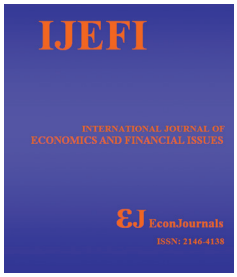

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An Analysis of The Shadow Economy in Malta: A Currency Demand and MIMIC Model Approach

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ABSTRACT

The paper applies two commonly used methods in the literature to estimate the shadow economy in Malta, the Currency Demand Approach and the Multiple Indicator Multiple Causes (MIMIC) model. Given the unobservable nature of the shadow economy, estimates are surrounded by a considerable degree of uncertainty. While these two methods differ somewhat on the historical evolution of the size of the Maltese shadow economy, which in turn can be traced back to their different underlying assumptions, both suggest that it has remained relatively stable over the last decade, standing at just below 21% of official GDP in 2019. Where possible, these estimates are compared to other studies on the same subject where we find that the dynamic properties of our variable follow those found in the literature.

Keywords: Shadow Economy, Structural Modelling, MIMIC, Currency Demand Approach, Malta
JEL Classifications: C32, E26, H26, O17

1. INTRODUCTION

The effects of the shadow economy on citizens, firms and government are numerous with repercussions on many aspects of the economic and social life of a country. As pointed out by Dell'Anno (2007), the shadow economy leads to the inefficient functioning of the goods and labour markets. A growing underground economy lures workers away from the official economy as workers are attracted to higher take-home wages, in turn leading to undue supply pressure on firms which try to tap labour resources through the official market. This creates considerable distortions in market competition with detrimental effects on overall economic activity and welfare. Moreover, the decision of entrepreneurs and employees to work outside the fiscal regulatory framework reduces government revenue, negatively affecting the tax base of government, in turn reducing the quality and quantity of expenditures on public goods. It also distorts official indicators (growth, unemployment, income distribution etc.) thereby influencing public sector decisions. On the other hand, literature also highlights potential positive aspects of the shadow economy. It is believed that the shadow economy creates an extra added value that can be spent in the official economy with several studies indicating that two-thirds of the income earned in the shadow economy is ultimately spent in the formal economy (see Schneider and Enste, 2002 and Williams and Schneider, 2016). Also, the shadow economy may act like an employer of last resort in times of turmoil and recession (Hassan and Schneider, 2016).

The shadow economy is a very complex phenomenon which is difficult to define and measure. This paper applies two commonly used methods in the literature to estimate developments in the underground economy in Malta, the Currency Demand Approach and that based on the Multiple Indicator Multiple Causes (MIMIC) model. Given the unobservable nature of the informal economy, estimates are surrounded by a considerable degree of uncertainty. While these two methods differ somewhat on the historical

evolution of the size of the underground economy in Malta, which in turn can be traced back to their different underlying assumptions, both suggest that it has remained relatively stable over the last decade, standing at just below 21%. Given the degree of uncertainty surrounding the estimates, the results should be interpreted as an approximation of the size of the shadow economy, rather than as a precise measure.

The rest of this note is organized as follows. Section 2 briefly describes the main approaches used in the literature to estimate the underground economy while outlining the main contributions of this study. Sections 3 and 4 document the estimates for Malta's underground economy using the Currency Demand Approach and the MIMIC, respectively. Finally, Section 5 concludes.

2. ESTIMATING THE SIZE OF THE SHADOW ECONOMY

Because of its nature, it is only possible to get some quantification of the size of the underground economy through estimation. Over the years, several methods have been employed in an attempt to estimate the size of the underground economy (see Schneider, 2005 and Schneider and Enste, 2002 among others). Studies aimed at measuring the size of the underground economy fail to reach a consensus on how to define this complex economic phenomenon (Orsi et al., 2012). This problem is even more pronounced since the list of activities that should be included in the measurement of the underground economy seems to be quite distinct across the different fields of social sciences. In line with other macroeconomic studies, this note follows a broad definition of the underground economy; that is, those activities which are productive and legal but are deliberately concealed from public authorities to avoid taxation and having to meet certain legal standards[1].

Literature also seems to fail to reach a consensus on the best approach for estimating the size of the underground economy. Broadly speaking, there are three different methods that can be applied to measure the size and the development of the shadow economy over time. These methods include:

1. Direct methods which make use either of survey data and samples based on voluntary participation, or tax auditing and other compliance methods.
2. Indirect methods which make use of various indicators as a proxy for the size of the underground economy over time. The currency demand approach is one of the most commonly used methods in empirical analysis whereby movements in narrow money are used to infer activity in the underground economy. The intuition behind this approach is that since the hidden transactions occur mainly in cash, an increase in currency demand signals an increase in the underground economy.
3. Model or structural approaches whereby the underground economy is considered as a latent variable which is caused by an array of factors. The most commonly used model in empirical analysis is the Multiple Indicators, Multiple Causes (MIMIC). The MIMIC approach idea is to represent the output of the underground economy as a latent variable, which has causes and effects that are observable but which cannot itself be directly measured.

