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## **ESTIMATING THE SIZE OF THE SHADOW ECONOMY IN JAPAN: A STRUCTURAL MODEL WITH LATENT VARIABLES**

***Abstract.** The current study adopts an approach to the Japanese case that is based on the theory of unobservable variables. This methodology involves the estimation of structural models (MIMIC) which analyses a set of causes of the shadow economy while simultaneously taking into account its influence upon a series of indicators. The proposed model permits the determination of a relative evolution over time of the size of the shadow economy, which requires the calibration of the model with an exogenous estimation in order to obtain real values. The exogenous estimation is obtained by a monetary method based on a money demand function. The results show that the size of shadow economy measures between 8-11% of GDP in the period 1980-2008, and demonstrate that the shadow economy is significantly influenced by the tax burden and its components (direct tax, indirect tax and social contributions).*

**Key words:** shadow economy, MIMIC model, Japan.

**JEL classification :** C22, C51, C87, E26

### **I. INTRODUCTION**

The shadow economy is one of the causes of the inefficient functioning of the goods and labour markets. It introduces a distortion of competition within countries and among States. It is clear that the SE not only has negative effects on the economic system but also generates positive ones.

Shadow economy creates an extra added value that can be spent in the official economy. Schneider and Enste (2000) state that at least two thirds of the income earned in the SE is immediately spent in the official economy, thus having a positive effect on the latter.

In this study, we want to respond to the following questions: What are the dynamics and size of the Japanese SE (as percentage of the official GDP) in the

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last thirty years?, What are the main causes of SE? To find answers to these queries, we apply an econometric model, namely a Multiple Indicators Multiple Causes (MIMIC) model which is a special specification of a more general approach called Structural Equation Modelling (SEM).

## II. DEFINITION OF THE SHADOW ECONOMY

No single definition of the underground economy serves all the diverse scientific aims. Several attempts are presented in the literature to summarize the wide range of proposed definitions of SE. Schneider and Enste (2000) defines the shadow economy like “all economic activities which contribute to officially calculated gross national product” and Feige(1989) as “economic activities include conscious efforts to avoid official detection”.

The System of National Accounts (SNA93) and the European System of National Accounts (ESA95) define the “non observed economy”, comprising all product activities that can be classified into the following three areas:

- (1) Underground production;
- (2) Informal production;
- (3) Illegal production.

*The Underground production* represents the area of production activities that are not directly observed due to:

(1.a) Economic reasons(T4, T5- the activities carried out outside government regulations such as avoiding tax, minimum wages, number of work hours, and working conditions for labourers.

(1.b) Statistical reasons (T1, T2, T3- production activities that are not registered due to failure to fill statistical questionnaires. Their activities go undetected using traditional survey methods due to the small nature of the enterprise.

*The Informal production* (T6) refers to productive institutional units characterised by:

- (2.a) a low level of organisation;
- (2.b) little or no division between work and capital;
- (2.c) work relations based on occasional jobs, kinship, or personal relations.

(This context comprises the activity of craftsmen, peddlers without licences, farm workers, home workers, and the unregistered activities of small merchants).

*Illegal production*\_(T7) includes the activities oriented at the production of goods and services whose sale, distribution or possession is prohibited by law. Included in this area are also productive activities carried out by unauthorised operators<sup>1</sup>.

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<sup>1</sup> SNA (1993) states explicitly that illegal activities should be included in the system of national accounts, noting that “despite the obvious practical difficulties in obtaining data on illegal production, it is included within the production boundary of the System” (SNA 1993: 6.30), and that: “All illegal actions that fit the characteristics of transactions – notably the characteristic that there is mutual agreement between the parties – are treated the same way as legal actions” (SNA 1993: 3.54). The 1993 SNA suggests that illegal actions for which there is no mutual agreement can be construed as an extreme form of externality for which, in general, no values are imputed in the national accounts. Therefore, it is absence of consent rather than illegality that is actually the criterion for exclusion from the production boundary (OECD 2002, p. 38).

