Estimating the magnitude of money laundering in the United Arab Emirates (UAE): evidence from the currency demand approach (CDA)

Mariam Aljassmi, Awadh Ahmed Mohammed Gamal and
Norasibah Abdul Jalil
Department of Economics, FPE, UPSI, Tanjung Malim, Malaysia
Joseph David
Lagos Business School, Pan-Atlantic University, Lagos, Nigeria, and
K. Kuperan Viswanathan
*Haas School of Business, University of California Berkeley,
Berkeley, California, USA*

Abstract

Purpose – Despite the vulnerability of rapidly developing and emerging market economies, researchers have paid less attention to the determination of the size of money laundering (ML) in these economies, including the United Arab Emirates (the UAE). Therefore, this paper aims to estimate the magnitude of ML in the UAE between 1975 and 2020 based on the currency demand approach (CDA).

Design/methodology/approach – The study uses the Gregory–Hansen cointegration technique alongside the autoregressive distributed lag bounds testing procedure to estimate the CDA model.

Findings – The results illustrate that an amount equivalent to about 19.034% of the GDP is laundered in the UAE between 1975 and 2020, on average, with the value lying between 15.129% and 23.121%. In addition, the results demonstrate the importance of the real estate market, gold trade, remittance channels and the size of the underground economy in facilitating the laundering of illicit funds in the country.

Originality/value – To the best of the authors' knowledge, the study is the pioneering attempt at estimating the amount of illicit funds laundered in the UAE. Besides, the adoption of a novel, yet robust, approach based on the modification of the CDA technique also sets the study apart as it ensures a correct, clear, unambiguous and indisputable estimate of the magnitude of ML is obtained. In addition, it is expected that the outcome of the study will expand the frontiers of knowledge among policy makers and relevant agencies and ensure the adoption of the most efficient and effective measures to curb the ML menace in the country.

Keywords Money laundering, Currency demand approach, ARDL, the UAE

Paper type Research paper

1. Introduction

One of the most remarkable features of the final decades of the 20th century is the rapid integration of the global economy through trade and technological advancement. It is widely

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believed that the removal of the traditional economic barriers has created a number of benefits, including the increase in international trade and capital mobility, rapid development of global financial market and the diffusion of technology, among others. However, such development was not with some costs. One notable, albeit very destructive, of such costs is money laundering (ML) (Bhattacharjee *et al.*, 2020). ML is simply the process of moving, disguising and integrating the proceeds of illegal or criminal activities (such as drug trafficking, human trafficking, illegal arms deal, grand corruption and large-scale tax evasion) into the mainstream economy to obscure its link with the underlying activity or people involved (Javaid and Arshed, 2021).

It is widely debated in the literature that ML activities often create both winners and losers. On the one hand, it is argued that the inflow of illicit funds for laundering may be beneficial to an economy through its role in expanding the financial service sector, lowering interest rate, creating income and improving access to finance (Alldridge, 2008; Unger, 2007). In contrast, evidence suggest that the possible economic, social and political consequences of ML activities, if left unchecked, are, at least, profound. These include the damage of investment potentials, destruction of the stability, integrity and reputation of the financial sector, loss of tax revenues, enablement of crime and corruption, distortion of international trade, capital flows and exchange rates and the inexplicable changes in interest rate, asset prices, consumption and money demand, among others (Alldridge, 2008; Bhattacharjee *et al.*, 2020; Pietschmann and Walker, 2011; Villa *et al.*, 2019).

In the recent decades, scholars, regulatory authorities and international organizations have put forward some estimates of the magnitude of ML at the national and global level in an attempt to give some sense of the scale of the phenomenon. One of the notable figures of ML was put forward by the International Monetary Fund (IMF). In 1998, IMF reported that the size of ML is between 2% to 5% of global gross domestic product (GDP). The absence of any "supporting material and methodology documenting how the 'consensus' estimate was established," and the tendency of the estimates (or "guesstimates") over or underestimating the magnitude of the issue has often limit its acceptability (Walker and Unger, 2009). Besides the IMF's estimates, several scholars and researchers have proposed and used series of approaches to determine the size of ML globally and within national economies (Ardizzi *et al.*, 2018; Argentiero *et al.*, 2008; Bagella *et al.*, 2009; De Boyrie *et al.*, 2005; Ferwerda *et al.*, 2013, 2020; Pietschmann and Walker, 2011; Schneider, 2007; Tanzi, 1997; Teichmann, 2020a; Unger, 2007; Walker, 1999; Zdanowicz, 2005).