Studies on the underground economy in Malta are few. The first attempts can be traced back to Micallef (1988) and Briguglio (1989) with both authors using a currency demand approach to quantify the size of the Maltese underground economy. Cassar (2001) constructs an index of underground economic activity in Malta for the years 1971-1997 using a MIMIC approach. This study finds that the underground economy grew from 16% to 25% of GDP between 1980 and 1997. More recently, Malta has featured in a number of studies analysing the shadow economy across the world. For instance, Murphy (2012) estimates that the underground economy in Malta as at 2009 amounted to 27% of GDP while Medina and Schneider (2018) find that Malta's underground economy averaged 30% between 1991 and 2015.

This note contributes to this strand of literature and measures the relative size of the underground economy for Malta. In view of the model uncertainty surrounding these estimates, together with the limitations inherent in all estimation methods used in the literature, this note presents results consistent with two distinct methods, the currency demand approach and the MIMIC model.

3. CURRENCY DEMAND APPROACH

3.1. Theoretical Overview

The currency demand approach is based on the assumption that all unregistered transactions are settled in cash. This method was first explored by Cagan (1958) who noted that changes in cash holdings relative to the size of a broad monetary aggregate may reflect the evolution of the underground economy. He also shows how these movements are correlated with changes in the average tax rate, suggesting that movements in the latter might be used to identify dynamics in the shadow economy. This approach was further developed by Gutmann (1977) and Feige (1979), both of which provide an analysis of the dynamics of the shadow economy without providing information about its relative size.

Tanzi (1980; 1983) further develops these approaches, proposing a method that is not only able to provide information on the dynamics of the shadow economy, but which can also pin down its level. The author builds on the methods proposed by Cagan (1958) and proposes a three-step approach to estimate the size of the underground economy. First the author estimates a demand equation for currency holdings as a function of a number of factors, such as formal economic activity, interest rates, payment practices and the overall tax burden in the economy, as in Equation 1:

$$C_t = c + \sum_{i=1}^{k} \beta_i I_{i,t} + \gamma TR_t + \epsilon_t \quad (1)$$

where C_t is a measure of currency in circulation, $I_{i,t}$ are a set of control variables and TR_t is a measure of the economy's tax burden.

1 This definition of the shadow economy excludes illegal activities, defined as productive activities that generate goods and services that are forbidden by law or are unlawful when carried out by unauthorised persons, and informal activities carried out by individuals and small enterprises which are difficult to measure formally. Moreover, throughout this paper the terms "underground economy" and "shadow economy" are used interchangeably and refer to the same concept defined above.

In this analysis, Tanzi (1980) suggests that excess cash used for underground activities might be estimated as the difference between the cash demand estimated by this model and the cash demand estimated when setting the tax rate to zero:

$$C_t^E = C_t^{FIT} - C_t^{FORM} \quad (2)$$

Where C_t^{FIT} is the fit estimated from Equation 1 and C_t^{FORM} is a measure of currency demanded by the formal economy and given by:

$$C_t^{FORM} = c + \sum_{i=1}^{k} \beta_i I_{i,t} \quad (3)$$

A measure in levels for the underground economy Y_t^U, is then given by multiplying the excess currency demanded C_t^E, by the velocity of circulation v_t:

$$Y_t^U = v_t C_t^E \quad (4)$$

3.2. Estimates for Malta

The estimation of the size of the underground economy can therefore be broadly divided into three parts, fitting an equation for currency demand, finding the "excess" currency demand and finally linking the "excess" currency in circulation to underground economic activity.

3.1.1. Currency demand estimates

As described in Grech (2017), the holding of currency normalised by GDP in Malta has traditionally been higher when compared to the European average. However, high currency demand might not be necessarily reflective of a large underground economy. Indeed, broadly speaking, literature considers two components for the demand for cash: a structural component explained by normal or structural factors reflecting the need for certain amount of cash to be used in normal activities, and the excessive component which typically relates to underground economic activities. In this light, there might be a number of structural reasons which are particular to the Maltese economy that could explain why cash still remains so popular in Malta. The most important factor is a general tendency of Maltese consumers as well as retailers to prefer payments by cash. This might be due to the fragmented nature of the Maltese retail market which results in an uneven impact of bank charges associated with electronic payment means. Despite being higher than the European Union (EU) average, currency in circulation expressed as a ratio of nominal GDP has been on the decline since the mid-1980s. This could possibly reflect the rapid liberalisation of the banking and financial sectors in Malta, leading to a rise in the non-cash payments, as well as technological developments in payment systems.

Another factor affecting the structural demand for cash is the relative thinness of the Maltese financial market. Despite the fact that the average Maltese household holds around twice the financial assets of the average EU household, the availability of Maltese financial instruments is considerably low when compared to other western economies. The lifting of capital controls following Malta's accession to the EU is likely to have helped increase the investment alternatives available to Maltese households. Still however, helped by a decade of record-low interest rates, cash might still form a larger than average share in Maltese household's financial portfolio.

Grech (2017) also argues that an often-ignored determinant of cash demand in Malta is the relatively large size of the inbound tourism industry. In 2019, total tourist arrivals in Malta amounted to more than 5 times the local population. When allowing for the average length-of-stay, the number of inbound tourists in a year is equivalent to around 50,000 local residents.

