inflation at zero, whilst coefficients for other variables remain unchanged. The different between the two estimations show an estimate of illegal stock of currency held for the purpose of tax evasion. The illegal stock money is then multiplied by the velocity of money, to yield an estimate of shadow economy. It is assumed that velocity of illegal stock of money is equal to the velocity of legal money.

## Data

In this study, annual data spanning from 1972 to 2012, consisting of 41 observations were used. Data for currency in circulation and broad money (M2) are drawn from International Monetary Fund's International Financial Statistics (IFS) CD-ROM (2013), Central Bank of Malaysia and World Bank's World Development Indicators (WDI). Data for tax rate is mainly collected from International Monetary Fund's Government Finance Statistics (GFS) and WDI. While other data such as interest rate, income per capita and inflation rate are collected from WDI.

## RESULTS AND DISCUSSION

We evaluate the order of integration of the selected variables using three different unit root tests. Due to the well-known low power of the augmented Dickey-Fuller, ADF (Dickey & Fuller, 1979, 1981) and Philips-Perron, PP (Phillips & Perron, 1988) unit root tests, this study also employed the KPSS (Kwiatkowski, Phillips, Schmidt, & Shin, 1992) unit root test. Table 2 provides the results for the unit root tests. Although the ARDL bounds test for cointegration does not require that all variables examined to be integrated of I(1), the unit root tests are important to check whether the variables examined are not integrated of I(2). This is because the critical values of the F-statistic for bounds test computed by Pesaran *et al*. (2001) and Narayan (2005) are based on the assumption that either the variables are I(0) or I(1). Therefore, the F-test will be invalid in the presence of I(2) variables. The results of unit root tests suggest that the underlying variables are integrated of either one or zero. Hence, we conclude that all variables used in this study are not I(2).

**Table 2** Unit root tests

| | ADF | | | | PP | | | | KPSS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Level | | | | | | | | | | | | |
| Variables | Constant Without Trend | k | Constant With Trend | k | Constant Without Trend | k | Constant With Trend | k | Constant Without Trend | k | Constant With Trend | k |
| LCM | -1.731 | 0 | -3.152 | 0 | -1.679 | 5 | -3.215* | 1 | 0.746*** | 5 | 0.072 | 3 |
| LTAX | -1.104 | 0 | -1.605 | 0 | -1.010 | 1 | -1.522 | 1 | 0.318 | 5 | 0.167** | 5 |
| LR | -1.671 | 0 | -3.353* | 1 | -1.714 | 4 | -2.544 | 5 | 0.553** | 4 | 0.144* | 3 |
| LY | -1.953 | 0 | -3.654** | 0 | -2.019 | 2 | -3.660** | 2 | 0.797*** | 5 | 0.081 | 4 |
| L$\pi$ | -6.405*** | 0 | -6.398*** | 0 | -6.405*** | 0 | -6.398*** | 0 | 0.09 | 0 | 0.077 | 1 |
| First Difference | | | | | | | | | | | | |
| LCM | -6.229*** | 1 | -6.215*** | 1 | -6.947*** | 6 | -7.331*** | 7 | 0.154 | 7 | 0.100 | 8 |
| LTAX | -7.131*** | 0 | -7.200*** | 0 | -7.177*** | 3 | -7.468*** | 6 | 0.192 | 5 | 0.098 | 7 |
| LR | -5.131*** | 0 | -5.080*** | 0 | -5.833*** | 13 | -6.266*** | 13 | 0.199 | 10 | 0.166** | 11 |
| LY | -6.265*** | 0 | -6.294*** | 0 | -6.319*** | 2 | -6.314*** | 1 | 0.257 | 3 | 0.097 | 2 |
| L$\pi$ | -8.124*** | 1 | -8.041*** | 1 | -34.615*** | 38 | -37.840*** | 38 | 0.270 | 19 | 0.253*** | 20 |

Notes: ***, ** and * denote significant at 1%, 5% and 10% significance levels, respectively. The optimum lag length *(k)* in the ADF is chosen by Schwarz Information Criteria, with assumption a maximum lag length of 9; whereas for PP and KPSS tests, the Bartlett Kernel bandwidth is specified using the Newey–West procedure. Both the ADF and PP tests are based on the null hypothesis of a unit root and the KPSS method tests the null hypothesis of stationarity.