Despite the numerous efforts in quantifying the magnitude of ML from different perspectives, it is apparent that the efforts are typically in favor of developed economies. Whereas evidence point to the fact that rapidly developing and emerging market economies are most vulnerable to the activities of money launderers, researchers have paid less attention to the determination of the magnitude of ML in these countries (Hendriyetty and Grewal, 2017). Unlike most rapidly developing economies, the United Arab Emirates' (the UAE's) geographic proximity to conflict zones and large illicit opium cultivation zones, together with its sizable and open financial sector, booming real estate market, highly active gold trade, large amount of remittances, cash-based economy, thriving underground economy and the population of migrants, present the country with inherent vulnerability to significant risks of attracting illicit funds from around the world for laundering [Centre for Advanced Defence Studies (C4ADS), 2018; Financial Action Task Force (FATF), 2020].

Beyond the seeming vulnerability of the UAE to ML, available evidences equally demonstrate the position of the country as a favorable pass-through for illicit financial flows and a significant destination for illicit funds for laundering (C4ADS, 2018). Moving from one sector to another, this position is well accentuated by the plethora of evidences which demonstrate the prevalence of the laundering of illicit funds in the country, notably through the real estate market, gold and diamond trade, financial sector and the money exchange markets. Notable cases include the recent smuggling of "stolen" US$169m into the country by former Afghan President Ashraf Ghani in 2021 (Hockaday and Brazell, 2021), and the multi-million-dollar property purchases by drug traffickers, corrupt current and former public office holders, conflict and terrorist financers and weapon traffickers and proliferators from developing countries in Europe, Middle East, Asia and Africa (C4ADS, 2018; Organised Crime and Corruption Reporting Project (OCCRP), 2019; Sarukhanyan, 2019). Others include the alleged laundering of about US$173m of Angola's oil money by Isabel dos Santos, daughter of former Angola's President, through Emirates NBD Bank account in 2017 (Freedberg *et al.*, 2020), as well as the laundering of over US$26m and US $357m through Abu Dhabi Commercial Bank and Emirates NBD, respectively, in the "Russian Laundromat" scandal [Organised Crime and Corruption Reporting Project (OCCRP), 2017]. The use of Dubai-based Al Zarooni Exchange by Khanani money laundering organization to launder between US$14bn and US$16bn in illicit proceeds annually for terrorist groups, drug cartels and organized crime groups around the world as another notable example (C4ADS, 2018).

Giving the prevalence of ML activities in the country, the importance of determining the amount of "dirty money" entering the country's laundering cycle cannot be overstressed. In the literature, several approaches have been proposed to determine the magnitude of ML. This includes the use of case studies, surveys, interviews, analysis of suspicious/unusual transactions and statistical discrepancies in official data and economic and econometric models (Pietschmann and Walker, 2011). However, the adequacy of these models is difficult to determine due in part to the number of biases or key information gaps which characterized most, if not all, the approaches. However, it is suggestive that a clear, unambiguous and indisputable estimate of ML in the UAE may be obtained by adopting the modified currency demand approach (CDA). The approach is the modified version of the well-known CDA which has been extensively employed to estimate the size of underground economy – another phenomenon which cannot be observed directly – in several countries, including in the UAE (Gamal and Dahalan, 2015).

Following Ardizzi *et al.* (2014), the traditional CDA can be adopted to estimate the volume of ML based on the argument that ML activity, like other aspects of the underground economy, is characterized by the use of both cash and demand deposits (Talani, 2018). Using the CDA function, the amount of illicit funds laundered in the UAE can be determined by separating demand for cash influenced by conventional transactions (legal transactions, tax evasion and underground economy) from those driven by the need to launder the proceeds of criminal and illegal activities. This can be achieved by refining the "drive" parameter(s) in the traditional CDA model to capture the factors that influence the demand for cash for laundering. In the case of the UAE, the "drive" factor(s) will include activities in the real estate market, gold trade, remittances, underground economy and military procurement which are reported to benign the thriving of ML activities in the country. One major issue with the use of the CDA to estimate ML is its likelihood of double counting. Fortunately, this is not an issue as the UAE, despite having one of the most developed banking systems in the world, is a cash-based economy (FATF, 2020).

Against this background, the present study seeks to estimate the magnitude of ML in the UAE between 1975 and 2020 using a modified version of the CDA model. The study is topical and justifiable for several reasons. First, the study is a pioneering effort to determine the magnitude of ML in the UAE. The important of determining the size of ML in the UAE cannot be trivialized. Among other things, the availability of such information can help policymakers and relevant stakeholders in visualizing the magnitude of the phenomenon and the extent of the country's risk and vulnerability, to enable the adoption of the most appropriate policy response (Ferwerda *et al.*, 2020). A correct estimate of ML is equally important for determining the dimension of the criminal economy and understanding the behavior of money launderers and the effect of their activities (Argentiero *et al.*, 2008). Additionally, the information on the size of ML can assist public and private entities determine the cost of implementing anti-money laundering measures and justify the burden placed on those responsible for chasing dirty money (Ferwerda *et al.*, 2013). Second, the study is very topical given the adoption of a novel, yet robust, approach based on the modification of the traditional CDA technique aimed at obtaining a correct, clear, unambiguous and indisputable estimate of the magnitude of ML in the UAE. Lastly, by quantifying the amount of illicit funds laundered in the UAE, outcomes from this study are expected to expand the frontiers of knowledge among policy makers and relevant agencies to ensure the adoption of the most efficient and effective measures to eliminate the ML menace in the country.