The equation specification used in this exercise follows those estimated by Briguglio (1989) and Grech (2017). The currency demand literature usually utilises the ratio of cash outside banks relative to M1 monetary aggregates. However, Malta's broad monetary aggregates have been distorted upon Malta's participation in a monetary union with the adoption of the euro. To this end, this study utilises log difference in nominal currency in circulation. In line with the above discussion, the variables meant to explain the structural motive for holding currency are nominal GDP proxying economic activity, financial wealth as a way to capture the fact that part of the financial wealth portfolio of Maltese households is usually kept as cash, and the bank deposit rate which is meant to capture the opportunity cost of holding cash. In line with the vast majority of literature, the variable meant to capture the excess component of currency demand is the tax burden, measured in line with Grech (2017) as the sum of income tax paid by households, social security contributions and indirect taxes expressed as a share of GDP. The estimated equation also includes a time trend to include for the growing trend in financial innovation in the Maltese financial market leading to new and more advanced payment methods. Moreover, the equations contain a number of dummy variables meant to capture well-documented one-off movements in the data for currency in circulation[2]. The equation is estimated using OLS in error-correction form using the Engle-Granger two-step procedure.

Results shown in Table 1 fail to reject the hypothesis that there is a cointegrating relationship between currency in circulation and economic activity (measured by GDP), financial wealth, the tax burden and financial innovation (proxied by the linear trend). As expected, an increase in economic activity raises the demand for currency both in the long run and short run. The positive and significant coefficient in front of financial wealth, confirms the hypothesis that Maltese households prefer to hold part of their financial portfolio in cash.

Households' preference to keep more cash as part of their financial portfolio seems to get stronger the lower bank deposit rates are, i.e. as the opportunity cost of holding cash falls. The negative and significant coefficient in front of the linear time-trend confirms that a growing number of payment alternatives being made available in the Maltese market, together with changing consumers' and retailers' preferences are reducing the demand for cash holdings.

2 The dummy variable *d2003q4* captures a significant change in monetary data compilation. *d2007q3* and *d2007q4* capture the adoption of euro in 2008 which resulted in a large decline in the currency in circulation. *d2009q1* captures the effect of the great recession.

Table 1: Currency Demand Specification for Malta

Dynamic Equation		Cointegrating Equation	
Explanatory Variable	**Dlog (Currency)**	**Explanatory Variable**	**Log (Currency)**
Constant	0.00	Constant	−15.09***
dlog (Currency$_{t-1}$)	0.05	Deposit Rate$_t$	−0.17***
d (Deposit Rate$_t$)	−0.08***	log (GDP$_t$)	2.07***
dlog (GDP$_t$)	0.12*	log (Financial Wealth$_t$)	1.06**
dlog (Financial Wealth$_t$)	0.16	Tax Burden$_t$	2.55***
d (Tourist-resident equivalent)	0.07**	Linear Trend	−0.06***
Error-Correction term	−0.04***		
d2003q4	−0.05***	R^2	0.63
d2007q3	−0.11***	Adjusted R^2	0.60
d2007q4	−0.35***		
d2009q1	−0.13***		
R^2	0.93		
Adjusted R^2	0.92		

Data sample ranges from 2000Q1 to 2019Q2. Data is not seasonally adjusted but seasonal dummies are included in the estimation. Results of seasonal dummies are not shown here for conciseness. ***P<0.01, ** P<0.05, * P<0.1

Finally, as expected *a priori,* an increase in tourist arrivals in Malta, measured in terms of resident equivalent, increases the demand for currency in the short run[3].

Finally, and as expected, the variable meant to capture the excessive component of currency demand is found to have a positive and statistically significant effect on currency demand in the long-run. As the tax burden increases, the potential economic gains of evading taxes as perceived by individual economic agents rises, increasing the demand for cash.

3.1.2. Finding excess currency demand

The method described in Equation 3.1 is used by the vast majority of studies that try to quantify the excess component of currency demand. However, this method relies on a very strong assumption. Indeed, the estimation of C_t^{FORM} as defined in Equation 3 relies on an extreme in-sample prediction whereby it is assumed that economic agents will fail to declare all transactions as long as the effective tax rate is larger than zero. As argued by Dybka et al. (2019), this assumption is quite extreme. There is no country that imposes an average tax burden equal or close to zero and assuming such low tax rates is usually unrealistic since such an economy would be practically ungovernable. Moreover, as argued by Briguglio (1989), the possibility of punishments for tax evaders means that there is an opportunity cost for taking part in unregistered transactions. This in turn implies that it will be rational for agents to stop evading taxes below some positive tax rate.

In view of this criticism, our methodology departs from the original method suggested in Tanzi (1983) and follows Dybka et al. (2019). We assume that the tax rate at which there is no tax evasion (*ZETR*) is larger than zero and is equal to the lowest observable level recorded among OECD countries[4]. Therefore, Equation 3 above is modified as follows:

$$C_t^{FORM} = c + \Sigma_{i=1}^{k} \beta_t I_{i,t} + \gamma TR_t^{ZETR} \quad (5)$$

where TR_t^{ZETR} is set to a low level of tax rate at which it is assumed that there is no incentive to go underground. It is therefore being assumed that as the actual tax rate moves close to TR_t^{ZETR}, the benefits of not declaring monetary transactions move closer to the potential costs of evading taxes.