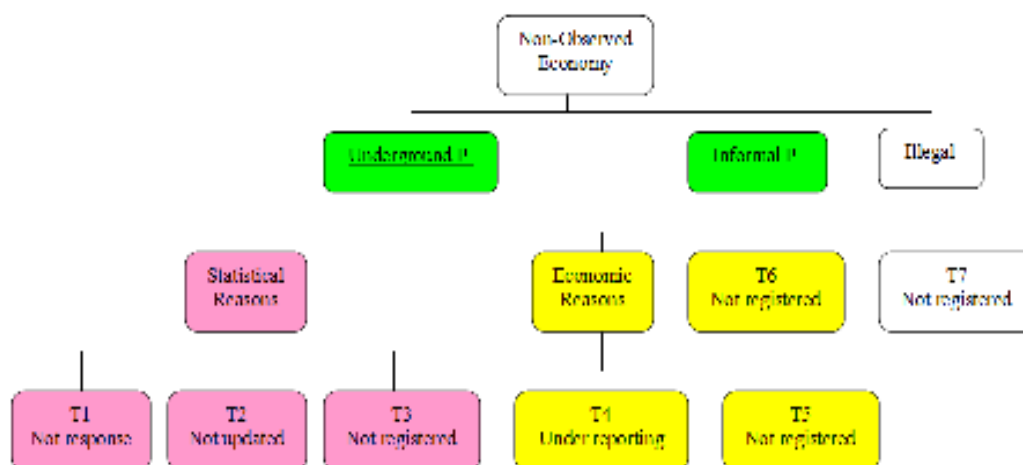


Figure 2.1: Framework of Non-Observed Economy<sup>2</sup>

The NOE is aggregated in three categories: the Shadow Economy or “economical part” of NOE is defined as the non-observed economy caused by economic reasons (T4, T5, T6); the Illegal Activities correspond to T7; the “Statistical part” includes T1, T2, T3 and imputed rentals. Only the first category is considered to be the SE.

### III. EMPIRICAL STRATEGY AND DATA

We model the Japan shadow economy using a different type of models-Structural Equations Models(SEM).Structural Equation Models (SEM) are statistical relationships among latent (unobserved) and manifest (observed) variables. A special case of SEM is the Multiple Indicators and Multiple Causes model. It allows to consider the SE as a “latent” variable linked, on the one hand, to a number of observable indicators (reflecting changes in the size of the SE) and on the other, to a set of observed causal variables, which are regarded as some of the most important determinants of the unreported economic activity.

The first economists to consider the size of the hidden economy as an ‘unobservable variable’ were Frey and Weck-Hannemann (1984).

This kind of models is composed by two sorts of equations, the structural one and the measurement equations system. The equation that captures the

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<sup>2</sup> Dell’Anno, Roberto, Offiong Hele Solomon(2006), “Shadow Economy And Unemployment Rate in SUA.IS there A Structural RelationShip? An Empirical Analysis” Annual Meeting of the European Public Choice Society, Finland

relationships among the latent variable ( $\eta$ ) and the causes ( $X_q$ ) is named “structural model” and the equations that links indicators ( $Y_p$ ) with the latent variable (underground economy) is called the “measurement model”.

So the shadow economy ( $\eta$ ) is linearly determined, subject to a disturbance  $\zeta$ , by a set of observable exogenous causes  $x_1, x_2, \dots, x_q$  :

$$\eta = \gamma_1 x_1 + \gamma_2 x_2 + \dots + \gamma_q x_q + \zeta \quad (3.1)$$

The latent variable ( $\eta$ ) determines, linearly, subject to a disturbances  $\varepsilon_1, \varepsilon_2, \dots, \varepsilon_p$ , a set of observable endogenous indicators  $y_1, y_2, \dots, y_p$  :

$$y_1 = \lambda_1 \eta + \varepsilon_1, y_2 = \lambda_2 \eta + \varepsilon_2, \dots, y_p = \lambda_p \eta + \varepsilon_p \quad (3.2)$$

The structural disturbance  $\zeta$ , and measurement errors  $\varepsilon$  are all normal distributed, mutually independent and all variables are taken to have expectation zero.