The result of bounds test for cointegration is shown in Table 3. Using the asymptotic critical value computed by Narayan (2005) for small sample size, the result reveals that the null hypothesis of no cointegration is rejected at 5% significant level. The computed $F$-statistic of 5.668 is greater than the upper bound critical value of 4.544, leading us to conclude that there exists a long-run relationship between LCM, LTAX, LR, LY and L$\pi$.

**Table 3** Bounds test for cointegration results

| Model | Calculated $F$-statistic | |
|---|---|---|
| LCM = f(LTAX, LR, LY L$\pi$) | 5.668** | |
| | k=4, n=41 | |
| Critical value for bounds test: Case III: Intercept and no trend | I(0) | I(1) |
| 1% | 4.428 | 6.250 |
| 5% | 3.202 | 4.544 |
| 10% | 2.660 | 3.838 |

Notes: ** denotes significant at 5% significance level. Critical values are obtained from Narayan (2005, p.1988). k denotes the number of regressors.

For the purpose of robustness testing, the lag selection criteria of SBC and AIC are reported in Table 4. Both model selection criteria give quantitatively similar results. According to Pesaran and Shin (1999, as cited in Emran, Shilpi, & Alam, 2007), the SBC-based ARDL model performs better than AIC-based as SBC is a consistent based model selection criterion. Therefore, we rely on the SBC-based ARDL model for the entire discussion. We observe that all the long-run estimated coefficients have the expected sign, which is in line with theoretical considerations and the parameters are statistically significant except inflation rate. This indicates tax rate, interest rate and income per capita are the key determinants of currency ratio. Tax rate is considered as the most important factor, where a higher tax rate increases the opportunity of evading taxes. Thus, people who wish to engage in the underground activities by under reporting their taxes will use more currency.

Panel B of Table 4 reports the short-run dynamic error correction term ($ECT_{t-1}$) equation derived from the ARDL models. The parameter estimates on the lagged residuals has an expected negative sign and statistically significant at 1% level. This implies that cointegrating relationships indeed exist among these variables. Furthermore, the coefficient for the speed of adjustment is -0.865, indicating that on average, approximately 86.5% of the deviation from the long-run equilibrium will be adjusted in the following year.

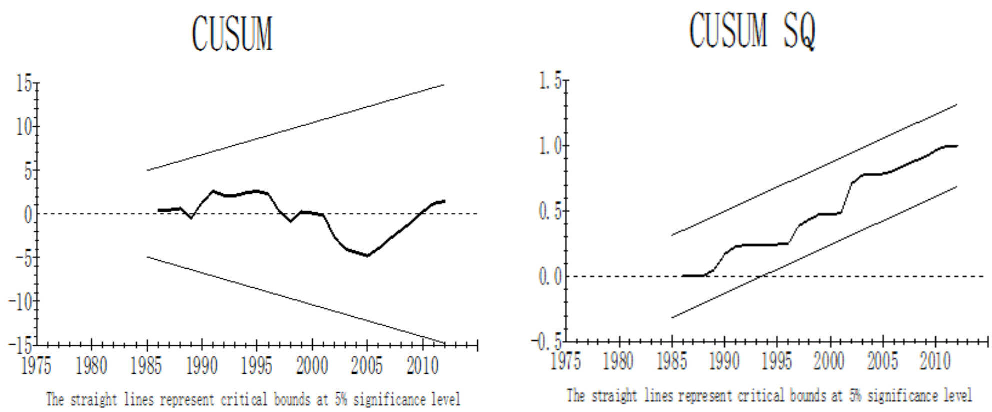
Finally, the robustness checking is diagnosed using several diagnostic tests such as Breusch-Godfrey serial correlation LM test, Ramsey RESET mis-specification test, Jarque-Bera normality test and ARCH test for heteroscedasticity, as demonstrated in Panel C of Table 4. These tests suggest that the residuals are not serially correlated and no heteroscedasticity. Similarly, the Ramsey RESET test also shows that the estimated model is correctly specify. However, the null hypothesis of normality residuals can be rejected at 1% level. Alternatively, the stability of parameter estimates for ARDL models are further analyzed using the cumulative sum of recursive residual (CUSUM) and cumulative sum of squares of recursive residuals