3.1.3. Estimating the size of the Maltese shadow economy

The method used by the vast majority of the literature to translate the volume of excess currency demanded into the value of underground economic activity and described in Equation 4 above relies on often highly uncertain estimates of the velocity of money[5].

To this end we follow Dybka et al. (2019) and refrain from using estimates for the velocity of money to come up with a measure for the level of underground economic activity in Malta, but instead bypass this issue by directly computing an estimate of the underground economy relative to total economic activity using the following equation:

$$\frac{Y_t^U}{Y_t} = \frac{C_t^{FIT} - C_t^{FORM}}{C_t^{FIT}} \quad (6)$$

This method does not require an estimate of money velocity, but instead requires us to assume that money velocity is equal across both formal and informal parts of the economy[6].

Results for the relative size of the Maltese shadow economy are shown in Table 2. This measure suggests that the size of Malta's underground economy has registered an increase after 2000 and in the run-up to Malta's accession to the EU but has remained broadly stable, averaging at just below 21%, over the last decade.

3 Tourist arrivals are converted to resident equivalent by using data on average nights stayed. For instance, if in a given month, the average nights spent by tourists is 7.5, each tourist throughout that month will be treated as a quarter of a resident (7.5/30 = 0.25).

4 The zero-effective tax rate threshold was calibrated to 15%, in line with the average of the lowest tax rates (measured in line with our definition) in the OECD.

5 See Dybka et al. (2019) for a detailed explanation for why the methods used in this strand of literature often result in a biased estimate of the velocity of money.

6 While there is no way to verify the equality between the velocity of money within the formal and informal economies, such an assumption is less restrictive than the assumptions required to derive a suitable estimate for the velocity of money.

Table 2: Size of the Maltese shadow economy between 2000 and 2019

Year	Shadow Economy (% of GDP)	Year	Shadow Economy (% of GDP)	Year	Shadow Economy (% of GDP)
2000	9.6	2007	19.8	2014	21.0
2001	14.3	2008	20.1	2015	21.0
2002	15.4	2009	20.4	2016	20.5
2003	16.1	2010	20.6	2017	20.2
2004	17.0	2011	20.8	2018	20.2
2005	18.0	2012	21.0	2019	20.4
2006	19.1	2013	21.0		

Results for 2019 are based on authors' estimates for some variables that were not yet officially available for the whole year as at the time of writing

While being relatively easy to follow, the Currency Demand approach to the measurement of the size of the underground economy is known to have a number of shortcomings. While the modifications done in this study try to address some of these shortcomings, this method has inherent drawbacks that are not easily addressed within this approach. For instance, the method relies on the assumption that all underground economic activity is paid for in cash and that therefore, currency in circulation can be thought of being the only indicator of the shadow economy. Moreover, this method assumes that the tax burden is the only determinant or cause behind the existence of an underground economy. In actual fact, literature suggests that there are also other reasons behind the existence of a shadow economy as well as a number of indicators that could help detect its size. Indeed, international studies have repeatedly shown that apart from the size of the tax burden, other qualitative variables such as the complexity of the tax system, tax morale and the institutional framework (such as the efficiency and effectiveness of law monitoring enforcement) are other important indicators that can affect the size of the underground economy. For instance, increases in the tax ratio that are the indirect effects of a relatively simple tax system might not be an indicator of an increase in underground economic activity.

4. MIMIC MODEL

The MIMIC model is a special type of structural equation modelling (SEM) based on the statistical theory of unobserved variables developed in the 1970s by Zellner (1970) and Jöreskog and Goldberger (1975). The first economists to consider the size of the shadow economy as an 'unobservable variable' were Frey and Weck-Hanneman (1984). The MIMIC model is considered to be superior to other methods because it can consider various observable and measurable causes and indicators at the same time in the analysis of the underground economy (Hassan and Schneider, 2016).

The MIMIC model also relates to the unobserved component literature and can therefore be cast in a state space representation, thus having a structural and a measurement part. In the structural equation, the underground economy (η_t) is linearly determined, by a set of observable exogenous causes $X_{i,t}$:

$$\eta_t = \Sigma_{i=1}^{l} \gamma_i X_{i,t} + \omega_t \tag{7}$$

where γ is a $l \times 1$ vector of unknown parameters and the disturbance term $\omega_t \sim N(0,\sigma\omega^2)$. In the measurement part, the shadow economy (η_t) linearly determines a set, p of endogenous indicators $Y_{i,t}$ subject to disturbance parameters $\epsilon_{p,t}$:

$$\begin{aligned} Y_{1,t} &= \lambda_1 \eta_t + \varepsilon_{1,t} \\ Y_{2,t} &= \lambda_2 \eta_t + \varepsilon_{2,t} \\ &\vdots \\ Y_{p,t} &= \lambda_p \eta_t + \varepsilon_{p,t} \end{aligned} \tag{8}$$

where λ is a $p \times 1$ vector of unknown parameters and the disturbance term $\varepsilon_t \sim MVN(0,\Sigma\varepsilon)$. It is further assumed that $\Sigma\varepsilon$ is diagonal, that is all error terms are uncorrelated with each other[7].

Under the additional assumption that ε_t is independent of ω_t, this model can be estimated by Maximum Likelihood Methods.