The rest of this paper is organized as follows. Section 2 describes the CDA methodology, the data and estimation techniques. The results are presented and discussed in the Section 3. Lastly, the conclusion and policy recommendations are provided in the Section 4.

2. Methodology and data

2.1 Model specification

Following Ardizzi *et al.*'s (2014) modification of the traditional CDA model, the CDA model can equally be extended to estimate the magnitude of ML in the UAE by incorporating the demand for money motivated by the intent to launder "dirty money" (X^{ML}), as well as the determinants of the money demand for legal transactions (X^{L}) and underground economic activities (X^{UE}) into the currency demand model. Assuming that M1, X^{ML}, X^{L} and X^{UE} are linearly related, the modified CDA models is specified as follows:

$$M1_t = \alpha_0 + \sum_k \alpha_k X_t^{ML} + \sum_h \alpha_h X_t^{L} + \sum_j \alpha_j X_t^{UE} + \mu_t \quad (1)$$

where $M1_t$ denotes currency in circulation at time t, X_t^{ML} is the ML component of money demand, X_t^{L} represents the legal component of money demand and X_t^{UE} denotes the underground component of money demand. α_0 denotes intercept; α_k, α_h and α_j represent the vector of the coefficients of the three component determinants of money demand; and μ_t is the stochastic error term.

Based on the evidences from the literature and reports of notable organizations, it is imperative that the demand for cash for ML in the UAE is driven by factors and/or activities in the real estate market (RES), gold trading (GB), money remittance-related activities (OUM) and defence procurement and spending (MIL). For instance, besides the absence of due diligence on source of funds and mandatory reporting of beneficial ownership, and weak financial regulation, reports have indicated the heavy use of cash in real estate and gold transactions as a key facilitator of ML activities in the UAE (Blore and Hunter, 2020; C4ADS, 2018; FATF, 2020; Kirechu and Vittori, 2020; Lezhnev and Swamy, 2020; Teichmann and Falker, 2020a). Also, while evidence of the movement of cash for laundering through remittance systems abounds (see FAFT, 2020; Siddique *et al.*, 2022; Teichmann and Falker, 2020b), the growing size of the country's defence budget despite its small population and the inherent secrecy and lack of transparency in defence budget demonstrate the possible laundering of illicit income through arms import vehicle (Page, 2020).

Similarly, with regards to the legal component of money demand (X^L), it is well documented in the economic literature that factors such as interest rate (opportunity cost of holding cash), formal economic activity, inflation rate, diffusion of financial technology, financial literacy, payment practices, among others influence the demand for cash (Ardizzi *et al.*, 2014). Notably, studies such as Gamal and Dahalan (2015) suggest that the demand for cash for legal transactions is mainly driven by factors such as national output (Y), interest rate on deposits (i) and inflation rate (π) in the UAE. Lastly, the size of the underground economy (UE) is considered to explore the demand for cash for underground economic activities. Premised on the argument that transactions and activities (including ML) in the underground economy are mainly conducted using cash, it is clear that the size of underground economy and the demand for money are strongly related (Cagan, 1958; Tanzi, 1983).

Based on the above submission, equation (1) is re-specified as follows:

$$M1_t = \alpha_0 + \alpha_1 RES_t + \alpha_2 GB_t + \alpha_3 OUM_t + \alpha_4 MIL_t + \alpha_5 Y + \alpha_6 i_t + \alpha_7 \pi_t + \alpha_7 UE_t + \mu_t \tag{2}$$

By taking the logarithm of the variables (except those in rates) to reduce skewness, the model in equation (2) is rewritten as follows:

$$lM1_t = \alpha_0 + \alpha_1 lRES_t + \alpha_2 lGB_t + \alpha_3 lOUM_t + \alpha_4 lMIL_t + \alpha_5 lY + \alpha_6 i_t + \alpha_7 \pi_t + \alpha_7 UE_t + \mu_t \tag{3}$$

The expected signs of the coefficient of the regressors in equation (3) are as follows:
α_1, α_2, α_3, α_4, α_5, and $\alpha_9 > 0$; α_6 and $\alpha_7 < 0$.

2.2 Estimating the magnitude of money laundering

Following the modification of the CDA procedure by Ardizzi *et al.* (2014), the amount of illicit funds laundered in the UAE is estimated in three steps. The first step is the estimation of the money demand model in equation (3). In the second step, we derive both the predicted values of currency holding for each year based on the full model with all incorporated factors $\left(ln\hat{M}1_t^{ML}\right)$ and a restricted version with the ML-component factors set to zero $\left(ln\hat{M}1_t^{WML}\right)$. In the last step, the amount of illicit funds laundered every year is obtained by subtracting $ln\hat{M}1_t^{ML}$ from $ln\hat{M}1_t^{WML}$. In other words, the annual estimate of ML is derived as follows:

$$ML_t = \left(ln\hat{M}1_t^{ML} - ln\hat{M}1_t^{WML}\right) \tag{4}$$

To have measurements which are compatible with existing studies, the estimates are normalized and expressed in relation to the total money in circulation and the nominal GDP.