To facilitate the identification of SEM some conditions are available: the necessary (but not sufficient) condition, so-called *t-rule*, states that the number of non-redundant elements in the covariance matrix of the observed variables must be greater or equal to the number of unknown parameters in the model-implied covariance matrix. A sufficient (but not necessary) condition of identification, is that the number of indicators is two or greater and the number of causes is one or more, provided that is assigned a scale to  $\eta$  (MIMIC rule). For assigning a scale to the latent variable it is needed to fix one  $\lambda$  parameter to an exogenous value. Although several econometric improvements are introduced in the last years, the most important criticism to the MIMIC method is the strong dependence of the outcomes by the (exogenous) choice of the coefficient of scale ( $\lambda$ ) (Dell’Anno, 2004).

### 3.1. Data Issues

The variables used in the estimation are defined in Appendix A. The data series are quarterly from 1980:Q1 to 2008:Q2. All the series have been seasonally adjusted.

The series in levels or differences have been tested for unit roots using the Augmented-Dicky Fuller (ADF) test. We test I(2) against I(1) and if we reject I(2), we test I(1) against I(0) as appropriate (Appendix A). All the data has been differentiated for the achievement of the stationarity. While all the variables have been identified like integrated on first order, the latent variable is estimated in the same transformation of independent variables (first difference).

### 3.2. Estimating the Shadow Economy of Japan using the MIMIC Model

In estimating the size of the shadow economy, the unobserved variable is modelled as a restricted linear function of a set of exogenous factors subject to a random disturbance term shown in equation 3:

$$\eta_t = \gamma_1 x_{1t} + \gamma_2 x_{2t} + \dots + \gamma_6 x_{6t} + \zeta_t \quad (3.3)$$

An analytical representation of the most general specification (MIMIC 6-1-3: six determinants, one latent variable and three indicators) is utilized in this research to measure the development of the Japan SE. This model framework is fundamental to qualify how correctly and comprehensively the MIMIC model is able to evaluate the SE because the model specification starts from the most general specification and continues omitting the variables, which do not have statistically significant structural parameters. In other words, the MIMIC 6-1-3 is the starting specification for subsequent model modification (appendix A).

According to the SEM classification, the equation with the relationships between the latent variable [ $\eta$ : shadow economy index] and the causes [ $Xq$ : direct tax ( $X1$ ), indirect tax ( $X2$ ), social security contributions ( $X3$ ), government employment in civilian labour force ( $X4$ ), unemployment rate ( $X5$ ), self-employment in civilian labour force ( $X6$ )] is called the Structural Model:

$$\eta_t = \gamma_1 X_{1t} + \gamma_2 X_{2t} + \dots + \gamma_6 X_{6t} + \xi_t \quad (3.4)$$

The equations system that links the indicators [ $Yp$ : real gross domestic product index ( $Y1$ ), civilian labour force participation rate ( $Y2$ ), currency ratio ( $Y3$ )] and the unobservable variable ( $\eta$ ) is the Measurement Model:

$$Y_{1t} = \lambda_1 \eta_t + \varepsilon_{1t} \quad (3.5)$$

$$Y_{2t} = \lambda_2 \eta_t + \varepsilon_{2t} \quad (3.6)$$

$$Y_{3t} = \lambda_3 \eta_t + \varepsilon_{3t} \quad (3.7)$$

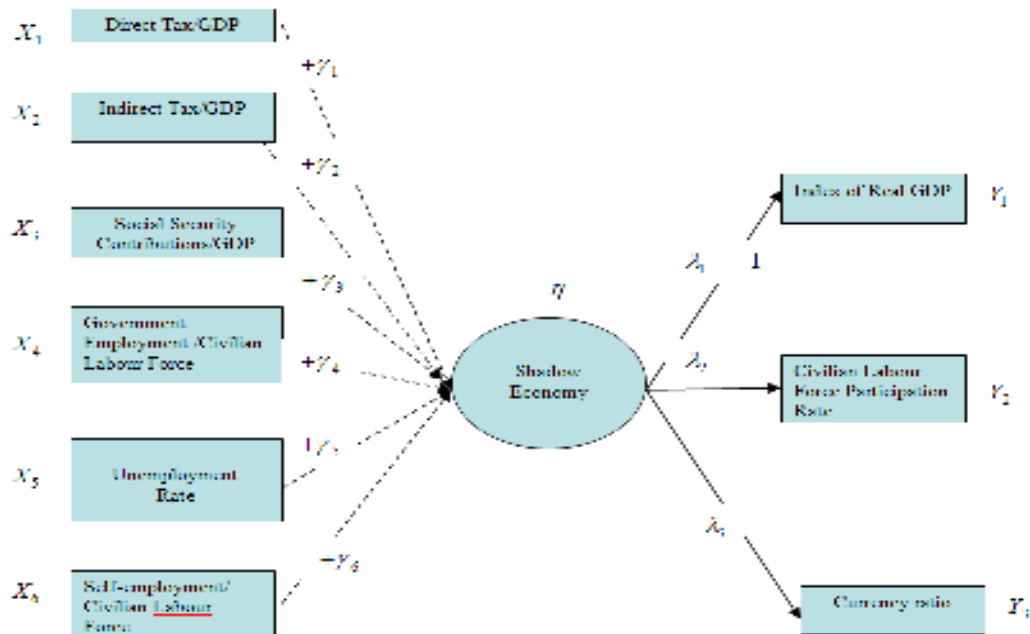


Figure 3.1. Diagram Path MIMIC 6-1-3

### **3.2.1. Determinants of the Shadow Economy**

**Tax burden** ( $X_1 + X_2 + X_3$ ). The tax burden is considered to be the most important determinants of SE. Usually, an increase in the tax burden offers a strong incentive to work in the unofficial economy, so the expected sign for this variable is a positive one. In the model, tax burden is calculated as ratio of total taxes (direct, indirect taxes and social security contributions) in gross domestic product.

**Government employment in civilian labour force** ( $X_4$ ). We introduce this variable in order to take into account the degree of regulation in the economy. The expected sign for this indicator is ambiguous. Some authors find a negative sign arguing that, in some sectors, the presence of the state could disincentive people to incorporate in the shadow economy. Other papers find a positive relation, arguing that we are capturing the degree of regulation in the economy, so the most regulated the economy is, firms find more incentive to develop their activities in the underground economy.

**Unemployment rate** ( $X_5$ ). Regarding the relationship between unemployment rate and shadow economy, an increase in unemployment could imply a decrease in the black economy as underground economy could be positively related to the growth rate of GDP and the latter is negatively correlated to unemployment. On the other side some "official" unemployed spend a part of their time working in the black economy<sup>3</sup>, thus we may find a positive correlation.

Therefore, economic theory does not give a clue to determine whether the expected sign of this variable is positive or negative, it has to be solved by the empirical analysis in each country.

**Self-employment in civilian labour force** ( $X_6$ ). The rate of self-employment as a percentage of the civilian labour force is considered as a determinant of the informal economy. According to Bordignon and Zanardi (1997) the significant diffusion of small firms and the large proportion of professionals and self-employed respect to the total workforce are important characteristics that justify higher level of the shadow economy. This kind of workers have more possibilities to evade as they usually have greater number of deductions in base and deductions in quote in personal income taxes. They are also very close to the customers so they can collude with them and evade in indirect taxes. Finally, these people have the possibility to employ irregular workers, because they do not have the same internal and external auditing control than bigger firms.

### **3.2.2. Indicators**

**Real gross domestic product index** (base year 1990=100) ( $Y_1$  variable of scale). In the model this variable is chosen as a *variable of scale* (or *reference*

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<sup>3</sup> Giles D.E.A., Tedds L.M. (2002), pp. 127.

*variable*). Consequently, in order to estimate not only the relative size of the parameters but their levels is necessary to fix a scale for the unobserved variable.