(CUSUMSQ) tests. The results of CUSUM and CUSUMSQ are displayed in Figure 1. Both tests provide strong supports of stability in parameter estimates at 5% level. Overall, we can conclude the models seem to be characterized as ARDL (2,0,3,0,0) model.

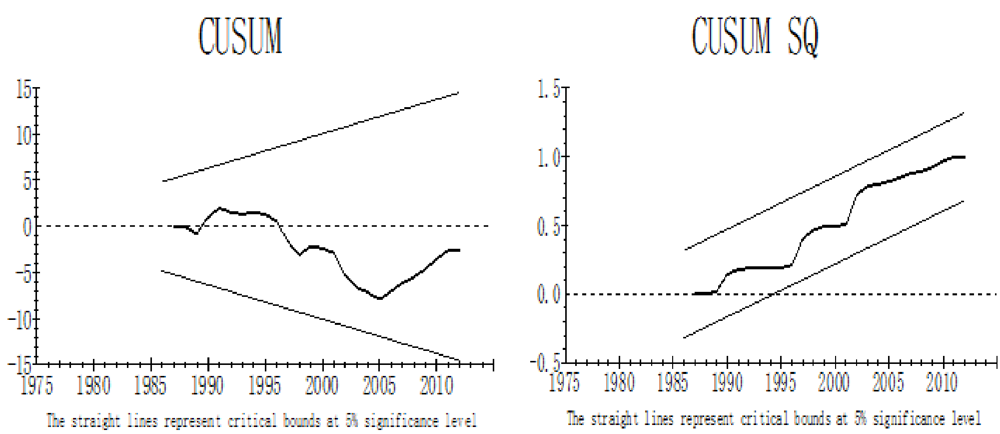
**Table 4** Results for long-run currency demand model, short-run dynamic ECT model and diagnostic tests

| | Model Selection Criterion | | | | | |
|---|---|---|---|---|---|---|
| | SBC ARDL(2,0,3,0,0) | | | AIC ARDL(2,1,3,0,0) | | |
| Variables | Coefficient | | t-Statistic | Coefficient | | t-Statistic |
| Panel A: The long-run results | | | | | | |
| Dependent variable: LCM | | | | | | |
| Constant | 1.897 | *** | 3.265 | 1.817 | *** | 3.329 |
| $LTAX_t$ | 0.622 | *** | 3.025 | 0.482 | ** | 2.290 |
| $LR_t$ | -0.517 | *** | -3.446 | -0.436 | *** | -2.997 |
| $LY_t$ | -0.533 | *** | -13.104 | -0.519 | *** | -13.362 |
| $L\pi_t$ | 0.067 | | 1.407 | 0.086 | * | 1.841 |
| Panel B: The short-run results | | | | | | |
| Dependent variable: ΔLCM | | | | | | |
| Constant | 1.642 | *** | 3.180 | 1.638 | *** | 3.238 |
| $ECT_{t-1}$ | -0.865 | *** | -5.542 | -0.901 | *** | -5.820 |
| $\Delta LCM_{t-1}$ | 0.253 | * | 1.811 | 0.278 | ** | 2.011 |
| $\Delta LT_t$ | 0.539 | *** | 2.937 | 0.860 | *** | 3.048 |
| $\Delta LR_t$ | -0.113 | | -0.955 | -0.070 | | -0.587 |
| $\Delta LR_{t-1}$ | 0.436 | *** | 3.794 | 0.403 | *** | 3.513 |
| $\Delta LR_{t-2}$ | 0.391 | *** | 3.058 | 0.402 | *** | 3.203 |
| $\Delta LYPC_t$ | -0.461 | *** | -5.714 | -0.467 | *** | -5.902 |
| $\Delta L\pi_t$ | 0.058 | | 1.362 | 0.077 | * | 1.767 |
| Panel C: Diagnostic tests | $\chi2$ [Prob.] | | | $\chi2$ [Prob.] | | |
| LM (1) | 1.988 [0.159] | | | .8136 [0.367] | | |
| RESET (1) | 1.123 [0.289] | | | .4174 [0.518] | | |
| JB | 18.142 [0.000] | | | 17.226 [0.000] | | |
| ARCH (1) | 0.305 [0.581] | | | 0.8855 [0.347] | | |