4.1. Theoretical Background for the Choice of Variables

Given the lack of theoretical structure imposed by a MIMIC model, the choice of the causal and indicator variables within this approach is seen as crucial. Indeed, as Thomas (1992) points out, the choice of variables may be the most relevant limitation of the MIMIC approach. For example, the seminal contribution of Frey and Weck-Hanneman (1984) with regards to MIMIC approaches for estimating the size of the underground economy has been repeatedly criticised by Helberger and Knepel (1988) in the light of the causal and indicator variables employed in their study, a concern that has been also voiced by Smith (2002) and Hill (2002).

In general, the tax burden, the share of public employment in the labour force, the unemployment rate and the self-employment rate are the main causes which are included in such studies (Dell'Anno et al., 2007). In our analysis, the indicator variables are real GDP growth, the participation rate of the labour force and the growth rate of real currency in circulation.

4.1.1. Causes of the shadow economy

1. Tax burden – the generally accepted hypothesis, which is also in line with the hypothesis maintained in the currency demand approach, is that the higher the tax burden, the stronger are the incentives to work informally in order to avoid paying taxes. To this end, a priori one expects a positive sign for

7 As argued by Dybka et al. (2019), this assumption implies that the latent variable is the only source of co-movement within the set of indicators.

the parameter associated to this variable[8]. For the purpose of this study, tax burden is measured as the total share of direct taxes, indirect taxes and social contributions as a percentage of nominal GDP[9].

2. Recurrent government expenditure – this explanatory variable, measured as a percentage of nominal GDP, is introduced as a proxy for the degree of economic freedom and as an index of over-burden of the public sector in the economy. This variable comprises compensation of employees, social benefits expenses, spending on the goods and services consumed by the government during its production process as well as other spending of a recurrent nature. An increase in the size of the public sector and/or the degree of regulation of the economic system provides an important incentive to participate in the underground economy (Aigner et al., 1988). Also, the larger the public sector the more power bureaucrats have, opening the way for corruption. Moreover, a large public sector needs to be financed by a complex system of taxes which again increases the scope for underground activities. Thus, we expect a positive sign for this coefficient.
3. Self-employment rate – the larger the share of professionals and self-employed in the labour force, the larger the potential to hide income from the authorities. Such workers have greater possibilities for tax evasion than large firms and their employed workforce, given they have fewer auditing controls and work very closely with their clients. Researchers have indeed found a significant and positive correlation between self-employment and the shadow economy in various European countries (Dell'Anno et al., 2007).
4. Unemployment rate – the relation between the shadow economy and the unemployment rate is ambiguous (Tanzi, 1999). On the one hand, an increase in unemployment could imply a decrease in the underground economy if the underground economy is positively related to the GDP growth rate and the latter is negatively correlated to unemployment. On the other hand, there may be a positive causal relation between unemployment and the shadow economy implying that when unemployment rises many workers have greater incentives to participate in the underground economy. Following Dell'Anno et al. (2007), we expect a positive sign for this coefficient.

4.1.2. Indicators of the shadow economy

1. Real GDP growth – latent variables estimated within a Structural Econometric Modelling approach do not have a natural scale. Thus the researcher is forced to choose a normalization constraint that allows the numerical estimation methods to converge while at the same time helping pin down the latent variable's unit of measurement. In line with MIMIC literature, we impose the normalization constraint on the coefficient of real GDP growth, λ_1. The choice of this value is usually restricted either as +1 or −1 because by using a unitary base for normalization, the estimated coefficients are more easily comparable. Unfortunately, in the literature there is no common view about what is the sign of the relationship between official and unofficial economy. In view of this well-known normalisation issue we set the value of λ_1 as −1, in line with most of the literature.
2. Real currency growth – similar to the Currency Demand Approach, MIMIC models literature often uses currency demand as one of the indicators of underground economic activity. A priori we would expect that as underground economic activity expands, the demand for cash increases. Similar to currency demand literature, studies in this area advocate the use of currency in circulation expressed as a ratio to M1 or M3. Unfortunately, since these broad monetary aggregates have been distorted in Malta over the sample period[10], we choose to use the same approach used for the currency demand equation, i.e. using the growth rate of currency issued.
3. Labour force participation rate – by including this variable as an indicator, it is possible to determine empirically if there is a flow of resources between official and underground economy. Empirical studies show that unrecorded economic activity is only partially undertaken by members of the measured workforce. It is believed that the participation rate may be unaffected by underground activity if such activities are undertaken after hours or on weekends when individuals are not working in the regular economy. Thus, it is advised to consider the MIMIC output for this indicator with caution.

4.2. Model Estimation

We estimate the model using annual data from 1980 to 2019 using Maximum Likelihood estimation. The variables in the study are differenced to the extent that secures their stationarity on the basis of individual unit root tests. An intuitive description to show the economic theory underlying this method is using a path diagram where the potential causes of the underground economy are shown on the left and the indicators on the right (Figure 1).

The maximum likelihood estimated coefficients are shown in Table 3. The causal variables are all positive, indicating that a rise in each of the variables is reflected in a rise in underground activity. Results show that the share of self-employed in the labour force has the largest effect on the shadow economy.

