

# **MODELING THE INFORMAL ECONOMY: A REVIEW**

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## **Abstract**

Informal economic elements are present worldwide and especially in emerging countries. Such elements are found in a wide range of economic aspects and seem to be immune to various policies aiming to contain and remove them. Quantifying the dynamics of informal economy is a complex endeavor. Despite this fact, the empirical literature dedicated to informal economic aspects has expanded during the last decades aiming to clarify the drivers and the dimensions of these phenomena. This paper follows the main contributions brought to the field in order to observe the evolution of the modeling tools devised to investigate, characterize and measure informal economy.

**Keywords:** informal economy, econometric modeling, estimation

**JEL Classification:** C01, C13, E26

## **1. Introduction**

In general, informal economy describes those activities that are not quantified as formal economic or fiscal parameters. The specific literature has consecrated a wide array of definitions and synonyms: shadow, submerged, irregular, subterranean (Frey and Pommerenhne (1982)), underground, parallel, unrecorded or twilight (Tedds (1998)). The most current definition presents informal economy as the sum of both legal and illegal activities that are not contained in the official formulation of the GDP. This is a very tractable solution as it does not require an expression in local currencies and thus lends a comparable character to the estimation.

Other authors such as for example, Tanzi (1999) extend this definition and consider as underground economy any practice which implies that forms of revenue aren't reported or detected by official fiscal authorities.

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The factors that catalyze the formation and expansion of such informal elements are numerous and in general country specific. In addition to this, many characteristic of informal economic actions are sector specific. In this logic, measuring the dimension of the informal economy is not the easiest of tasks. Despite this complex character, economic literature has germinated a series of approaches that try to fundament on the genesis and dynamics of informal economy.

Giles and Tedds (2002) and Tedds (2005) argue on the existence of six classical modeling approaches for informal economy applications. These methodologies rely on parameters such as: the circulation of currency in the economic system, national accounts, Mimic models, and relationships between different economic variables.

Dell'Anno (2003) arranges the investigation alternatives of informal practices into three distinct categories: direct methods (investigations on forms of undeclared revenue), indirect methods (investigations on the clues that derive from official statistics and hint to possible underground practices) and modeling approaches.

La Porta and Shleifer (2014) build on the taxonomy of methods for the assessment of informal economy. Among the standard quantifying apparatus they highlight the relevance of surveys and census counts and the study of the dynamics of certain variables that can be used as proxies, such as for example aggregate electricity consumption.

In addition to these modeling tools, the economic literature has witnessed the creation of wide range of empirical instruments that address various forms of informal activity. In this context, the aim of this paper is to investigate both classical and modern approaches in order to offer a compressive review on the evolution of informal economy modeling tools.

## **2. Investigations on the informal economy**

As observed by Tedds (2005), several early modeling initiatives rely on the quantification of the currency that circulates in the economic system. This approach originates from the study of Gutmann (1977) which considers informal economy as a quantity of undisclosed income. Following this logic, the author decomposes the money supply and focuses on the dynamics of its components.

Another fundamental contribution comes from Tanzi (1980) and assumes a cash ratio approach. The author considers that the

motivation of informal economy resides in tax avoidance and from this logic sees tax elasticity and demand for currency as suitable proxies. Relying on the currency to deposits ratio, Tanzi (1980) puts forward the following model:

$$(C/M_2) = \alpha_0 + \alpha_1 T_t + \alpha_2 W_t + \alpha_3 Y_t + \alpha_4 R_t + v_t$$

Where:

$C/M_2$  – cash ratio;

$T_t$  – ratio of income taxes relative to income;

$W_t$  – share of wage in total income;

$R_t$  – current interest rate for deposits;

$Y_t$  – real per capita income;

According to Tanzi (1980) the above mentioned equation forms a link between the dynamics of income taxes and changes in the cash ratio that is related to the existence of an informal economy in which transactions are done by using cash. In an estimation exercise, the author concludes that the dimension of US informal economy ranged at that time between 3.4% and 5.1% of GNP.

Tanzi (1983) builds on the same modeling approach, but considers a different equation:

$$\ln\left(\frac{C}{M_2}\right) = \beta_0 + \beta_1 \ln(T) + \beta_2 \ln\left(\frac{WS}{NI}\right) + \beta_3 \ln R + \beta_4 \ln(Y) + \mu$$

Where  $\left(\frac{WS}{NI}\right)$  denotes the portion of cash wages in national income.