2.3 Econometric procedure

To estimate the money demand model, the Gregory–Hansen cointegration approach (GH) and the autoregressive distributed lag (ARDL) bounds testing procedure are adopted.

2.3.1 Model specification. The GH, proposed by Gregory and Hansen (1996), is adopted to capture and identify the exact structural break in the cointegrating (long-run) relationship between money demand and the selected variables. Whereas the technique is an extension of the Engle–Granger cointegration test; it is, however, more superior to the test given the fact that its make provision for possible structural breaks, thus making it robust in the presence of structural breaks in the cointegrating relationship. To determine cointegration between series, Gregory and Hansen (1996) presented three models based on different assumptions about the form of the structural beaks in the cointegrating relationship. The models assume a possible structural change in the level shift (*C*), level shift with trend (*C*/*T*) and a regime shift (*C*/*S*), in the co-integrating relationship. The third assumption allows the co-integrating relationship to rotate and shift in a parallel fashion.

Therefore, given a bivariate model with variables y_t and x_t which are both integrated of order one (i.e. $I(1)$), but e_t, the error term, is $I(0)$, the specifications for the three models are given as follows:

Model 1: Level shift at unknown time break-point, T_b (*C*):

$$y_t = \mu_1 + \mu_2\varphi_{t\tau} + \alpha_1 x_t + e_t, t = 1, \ldots, n \tag{5}$$

Model 2: Level shift with the trend at unknown time break-point, T_b (*C*/*T*):

$$y_t = \mu_1 + \mu_2\varphi_{t\tau} + \mu_3 t + \alpha_1 x_t + e_t, t = 1, \ldots, n \tag{6}$$

Model 3: Regime shift or full break where both the level shift and the slope coefficients change at unknown time break-point, T_b (*C*/*S*):

$$y_t = \mu_1 + \mu_2\varphi_{t\tau} + \alpha_1 x_t + \alpha_2 x_t\varphi_{tk} + e_t \;\; t = 1, \ldots, n \tag{7}$$

where y_t is the dependent variable, x_t represents a vector of covariates, μ_1 is the intercept before the level change or shift and μ_2 denotes the change in the intercept at the time of the shift/break. α_1 denotes the co-integrating slope coefficients before time break occurs (regime shift), α_2 is the change in the slope coefficients of the co-integrating system after time break occurs, e is an error term, t denotes time subscript and φ represents dummy variable defined as follows:

$$\varphi_{t\tau} = \begin{cases} 0 \;\, if \;\; t \leq [n\tau] \\ 1 \;\, if \;\; t > [n\tau] \end{cases}$$

where the unknown parameter $\tau \in (0, 1)$ denotes the (relative) timing of the change point, and [.] denotes the integer part.

As the time break-points are endogenously determined, Gregory and Hansen (1996) constructed three test statistics (ADF^*, Z^*_α and Z^*_t), which corresponds to the traditional ADF test and Phillips-type unit root tests. The time break date is then chosen at a value which the absolute value of the test statistic is at its maximum compared to the critical values provided by Gregory and Hansen (1996). Therefore, the null hypothesis of no co-integration is rejected if the ADF^*, Z^*_α or Z^*_t statistic exceeds the corresponding critical value; else, the null hypothesis cannot be rejected. The rejection of the null hypothesis denotes that the linear combination of the series exhibits stable properties in the long term, albeit in the presence of a structural break.

2.3.2 Autoregressive distributed lag bounds testing procedure. The ARDL bounds testing cointegration procedure of Pesaran *et al.* (2001) is used to estimate the currency demand model and equally examine the cointegrating relationship between the series. The justification for the adoption of the procedure is based on the several advantages which it has over conventional cointegration techniques including its flexibility and robustness in assessing cointegrating relationship regardless of the sample size and order of integration of the regressor(s), its use of a dynamic single-equation error correction specification to simultaneously estimate the short- and long-run parameters of a model and the provisions for both the explained and explanatory variables to have different lags (Abu *et al.*, 2021).

Generally, a bivariate ARDL model can be specified as follows:

$$y_t = \alpha + \sum_{i=1}^{p} \beta'_i y_{t-i} + \sum_{i=0}^{q} \vartheta'_i x_{t-i} + \varepsilon_t \quad (8)$$

where i and j are the index of lags, $i = 1, 2, \ldots, p$; $j = 0, 1, 2, \ldots, q$. $t = 1, 2 \ldots, T$ denotes time. y_t is the dependent variable, x_t is the independent variable. β_i and ϑ_i are the coefficient of the lags of y_t and x_t, respectively, and α is the constant term, and ε_t is the error term.