The value of fix parameter is arbitrary, but using a positive (or negative) unit value is easier to find out the relative magnitude of the other indicator variables. To choice the “sign” of coefficient of scale ( $\lambda_1$ ) is based on theoretical and empirical motivations.

Unfortunately, in the literature there is no common view about what is the sign of the relationship between official and unofficial economy. Some authors, like Adam and Ginsburgh (1985) for Belgium, Giles and Tedds (2002) for Canada, Chatterjee, Chaudhuri and Schneider (2003) for Asian countries, find a positive relation between SE and official GDP, while Frey and Weck-Hannemann (1984) for 17 OECD countries, Kaufmann and Kaliberda (1996) for Transition countries, Schneider and Enste (2000) for 76 Countries, Dell’Anno (2003) for Italy, Dell’Anno, Alañón (2007) for France, Greece and Spain, find a negative relationship. Moreover, Schneider (2005) shows a negative sign for transition and developing countries and a positive relationship for developed ones. As in the MIMIC model, if the “sign” of the coefficient of scale ( $\lambda_1$ ) is changed, all the structural parameters of the causes became from positive to negative (keeping the same absolute values), and this result completely diverges from well-known theories and empirical studies that assign a “positive” link between underground economy and tax burden and/or government consumption. For this reason the hypothesis that supports the sign “minus” for the relation between shadow economy and growth rate of GDP is accepted as more credible.

***Civilian labour force participation rate*** ( $Y_2$ ).The civilian labour force participation rate is calculated as the ratio of the total civilian labour force in working age population (15-64 years old). According to Giles (1998) a decrease in this rate over time may reflect a movement of the workforce from the measured economy into hidden activities. By including this variable as an indicator, we investigate if there is a flow of resources between official and underground economy.

***Currency ratio***( $Y_3$ ).The monetary approach to estimate the size of shadow economic activities is based on the assumption that, the irregular transactions, are paid in cash instead of cheque or credit card in order to circumvent the auditing controls. In the model we use the currency ratio (M1/M2).

### 3.2.3. Model Identification

The identification procedure starts from the most general model specification (MIMIC 6-1-3) and continues leaving out the variables which have not structural parameters statistically significant.

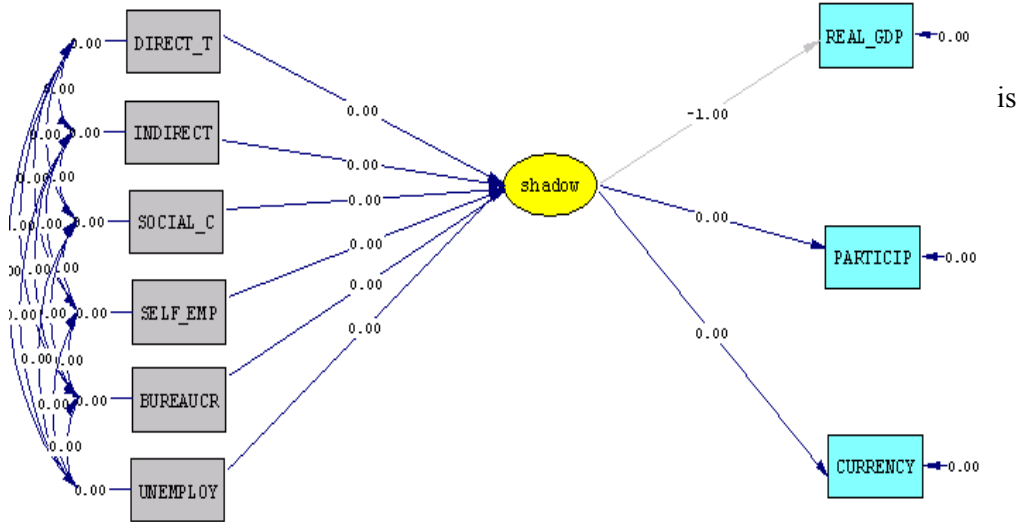


Figure 3.2. Path diagram of the MIMIC 6-1-3<sup>4</sup> model

This choice model is based on: the statistical significance of parameters, the parsimony of specification, the p-value of “chi-square” and the Root Mean Square Error of Approximation (RMSEA) test. The MIMIC model is built for estimating the size of shadow economy like a percentage of gross domestic product.