Notes: ***, ** and * indicate significant at 1%, 5% and 10% significant levels, respectively. LM, RESET, JB and ARCH are Lagrange multiplier test for residual serial correlation, Ramsey's RESET test for mis-specification error, Jarque-Bera normality test and ARCH test for heteroscedasticity. The ARDL cointegration procedure is implemented to estimate Equation (2) with a maximum lag of 3.




a) SBC-based model selection criterion




b) AIC-based model selection criterion

**Figure 1** CUSUM and CUSUM square tests using SBC and AIC-based model selection criterion

The size of the shadow economy as a percentage of GDP is depicted in Figure 2. It is obvious that shadow economic activity in Malaysia is likely to constitute a large share of overall economic activities in the 1970s, ranging between 46%-67% (of official GDP). Not surprisingly, the shadow economy skyrocketed to reach its peak point after the mid-1980s with 76%-115% of economic activities in which were underground. The size of the shadow economy had been fluctuating around 30% (of official GDP) from 1990s to early 2000s and continued to decrease at the end of 2000s, hovering below 20% (of official GDP).

Our estimates of the size of the shadow economy can be explained and tightened up reasonably well with the performance of the Malaysian economy during the period 1972 to 2012; where the increase in the size of the shadow economy coincide with several episodes of economic "hardships" and financial crises in Malaysia. The episode of the first oil shock of 1973/74; the second oil shock of 1978/81; commodity price collapse of 1981/86; and the Asian financial crisis of 1997/98 (Hamilton, 2013) - all these episodes contributed to the increase in the size of the shadow economy.

These economic and financial crises cost Malaysia billions of ringgit in losses and thousands of workers being laid off. The eighties saw the worst of many crises that Malaysian had experienced. The commodity price collapsed in the early 1980s, leading to the Maminco crisis in Malaysia. When the world tin market crashed in 1985, the tin price plunged by 50%, many mines closed down and thousands lost their jobs. The Perwaja Steel crisis, Bumiputra Malaysia Finance (BMF) crisis, the 24 deposit-taking cooperatives crisis and the Pan-Electric Industries crisis that originated from Singapore, had causes "hardships" to the Malaysian people.

There are instances that government is using taxpayers' money to rescue their crony ailing companies, and companies which are politically-connected with the government will benefit more during the crisis (Johnson & Mitton, 2003). On the other hand, Torgler (2005) has pointed out that government using taxpayers' money for good use by financing public goods for the people, trust will be bestowed upon them. Torgler (2005) argues that people will be more prone to pay taxes if they trust their fellow tax-payers to do the same, and if they trust the government to use tax revenues to finance public goods. In this situation, high level of trust leads to high tax morale and consequently, tax evasion (and shadow economy) will be low.