4.3. Benchmarking Procedure

Once we have estimates for the γ vector, we can use Equation 7 above to project the fitted value of our latent variable $\hat{\eta}_t$ which in turn tracks the dynamics of the Maltese underground economy. As previously mentioned, even after imposing a normalisation constraint on one of the parameters to be estimated, there will still

8 However, a high tax burden does not necessary equate to a large shadow economy. In fact, there are countries where the tax base is large yet the shadow economy is trivial. The reason for this is the good institutional framework that these countries enjoy which leads citizens to willingly pay taxes to benefit from a high quality of goods and services from the state.

9 It is important to note that while the imposition of a normalisation constraint is important for the numerical estimation method to converge, the choice of the sign of this constraint does not affect the dynamic properties of the benchmarked latent variable. As discussed later on, the benchmarking method used in this study is robust to both normalisation choices.

10 For member states in a monetary union, it is not possible to calculate how much of the various measures of money are held by residents of an individual member state. Over the sample period, there were also instances where the definitions of the monetary aggregates were revised.

Figure 1: Representation of the MIMIC model

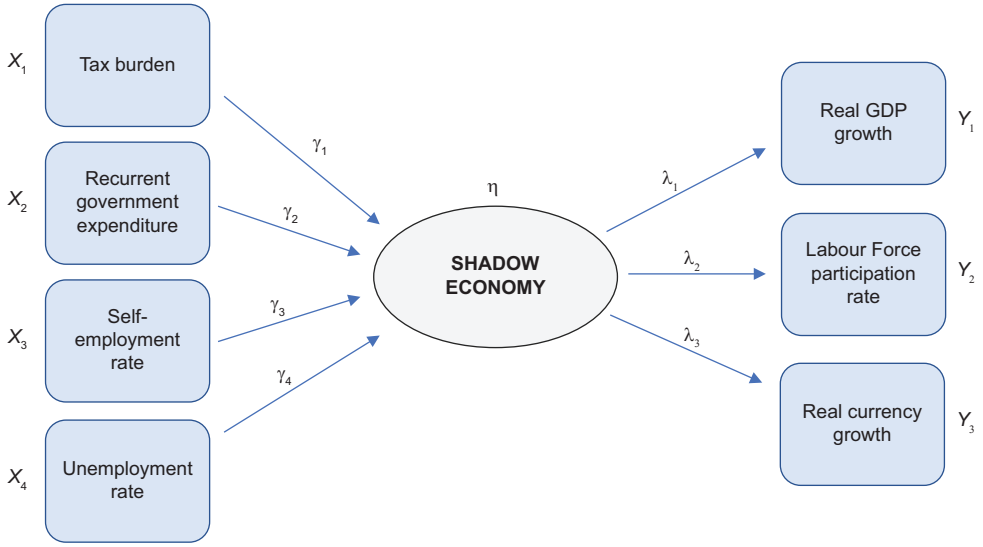


Table 3: Estimated coefficients of the MIMIC model

Variable	MIMIC 4-1-3 coefficient
Tax burden	0.14
Unemployment rate	0.06
Self-employment rate	0.60
Government expenditure	0.28
Labour Force participation rate	−0.58
Real currency growth	0.80

2019 data are based on authors' estimates for some variables that were not yet officially available for the whole year as at the time of writing.

be a degree of indeterminacy in the scale of the fitted latent variable. To determine the level of the underground economy, we benchmark the results using the multiplicative method used in Giles and Tedds (2002), a method which is robust to the normalisation assumption chosen in the estimation of the model:

$$Y_t^U = \kappa \frac{\hat{\eta}_t}{\hat{\eta}_T} \text{ for } t = 1980,\ldots,2019 \quad (9)$$

where Y_t^U is the share of underground economy in overall economic activity, $\hat{\eta}_t$ is the level of the estimated latent variable observed at time T and κ is the external calibrating point consistent with the size of the underground economic activity at time T. As normally done in literature we use the results obtained from the currency demand model to benchmark the fitted latent variable such that the estimate of the underground economy for 2013 is equal to 21.0% of GDP in both methods.

The results indicate that, in general, the underground economy fell steadily relative to measured GDP over the period 1980-2019. The value of the underground economy fell from about 32% of GDP in the early 1980s to about 21% in 2019 (Figure 2). This method indicates that since 2000, the shadow economy averaged 23% (Table 4).

Cassar (2001) had adopted a similar approach to estimate the size of the Maltese shadow economy. He had found that the underground economy grew from 16% to 25% between 1980 and 1997. These numbers differ somewhat from the analysis

Table 4: Size of the Maltese shadow economy over the period 1980-2019

Time period	Shadow economy (% of GDP) – period average
1980-1984	31.6
1985-1989	25.2
1990-1994	25.5
1995-1999	23.3
2000-2004	25.2
2005-2009	24.0
2010-2014	21.5
2015-2019	20.0

Results for 2019 are based on authors' estimates for some variables that were not yet officially available for the whole year as at the time of writing

above, but may reflect significant revisions in data since that study, as well as the use of different indicators of the underground economy.