Despite the pioneering status of these modeling approaches, their assumptions and specification have been questioned in the specific literature in studies such as Thomas (1986), Porter and Bayer (1989), Thomas (1989), Thomas (1992) or Ferwerda et al (2010).

An alternative modeling scenario was the so called monetary transaction methodology put forward by Feige (1979) and later refined in Feige (1980 a) and Feige (1989 b). This approach does not track the dynamics of currency but focuses on the quantity of payments issued. The Feige model starts from the expression of total income:

$$Y_T = Y_R + Y_U$$

Where  $Y_T$  denotes the total income;

$Y_R$  – the official (recorded) income and;  
 $Y_U$  – the unrecorded income.

The author then expresses the PT term that derives from Fisher's equation ( $MV = PT$ ) in the following manner:

$$PT = CV_c + DV_d$$

Where:

C – amount of currency;

D – amount of deposits;

$V_c$  – currency speed or velocity;

$V_d$  – deposit velocity;

By restructuring the above noted equations, Feige (1989 b) obtains:

$$Y_U = \left[ \frac{CV_c + DV_d}{K} \right] - Y_R$$

This equation states that the informal economy can be estimated for given levels of the total and recorded income. Using this procedure, Feige (1979) finds that for the year 1976 the informal economy gravitated between 13.2% and 21.7% of GNP.

This approach also received a considerable amount of criticism in studies such as Thomas (1989) and Porter and Bayer (1989), given the clear frailty of its assumptions.

The end of the 90th decade sees an increase in the use of the MIMIC models (or the latent variables models) in estimating the size of the shadow economy. This method is a particular case of the Structural Equation Modelling and allows the presence of a relationship between determinants, the latent variable and the indicators as the effects of that unobserved variable. Schematically, the above mentioned parameters are characterized by the following set of equations:

$$\eta = \gamma X + \xi \text{ – for the scalar latent variable}$$

and

$$y = \lambda n + \epsilon \text{ - for observable indicators (Tedds, 1998).}$$

For example, Tedds (1998) estimates the size of the informal economy in Canada during 1976 to 1995 starting with a MIMIC 6-1-3

model. The author finds that the dimension of the Canadian hidden economy reached 15% of GDP in 1995.

A year later, Giles (1999) uses the latent variable model (the MIMIC model) for estimating the size of the informal economy in New Zealand during 1968 to 1994. For calibration, the author employs the information provided by the currency-demand model he develops in the research.

Dell'Anno (2003) uses the MIMIC (Multiple Indicators and Multiple Causes) model approach in order to estimate the informal economy of Italy. In the model also, shadow economy is seen as a latent variable, depending on several observable variables (as is the case, in the model, of tax burden, the real government consumption, the unemployment rate, the self-employment, the index of efficacy in justice and the index of illegality) and that produces other observable effects (on the real GDP and on the currency outside the banks, in the mentioned study). In this respect, the accuracy of the model is given by the variables included and by the calibration value.

In a more recent research, Dell'Anno (2007) employs a similar method for estimating the shadow economy of Portugal in the period 1977 to 2004. The author starts with the MIMIC 6-1-2 model with means and intercepts, using as cause-variables the government employment in labor force, the tax burden, the percentage of subsidies in GDP, the social benefits paid by government, the self-employment and the unemployment rate. The indicators (or the effects variables) are the index of real GDP and the labor force participation ratio. The model is composed of a structural component and a measurement model as show below.

Structural Model

$$\eta = \gamma_{11}X_1 + \gamma_{12}X_2 + \gamma_{13}X_3 + \gamma_{14}X_4 + \gamma_{15}X_5 + \gamma_{16}X_6 + \zeta$$

Measurement Component

$$Y_1 = \lambda_{11}\eta + \varepsilon_1$$

$$Y_2 = \lambda_{21}\eta + \varepsilon_2$$

According to Dell'Anno (2007), the size of the informal economy decreased from 29.6 percent in 1978 to 17.6 percent in 2004, while the main determinants of its evolution are the social benefits, the lack of economic freedom, the unemployment rate and the percentage of self-employed in the total labor force.

The method of the structural equation model continues to be employed and tested in identifying the size of the shadow economy. Buehn and Schneider (2009) develop a more complex model, with two latent variables (corruption and shadow economy) also using a set of causes and indicators. Besides the identification of the relevant determinants, the authors prove the positive relationship among the two latent variables.