Equation (8) can be re-parameterized and expressed in an error correction representation as follows:

$$\Delta y_t = \alpha + \rho' y_{t-1} + \gamma' x_{t-1} + \sum_{i=1}^{p} \lambda'_i \Delta y_{t-i} + \sum_{i=1}^{q} \delta'_i \Delta x_{t-i} + \varepsilon_t \quad (9)$$

where Δ represents the difference operator; λ_i and δ_i are functions of the original parameters in equation (8). $\rho = -\left(1 - \sum_{i=0}^{p} \beta_i\right)$, and $\gamma = \sum_{j=0}^{q} \vartheta_j$.

Following Pesaran *et al.* (2001), the cointegration between y_t and x_t is established by testing the null hypotheses of no cointegration H_0: $\rho = \gamma = 0$ against the alternative of cointegration H_1: $\rho \neq \gamma \neq 0$. To reach a valid conclusion, the null hypothesis must be rejected. To make this conclusion, the F-statistics computed from Wald test is compared with the upper and lower critical bounds provided by Pesaran *et al.* (2001). H_0 can only be rejected if the f-statistic value exceeds the upper critical bound value. However, the inference in inconclusion if the computed test statistic falls between the lower and upper bounds. If cointegration is established, then the long-run estimate is obtained by normalizing the coefficients of the lagged explanatory variables (γ) by the coefficient of lagged dependent variables (ρ), i.e. $-(\gamma/\rho)$.

The dynamics short-run ARDL-ECM model is specified as follows:

$$\Delta y_t = \alpha + \sum_{i=1}^{p} \zeta'_i \Delta y_{t-i} + \sum_{i=1}^{q} \xi'_i \Delta x_{t-i} + \phi \mu_{t-1} + \varepsilon_t \quad (10)$$

where ϕ is the coefficient of the error term lagged by one period (μ_{t-1}). It represents the speed of adjustment back to equilibrium in the long-run following a deviation from the equilibrium in the short-run.

3. Empirical results

This section presents the results obtained from the time series data analysis using different techniques.

3.1 Results of unit root test

Prior the estimation of the money demand model, and thus determination of the magnitude of ML, the augmented Dickey–Fuller (ADF) and Zivot–Andrews (ZA) unit root tests are conducted to determine the properties of the underlying time series. The results are reported in Table 1. The results of the ADF and ZA tests presents sufficient evidence to reject the null hypothesis of nonstationarity (unit root) in all the series at 5% significance level. However, while the ADF test indicate that the arms import and inflation rate are integrated at order I (0) and the remaining variables are integrated of order I(1) process, ZA test suggest that money demand, gold trade, arms import and interest rate are integrated of order I(0) and the rest I(1) process. Regardless, both tests confirm that the series are mixture of I(0) and I(1), thus providing the basis for using the ARDL bounds testing procedure.

3.2 Cointegration test results

To determine the cointegrating relationship in the currency demand model, the GH and the ARDL bounds testing cointegrating procedure of Pesaran *et al.* (2001) are adopted. The results of the GH and ARDL bounds testing are summarized in Tables 2 and 3, respectively. The GH results reveal that the value of *ADF** test statistic (–5.404) exceeds the −4.61 critical value at 5% level of significance in GH-1 (cointegration equation with level shift). However, the test statistic value is less than the critical values in the GH-2 and GH-3 models. Thus, there exist sufficient evidence to conclude on the presence of cointegration between

	ADF			ZA				
Variable	Level	1st diff.	I(d)	Level	T_b	1st diff.	T_b	I(d)
*lM*1	−1.709	−6.338**	I(1)	−5.188**	2011	–	–	I(0)
lRES	−1.069	−5.489**	I(1)	−4.883	1993	−6.336**	1988	I(1)
lGB	0.222	−5.287**	I(1)	−5.539**	2006	–	–	I(0)
lOUM	0.125	−5.999**	I(1)	−3.754	2012	−6.841**	1985	I(1)
lMIL	−3.209**	–	I(0)	−−5.960**	1986	–	–	I(0)
lY	−2.009	−4.643**	I(1)	−3.824	1985	−5.045**	1989	I(1)
i	−2.255	−4.585**	I(1)	−6.027**	1985	–	–	I(0)
π	−2.932**	–	I(0)	−4.014	2003	−6.439**	2009	I(1)
UE	−1.441	−6.5623**	I(1)	−4.819	1991	−6.653**	2000	I(1)

Notes: *I*(*d*) denotes variables' order of integration. Tests are conducted with intercept (random walk with drift). ADF's MacKinnon's (1996) critical values for intercept are given as: −3.60, −2.93 and −2.60, at 1%, 5% and 10% levels, respectively. Zivot and Andrews (1992) critical values for intercept break are −5.34 (1%), −4.93 (5%) and −4.58 (10%). Asterisks (**) indicate significance at 5% level
Source: Estimation's output