Looking at more recent studies, we find that the dynamic properties of our variable are similar to those found in Medina and Schneider (2018), although our results are lower. Both measures indicate that Malta's shadow economy fell in the 1990s but then registered an increase in the run-up to EU accession. Our figures show that the shadow economy fell once again following Malta's accession to the EU such that it amounted to 19% of GDP in 2015. This contrasts with the estimates found in Medina and Schneider (2018), who report that the shadow economy in Malta remained relatively unchanged between 2005 and 2015. We estimate that the average size of the shadow economy in Malta between 1991 and 2015 has been around 24%, a figure comparable to that found in the Baltic States and lower than that of other southern European countries such as Italy and Greece (Figure 3).[11]

The downward trend in the size of Malta's underground economy is consistent with a number of stylized facts. For instance, Kelmanson et al. (2019) show that the size of the underground economy is strongly negatively correlated with

11 Table AI in the Appendix compares our results with all euro area members.

Figure 2: Size and development of the Maltese shadow economy

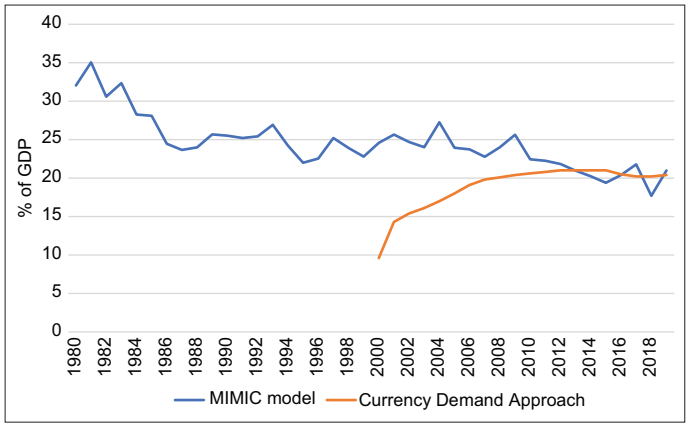
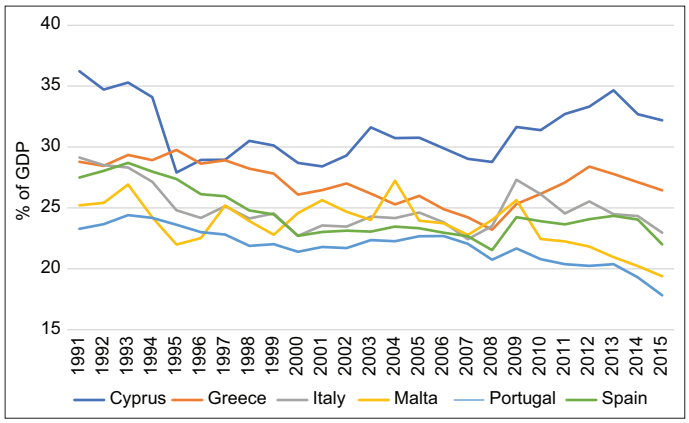
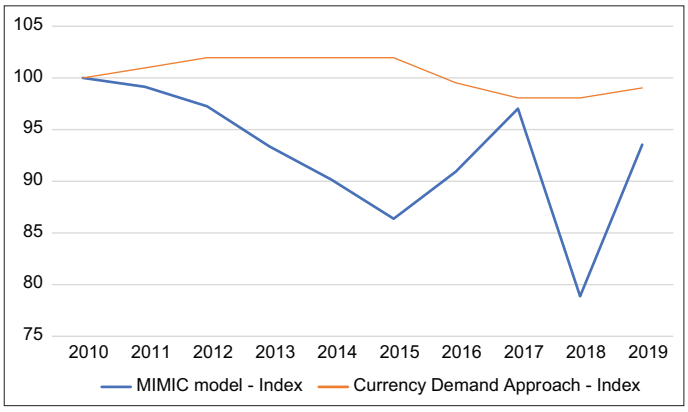


Figure 3: Size and development of shadow economies of selected European economies



Source: Medina and Schneider (2018). Figures for Malta are based on authors' calculations using the MIMIC approach

Figure 4: Size and development of the Maltese shadow economy



income per capita across different country samples and time periods. The same authors, together with Torgler and Schneider (2007) show that trade openness is also found to be negatively associated with the size of the economy. The downward trend in Malta's underground economy, as measured by the MIMIC approach, has occurred in a period which was characterised by an increase in Malta's trade openness, as well as by a rapid increase in its GDP per capita, thereby corroborating these two stylized facts.

4.4. Developments Over the Period 2010-2019

As outlined in the description of the MIMIC approach, this procedure has a considerable degree of uncertainty surrounding the scale of the latent variable being measured. Thus, the level of the underground economy is very sensitive to the point at which the benchmarking procedure outlined above is performed. In this light, the reader needs to interpret the level of the underground economy with extreme caution. Instead, attention should be focused on the dynamics of the indexes calculated.

In view of this, and to make comparisons easier, Figure 4 shows the two measures of the underground economy estimated in this study for the period 2010-2019, with 2010 taken as the base year. Both models suggest that the size of the shadow economy in Malta has remained relatively stable over the last decade. The index based on the currency demand approach indicates that the underground economy has remained practically unchanged over the period in consideration. On the other hand, estimates from the MIMIC model indicate a downward trend in the size of the underground economy with the index falling by around 6% over the period.