In Buehn and Schneider (2009) the structural equation model is given by the following relation:

$$\eta = B\eta + \Gamma x + \zeta$$

Where vector  $x$  contains all the possible determinants for the latent variables captured by the vector  $\eta$ . The relation between the latent variables and their determinants are expressed as a matrix denoted by  $\Gamma$ . The authors add a measurement model given by:

$$y = \Lambda\eta + \varepsilon$$

In this setup, the authors observe a clear link between large levels of corruption and informal economy.

Another popular approach in modeling informal economy relies on monitoring the discrepancies between certain economic variables that in general follow a certain equilibrium. Key contributions in this direction have been brought by MacAfee (1980) and Dilnot and Morris (1981). These paved the way to more fundamental methods that rely on consumer expenditure.

Pissarides and Weber (1989) offer a model that uses a consumption function to estimate informal economy that has the following form:

$$\ln C_{ij} = Z_{iaj} + \beta_j \ln Y_{ti} + \gamma_j SE_i + \eta_i$$

Where

$C_{ij}$  represents the amount of the good  $j$  consumed by the household  $i$ ;

$a_j$  – parameter vector;

$\beta_j$  – marginal propensity of consuming

$Y_{ti}$  – income after taxation;

SE – dummy variable for the portion of the population that is self-employed;

Following this logic, Pissarides and Weber (1989) succeed to estimate the UK informal economy at approximatively 5.5% of GDP. Similar contribution can be observed in McCrohan and Smith (1986) or McCrohan, Smith and Adams (1991).

Lyssiotou et al. (2004) formulate a demand scenario considering as sources of income regular wages and self-employed income. They also consider six types of non-durable goods and build the following model:

$$\omega_{ih} = \alpha_i + \sum_j \alpha_{ij} z_{jh} + \delta_i y_h^s + \beta_i [\ln Y_h + \ln(\theta_0 y_h^\omega + \theta_1 y_h^s)] + \lambda_i [\ln Y_H + \ln(\theta_0 y_h^\omega + \theta_1 y_h^s)]^2 + v_{ih}$$

Where

$\omega_{ih}$  - budget for good i

Z - vector that characterizes the households;

$y_h^s, y_h^\omega$  – proportions for the two categories of income;

$\theta$  – informal economy factor

By estimating this equation, the author obtains informal economy coefficients that range from 2.18 to 1.64 for UK households.

Gunes et al (2013) extend the perspective found in Pissarides, Weber (1989), Lyssiotou et al. (2004), and Fortin et al. (2009) and estimate the informal economy for Turkey in a consumption behavior framework.

The authors start from the Hicksian cost function which has the following form:

$$C(p, U) = F(c(p, U), d(r, U), U)$$

Where  $p$ ,  $r$  and  $U$  characterize price vectors for durable and nondurables goods,

and  $c$  and  $d$  stand for price indices for the respective goods.

In this context, the demand for a nondurable good can be written in the following way:

$$q_i = \frac{\partial F(.)}{\partial c} \frac{\partial c(.)}{\partial p_i}$$

From this point the model assumes the fact that the household determines the amount of the budget invested in nondurable goods. This has the following expression:

$$w_t = \frac{p_i q_i}{Y} = \frac{p_i \frac{\partial F(.)}{\partial c} \frac{\partial c(.)}{\partial p_i}}{\frac{\partial F(.)}{\partial c} c(.)} = \frac{p_i \frac{\partial c(.)}{\partial p_i}}{c(.)} = \frac{p_i}{c(.)} \frac{\partial c(.)}{\partial p_i} = \frac{\partial \ln c(.)}{\partial \ln p_i}$$

Albu (1995) provides an extensive and industrious research aiming at the underground economy and its linkages with financial policies. After reviewing a consistent part of the specific literature, the author provides econometric evidence for informal economy assessment. The perspective is extended for the case of Romania in Albu et al (2001). Starting from the income structure of households Albu (2008) finds that almost a quarter of the household income is informal. This spatial distribution approach is also used in Albu et al (2011).

More recent, applications incorporate elements of informal economy in DSGE modeling setups. Interesting examples can be found in: Busato and Chiarini (2004), Ahmed et.al (2012) or Orsi et al (2014).

### **3. Conclusions**

Informal economy has been studied profoundly during the last decades given the importance of the phenomenon and its multiple reverberations on the economic system, its health and dynamics.

This paper sets out to review and analyze several key contributions brought to this literature, following the main landmarks in terms of modeling progress. We investigate the logic, the characteristics, the modeling particularities and the construction and estimation details for the major contributions that appeared in the academic literature from the pioneering days of Gutmann (1977) and Tanzi (1980) until present.

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