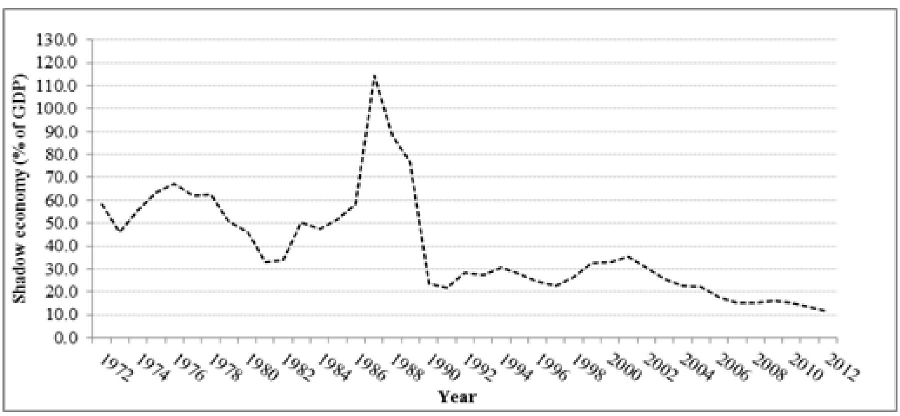



**Figure 2** The Size of the shadow economy (% of official GDP)[5]

## Further evidence: Determinants of shadow economy

To determine factors affecting shadow economy in Malaysia, we specify the following,

$$\mathrm{LSE}_t = \delta_0 + \delta_1 \mathrm{LY}_t + \delta_2 \mathrm{LU}_t + \delta_3 \mathrm{LTAX}_t + \omega_t \quad (5)$$

where $LSE_t$ is the estimated size of shadow economy; $LY_t$ is real GDP per capita to measure economic development or income; $LU_t$ is unemployment rate; $LTAX_t$ is tax burden proxy using personal income tax revenue divided by GDP. It is expected that $\delta_2$, $\delta_3 > 0$ and $\delta_1 < 0$ . We hypothesize that higher unemployment and tax burden will lead to people participating in the shadow economy. On the other hand, the increase in income will lead to lower shadow economy.

[5] The estimates for the size of the shadow economy are available upon request.

Table 5 presents the estimation results of the stationarity test for all variables in Equation (5). Result in Panel A clearly indicates that all variables are I(1), that is the series achieved stationarity after first-differencing. Since all variables are of the same order of integration we can proceed to test for cointegration. In this study, to estimate the long-run model as per Equation (5), we endeavor to employ ordinary least square (OLS) with robust standard error, dynamic OLS (DOLS), fully modified OLS (FMOLS) and canonical cointegrating regression (CCR). Except for OLS, the other three estimators are able to correct for endogeneity and serial correlation effects as well as eliminate the small sample bias (see for example, Narayan & Narayan, 2004; Park, 1992; Phillips & Hansen, 1990; Stock & Watson, 1993). The validity of the long-run model is tested for the presence of cointegration. For OLS we used the conventional Engle and Granger (1987) two-step procedure (E-G test) for testing the null hypothesis of non-cointegration or the presence of unit root on the residuals. On the other hand, the $L_c$-statistic proposed by Hansen (1992) tested the null hypothesis of cointegration for FMOLS, DOLS and CCR. These results are presented in Panel B of Table 5. Interestingly, all four estimators converge to the same conclusion that there is cointegration between shadow economy and income, unemployment rate and tax burden in Malaysia. The E-G test suggests that the null hypothesis of no cointegration can be rejected. On the other hand, the $L_c$ test statistics indicate that the null hypothesis of cointegration cannot be rejected for FMOLS, DOLS and CCR.

Table 5 clearly indicates that all four estimators give similar results with respect to the size and sign of the regressors. Economic development or income shows negative relationship with shadow economy, while both unemployment and tax burden exhibit positive relation with shadow economy in Malaysia. This implies that an increase in unemployment rate as well as the tax burden will increase the size of the shadow economy. On the other hand, the increase in the level of economic development will reduce the occurrence of shadow economy.