Table 1. Results of ADF and ZA unit root tests

Model	ADF*	T_b	*t*-critical	Decision
GH-1 (Level shift)	−5.404**	2009	−4.61	Reject null hypothesis
GH-2 (Level shift with trend)	−4.612	2011	−4.72	Accept null hypothesis
GH-3 (Region shift of full break)	−4.162	2011	−4.68	Accept null hypothesis

Notes: T_b is time break. Asterisk (**) denote statistical significance at 5 % level. Critical values are obtained from Gregory and Hansen (1996, Table 1, p. 109) for $m = 1$
Source: Estimation's output

Table 2. Results of Gregory–Hansen cointegration test

the series, with structural breaks occurring in the level shift. The 2009 break date point associated with GH-1 model coincides with the 2008/2009 global financial and economic crisis which dealt a heavy blow on the country's economy, leading to the contraction of key sectors of the economy, including real estate, construction, tourism and financial services, among others. The period is equally associated with the large-scale capital outflow and sharp increase in money demand in the country.

In addition, the results of the ARDL bounds testing (with the inclusion of a 2009 break dummy) illustrate that the F-statistics (4.343) exceeds the upper critical bound value (3.15) at 5% significance level. Thus, the null hypothesis of no cointegration between the series can also be rejected. In other words, there is a significant cointegrating (long-run) relationship between money in circulation and the selected ML-induced determinants of money demand.

3.3 Estimation results of the autoregressive distributed lag model

Following the determination of cointegration between the series, the results of the selected ARDL model is presented in Table 5. The long-run and short-run estimates, and the post-estimation diagnostics results are summarized in panel A, panel B and panel C of Table 5, respectively.

The long- and short-run results illustrate that all the variables, except gold trade, outflow of money and size of underground economy, have the expected signs. Particularly, the results demonstrate that activities in the real estate market, arms importation, expansion of the national output and inflation rate are important drivers of money demand both in the short- and long-run. This finding supports the findings of existing studies (Gamal and Dahalan, 2015; Gamal, Dahalan and Viswanathan, 2019, 2020; Gauci and Rapa, 2020). In contrast, the results suggest that activities in the gold market, the outflow of money, interest rate and the size of the underground economy discourage the demand for money, both in the short and long run. The negative relationship between money demand and deposit interest rate is consistent with economic theory and recent empirical studies (Gamal and Dahalan, 2015; Gauci and Rapa, 2020; Schneider and Hametner, 2014). However, the adverse effect of the size of underground economy on money demand is a likely scenario following the adoption of a cashless monetary policy in response to expansion in the demand for money underground activities.

Lastly, the results reveal that the coefficient of the error correction term lagged by one period (ECT_{t-1}), which represents the speed of adjustment towards long-run equilibrium, is correctly signed, less than one and significant at 1% level. The size of the coefficient implies that about 68% of disequilibrium in the short term will be corrected within one year.

Lag length	F-statistic	Bounds I(0)	10% 1.85	5% 2.11	1% 2.62
1, 3, 1, 2, 0, 1, 2, 3, 2	4.343**	I(1)	2.08	3.15	3.77

Notes: K is the number of explanatory variables, and N represents the sample size. Asterisk (**) denotes significance at 5% level based on critical values provided by Pesaran *et al.* (2001). The optimal lag-length is suggested by AIC
Source: Authors' estimation output

Table 3. Results of ARDL bounds testing

3.4 Results of post-estimation diagnostics and model stability tests

To determine the adequacy and stability of the estimated model some post-estimation tests are conducted. The results of the tests in panel C of Table 4 demonstrate that the estimated ARDL model is free from the issues of serial-correlation, heteroscedasticity, non-normality and specification bias. Furthermore, the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) plots presented in Figure 1(a) and (b), respectively, indicate that the parameters of the estimated model are stable over time.

Furthermore, the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) plots presented in Figure 1(a) and 1(b), respectively, indicate that the parameters of the estimated model are stable over time.

3.5 Analysis of the magnitude of money laundering in the UAE

Following the Tanzi (1983) procedure, the magnitude of ML in the UAE between 1975 and 2020 is estimated based on the long-run estimates of the ARDL model in panel A of Table 5. The results are summarized in Table 5 and the plot presented in Figure 2. The results suggest that the amount of illicit funds laundered in the UAE is enormous. For instance, as a percentage of the GDP, the result demonstrate that the magnitude of illicit funds laundered in the UAE (as a share of the GDP) varies between 15.129 (2007)% and 23.121 (1977)%, with an average of about 19.034% during the 1975–2020 period. Similarly, as a percentage of the money in circulation (M1), the results reveal that the size of illicit funds laundered in the