Like any other econometric model, the MIMIC model is also known to have a number of shortcomings. The MIMIC model is a statistical model in which the choice of causal and indicator variables plays a key role in shaping the theoretical underpinnings of the model. Thus results consistent with the MIMIC approach are very sensitive to the choice of variables. Moreover, it is also possible that the causal variables used in the estimation are also driving forces for illegal activities, which are not included in our definition of shadow economy. This means that our results for the size of the shadow economy estimates may be inflated.[12] Moreover, it may be difficult to determine whether a variable is a cause or an indicator. For instance, the unemployment rate is usually regarded as a causal variable leading to the development of the shadow economy. At the same time, unemployment rate can be regarded as an effect of the existence of the shadow economy in a certain country. These factors together with the econometric issues discussed above regarding the estimation and normalisation of MIMIC models further highlight the uncertainty surrounding these results. In this light, the reader should treat these results with caution, especially with regards to the interpretation of the absolute size of the underground economy relative to GDP.

5. CONCLUSION

This paper applies two commonly used methods in the literature to estimate developments in the shadow economy in Malta. While the two methods give a somewhat different indication about the trend in the size of the underground economy before 2010, reflecting differences in the underlying assumptions and methodology, the results for more recent years are very similar. Indeed, both estimates show that in the last 10 years, the size of the shadow economy in Malta has been quite stable, with the

12 Medina and Schneider (2018) use a correction factor to calculate an adjusted size of the shadow economy. The shadow economy appears considerably smaller and the authors believe that this might be a more realistic value of the actual size of the shadow economy.

MIMIC measure also showing a slight downward trend. The size of the shadow economy in Malta seems to have stabilised at just below 21% of overall economic activity in recent years, close to the levels measured in Baltic countries and somewhat lower than other Southern European countries.

Studies dealing with estimating the size of the shadow economy are surrounded by uncertainty, both with regards to the definition of what constitutes the shadow or informal economy, as well as with regards to the methods used for its measurement. As acknowledged in this literature, there is no best method to estimate the size of the shadow economy. The MIMIC approach is usually considered as potentially superior to the currency demand approach, mainly due to its ability to simultaneously consider several causes and indicators. However, as outlined in this report, no method is free from limitations.

In this regard, and considering that the shadow economy is by its very nature untraceable, the estimates presented in this study should be interpreted as approximations of the true size of the shadow economy, rather than precise measures. Consequently, economic policies arising from these figures should be formulated cautiously and with a full understanding of the models' limitations. Crucially, while it is possible to gain information on the most important factors that influence the trends and dynamics of the shadow economy, it is indeed much harder to elicit information on the level of underground economic activity.

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APPENDIX A: SHADOW ECONOMY ESTIMATES FOR EURO AREA COUNTRIES

In Table A.I we show the estimates of the shadow economies in the 19 euro-area countries, as reported by Medina and Schneider (2018), for the period 1991-2015. The mean value of the size of the shadow economy of the 158 countries reported in this study is 31.9% of GDP. Malta's shadow economy estimate for the period 1991-2015, as calculated in our study, is 23.7% which is comparable to that found in Baltic States, and somewhat lower than that reported for other southern European countries.

Table A.I: Size of the Maltese shadow economy over the period 1980-2019

	1991	1994	1997	2000	2003	2006	2009	2012	2015	Average
Austria	9	9.7	9.6	8.8	8.7	8.3	9.7	8.4	9	8.9
Belgium	22.1	23.5	22.2	19.9	21.7	20.7	18.7	18.3	17.8	20.6
Cyprus	36.2	34.1	29	28.7	31.6	29.9	31.6	33.3	32.2	31.3
Estonia	23.5	29.8	27	27.7	24.8	19	24.6	18.3	18.5	23.7
Finland	16.5	16.3	14.5	12.5	12.7	11.3	13.1	12.6	13.3	13.5
France	15	16.6	16	13.8	14.6	13.3	13.9	12.1	11.7	14.1
Germany	13.3	14.2	14	12.9	13.2	11.4	11.7	8.9	7.8	12
Greece	28.8	28.9	28.9	26.1	26.2	24.9	25.3	28.4	26.5	27.1
Ireland	18.4	17.7	15.5	13.4	13.8	12.6	13.4	11.4	9.6	13.9
Italy	29.1	27.2	25.1	22.7	24.3	23.8	27.3	25.5	23	24.9
Latvia	20.1	24.8	27	26.7	23.7	18.1	21.2	17.3	16.6	22.2
Lithuania	21.2	28.8	30.9	31.1	27	22.4	24.3	19.3	18.7	25.1
Luxembourg	11.1	11.2	11.4	9.8	10.7	10.3	11	10.8	10.4	10.7
Malta	25.2	24.2	25.2	24.6	24	23.7	25.6	21.8	19.4	23.7
Netherlands	13.2	13.3	11.8	10.5	11.8	10.9	8.9	8.1	7.8	10.8
Portugal	23.3	24.2	22.8	21.4	22.4	22.7	21.7	20.2	17.8	21.9
Slovakia	17.2	18.3	17.2	17.6	16.6	13.5	13.5	11.8	11.2	15.3
Slovenia	27.4	28.2	26.5	25.2	24.4	20.9	22.2	22.9	20.2	24.1
Spain	27.5	28	26	22.7	23.1	23	24.2	24.1	22	24.5

Source: Medina and Schneider (2018). Figures for Malta are based on authors' calculations using the MIMIC approach