**Table 5** Results of long-run shadow economy regression equation

| **Panel A: ADF unit root test** | | | | |
|---|---|---|---|---|
| | LSE | LY | LU | LTAX |
| | | **Level** | | |
| Constant Without Trend | -1.04 (0) | -1.42 (0) | -1.21 (0) | -2.91 (3) |
| Constant With Trend | -3.42 (1) | -2.10 (0) | -3.16 (3) | -3.06 (0) |
| | | **First Difference** | | |
| Constant Without Trend | -5.54*** (0) | -5.65*** (0) | -5.37*** (0) | -6.13*** (0) |
| Constant With Trend | -5.55*** (0) | -5.64*** (0) | -5.30*** (0) | -6.24*** (0) |
| **Panel B: Long-run model and cointegration tests** | | | | |
| | Constant | LY | LU | LTAX |
| OLS | 7.769** | -0.690*** | 0.708** | 0.476*** |
| (robust estimates) | (3.486) | (3.000) | (2.150) | (3.450) |
| | *E-G* test: -3.08*** | | $R^2$ =0.77 | |

**Table 5** (Cont.)

| | | | | |
|---|---|---|---|---|
| FMOLS | 9.652*** | -0.897*** | 0.504** | 0.617** |
| | (5.868) | (5.210) | (2.333) | (2.411) |
| | $L_c$ =0.524 | | $R_2$ =0.76 | |
| | [>0.20] | | | |
| DOLS | 7.683*** | -0.682** | 0.690** | 0.485 |
| {lead=1, lag=0} | (2.844) | (2.506) | (2.074) | (1.134) |
| | $L_c$ =0.043 | | $R_2$ =0.80 | |
| | [>0.20] | | | |
| CCR | 9.508*** | -0.879*** | 0.537** | 0.566** |
| | (5.913) | (5.273) | (2.670) | (2.462) |
| | $L_c$ =0.308 | | $R_2$ =0.76 | |
| | [>0.20] | | | |

Notes: *** and ** denote statistically significant at 1% and 5% level respectively. In Pane A, the figures in round bracket are lag length truncated. In Panel B, the figures in round bracket are ADF *t*-stastistics and figures in square brackets are the *p*-values. *E-G* test denote the DF *t*-statistic on the cointegrating regression's residual. $L_c$-statistic measures Hansen parameter instability test for cointegration. The *E-G* tests with null hypothesis of no cointegration while the Hansen test the null hypothesis of cointegration.

## CONCLUSIONS

By its hidden nature, the size of the shadow economy is difficult to measure as none of those involved in the underground activities wants to be recognized (Faal, 2003; Schneider & Enste, 2000). Measuring the size of the shadow economy is important as it provides a good illustration of how large the shadow economy for a country. The sizeable shadow economy estimates cast serious doubt on the reliability of the standard macroeconomic aggregates and the official statistics used for policy making. As highlighted by Ott (1999, p.30), the shadow economic activities may distort the public's impression on the actual size and growth of the official economy as well as the income distribution of a country. As a result, the existing national accounts series are no longer thought to be sufficient and reliable for policy formulation. Therefore, sustained efforts are needed for the national accounts authorities to incorporate shadow economy into the official statistics in order to establish reliable estimates. The resulting robust national accounts series will enable more sound and meaningful analysis of the country's economy.

Most existing studies on this subject have paid more attention in the advanced economies while less focus on developing countries. Therefore, the aim of this study is to estimate the size of the shadow economy in Malaysia over the period of 1972-2012 using the traditional currency demand approach. In particular, we employed ARDL method to examine the long-run relationship between currency demand and its determinants - indirect tax revenue to GDP ratio, interest rate, income per capita and inflation rate. Shadow economy was calculated based on the long-run estimates of the currency demand function.

Our results further suggest that higher level of economic development will be able to reduce the size of the shadow economy. Higher economic development commensurate with higher income will enable the population to enjoy their livelihood without resorting to participate in the shadow economy. Furthermore, any policy that can increase the employment level as well as reducing the tax burden of the people will potentially be an important policy action that can mitigate the activities of the shadow economy in Malaysia.

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