Panel A: ARDL (1,3,1,2,0,1,2,3,2) Long-run estimates – Dependent variable: $lM1$

C	$lRES$	lGB	$lOUM$	$lMIL$	lY	i	π	UE
−8.92**	1.12***	−0.99*	−0.021**	0.15*	1.61***	−0.011*	0.049***	−0.073**
(−2.88)	(2.96)	(−1.68)	(−2.55)	(1.84)	(3.49)	(−1.94)	(4.24)	(−2.26)

Panel B: ARDL (1,3,1,2,0,1,2,3,2) Short-run estimates – Dependent variable: $\Delta lM1$

Regressors	Lag order		
	0	1	2
$\Delta lRES$	0.244 (1.592)*	−0.287 (−1.418)*	−0.446 (−3.236)**
ΔlGB	−0.104 (−1.142)		
$\Delta lOUM$	−0.359 (−2.937)**	−0.351 (−2.929)**	
ΔlY	0.020 (0.074)		
Δi	−0.021 (−3.505)**	0.014 (2.369)**	
$\Delta\pi$	0.019 (4.680)**	−0.012 (−3.231)**	0.027 (6.332)**
ΔUE	−0.015 (−2.181)**	0.040 (6.346)**	
D_2009	0.009 (0.129)		

Panel C: Diagnostic statistics tests

ECT_{t-1}	$\chi^2_{SC}(3)$	$\chi^2_{FF}(1)$	χ^2_{HET}	χ^2_{NORM}	$Adj.R^2$
−0.68** (–8.07)	3.301 [0.07]	1.97 [0.41]	18.80 [0.76]	1.53 [0.47]	0.863

Notes: Δ represent first difference operator. Asterisk (***), (**) and (*) denote significance at 1%, 5% and 10% level, respectively. Values in parenthesis (.) in panels A and B are the *t*-ratio, and values in square parenthesis [.] in panel C are the probability values of the LM test statistics. χ^2_{SC}, χ^2_{HET}, χ^2_{N} and χ^2_{FF} denote BG LM tests for serial correlation, BPG LM test heteroscedasticity, JB normality test and Ramsey RESET *f*-statistic, respectively. The model is estimated by setting the maximum lag to 4, while the optimal lag-length is suggested by AIC

Source: Authors' estimation output

Table 4. Estimation results of ARDL model for UAE's currency demand model

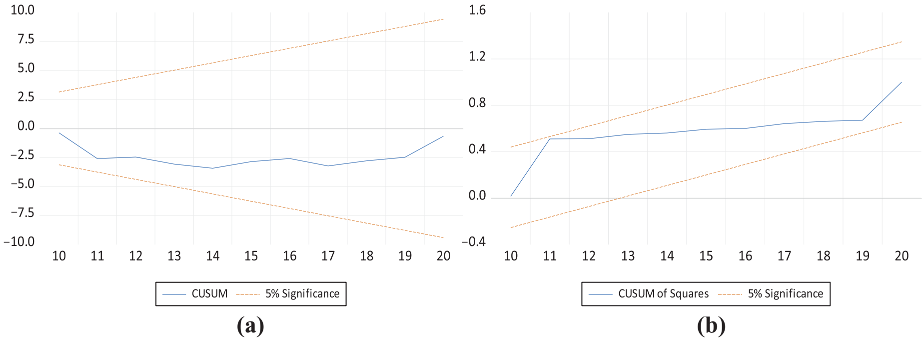


Figure 1.
Plot of (a) CUSUM and (b) CUSUMQ

Source: Eview's Output

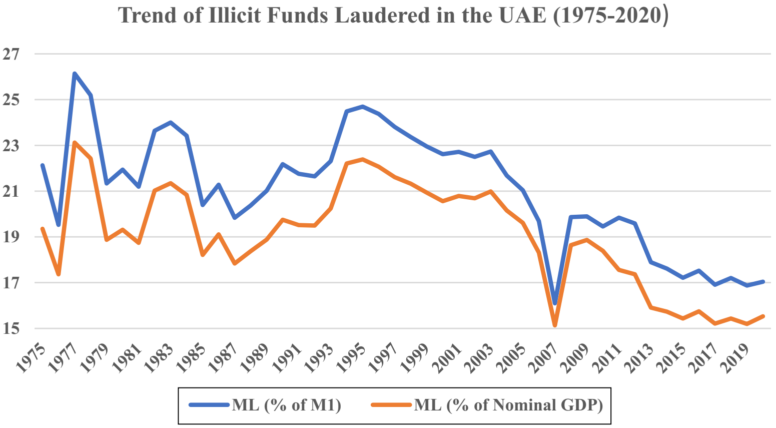
Table 5.
Estimates of illicit funds laundered in the UAE during the 1975–2020 period

Year	ML (% of M_1)	ML (% of GDP)	Year	ML (% of M_1)	ML (% of GDP)
1975	22.128	19.351	1998	23.368	21.326
1976	19.527	17.364	1999	22.954	20.935
1977	26.143	23.121	2000	22.614	20.562
1978	25.190	22.429	2001	22.717	20.788
1979	21.335	18.871	2002	22.497	20.689
1980	21.939	19.312	2003	22.729	20.986
1981	21.195	18.738	2004	21.681	20.153
1982	23.640	21.021	2005	21.039	19.611
1983	23.998	21.348	2006	19.687	18.311
1984	23.424	20.834	2007	16.094	15.129
1985	20.392	18.211	2008	19.867	18.639
1986	21.278	19.108	2009	19.898	18.868
1987	19.834	17.834	2010	19.457	18.389
1988	20.374	18.375	2011	19.839	17.557
1989	21.019	18.881	2012	19.585	17.364
1990	22.181	19.747	2013	17.894	15.906
1991	21.759	19.515	2014	17.611	15.732
1992	21.645	19.493	2015	17.212	15.432
1993	22.309	20.239	2016	17.523	15.748
1994	24.488	22.209	2017	16.908	15.211
1995	24.695	22.385	2018	17.203	15.429
1996	24.376	22.065	2019	16.871	15.191
1997	23.808	21.611	2020	17.039	15.527

Source: Author's computation based on the long-run estimates of ARDL model in panel A of Table 4

country is about 21.064% of money in circulation, on average, lying between 16.094 (2007)% and 26.143% (1977).

The results generally indicate the variation in the size of illicit funds laundered in the country between 1975 and 2020. However, while the 1975–1987 period was characterized by marked variations, the periods between 1988 and 1997 saw the magnitude of illicit funds laundered in the country increasing. Between 1996 and 2009, it was observed that that the magnitude of illicit funds laundered in the country declined rapidly. Such reduction may be



Source: Authors' Preparation

Figure 2.
Plot of the size of illicit funds laundered in the UAE: 1975–2020 period

attributed to the efforts of the government in clamping down on the laundering of illicit funds in the country, due in part to the immense pressure from Western countries, intergovernmental organizations and nongovernmental organizations. Unfortunately, the decrease was not sustained for too long as the amount of illicit funds laundered rose rapidly in 2008 and 2009 before eventually taking a downward posture from 2010 to 2020.

Besides, in comparison, the results suggest that the 19.034% average of illicit funds laundered (as a share of the GDP) in the UAE between 1975 and 2020 exceeds the ML estimate of countries such as the USA (13 %, 2000–2007 period), EU-15 countries – Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the UK – (19 %, between 2000 and 2007) (Bagella *et al.*, 2009). The estimate also exceeds Italy's 12.17% during the 1981–2001 period; Colombia's 4.7% between 1985 and 2013; Italy's 6.4% during 2005–2008 period; and the 1.9% of 36 OECD countries between 2009 and 2014 (Ardizzi *et al.*, 2014; Argentiero *et al.*, 2008; Ferwerda *et al.*, 2020; Loayza *et al.*, 2019; Villa *et al.*, 2019).

4. Conclusion

This study provides a rather convincing estimates of the amount of illicit funds laundered in the UAE during the 1965–2020 period following the recently improved CDA procedure. Using the GH and the ARDL bounds testing approach, the results suggest that between 1975 and 2020, an amount equivalent to about 19.034% of the GDP is laundered in the UAE, on average, with the value lying between 15.129% and 23.121%. The results clearly reflect the enormous size of dirty money being laundering in the country despite the actions of the government. Moreover, the results demonstrate the importance of the real estate market, gold trade, remittance channels and the size of the underground economy in facilitating the continuous laundering of illicit funds in the country.

Based on these findings, the following recommendations are provided to ensure the sustained decline in ML activities in the country. First, the government is advised to strengthen existing laws and regulations and abolish the culture of secrecy and anonymity which characterize most transactions in the country's lucrative sectors. This will also include the overhaul of the complex but lax regulatory arrangement across the country's extensive offshore sector to block the many loopholes and opportunities which such complexity creates for ML. Second, the country is encouraged to improve its cooperation and collaboration with international partners to help disrupt the illicit financial flows and facilitate ML investigations. Third, to deter the use of the country's real estate market as vehicles for ML, the country is enjoined to improve the transparency of transactions in the market through the adoption of a robust reporting framework and the creation of a detailed and centralized beneficial ownership database. Fourth, the governments of the Emirate are advised to effectively monitor activities in the Gold Souk, discourage the use of cash for transactions in the precious stones and metals market and adopt a central immigration system across the international airports to strengthen the country's customs control against the smuggling of cash and precious stones and metals. Fifth, the government is encouraged to adequately regulate the Hawala payment system and ensure its transparency and equally remove the barriers in the use of official money transfer channels which encouraged the patronage of the alternative money transfer systems. Lastly, it is the government is enjoined to implement policies and measures which will ensure the decline in the size of underground economy in the country.

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Corresponding author

Awadh Ahmed Mohammed Gamal can be contacted at: awadh.gamal@fpe.upsi.edu.my