The following table presents the estimations of various MIMIC models considered for the informal economy of Japan. The models have been estimated with Lisrel 8.8 software. The coefficient of the index of real GDP<sup>5</sup> is normalised to -1 to sufficiently identify the model ( $\lambda_1 = -1$ ). This indicates an inverse relationship between the official and shadow economy.

Examining the table 3.1, we observe the sign and the significance of the variables. In terms of indicators, the currency ratio (M1/M2) is not relevant like indicator of shadow economy for the period analysed, but in change it have positive sign showing that the higher the size of informal sector, the higher the demand of broad money relative to narrow money. Therefore, informal economy and currency ratio are positive correlated. The table presents an insignificant

<sup>4</sup> Diagrama este realizata in programul LISREL 8.80

<sup>5</sup>  $IndexrealGDP = \frac{RealGDP_t}{RealGDP_{Q,1990}}$



relationship between the civilian labour force participation rate and the size of shadow economy.

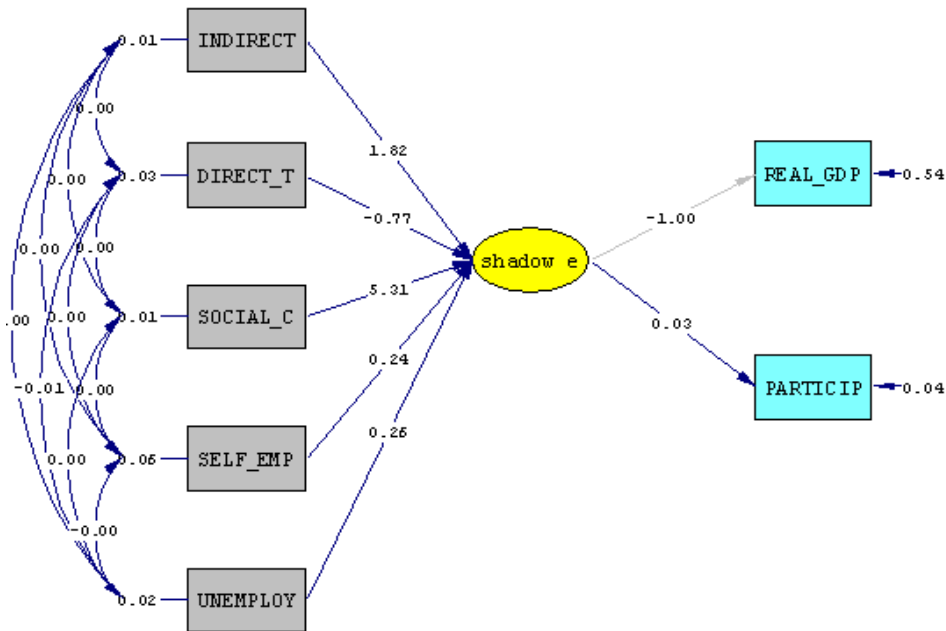
With respect to causal variables, tax burden are significant correlated with the size of shadow economy, and its components: direct taxes are negatively correlated and indirect taxes and social security contributions are positively correlated with the size of informal economy.

The table also point out an insignificant relationship between bureaucracy index, unemployment rate, self-employment and shadow economy.

### 3.2.4. Obtaining the size of the shadow economy in Japan

Once the models have been selected and identified, an index of shadow economy can be constructed. The selected model is an MIMIC 5-1-2 with five causal variables (direct tax, indirect tax, social security contributions, unemployment rate, self-employment) and two indicators (index of real GDP and civilian labour force participation rate).

The choice is based on: the statistical significativity of parameters, the parsimony of specification, the p-value of chi-square, and the Root Mean Square Error of Approximation (RMSEA) test.



Chi-Square=7.88, df=4, P-value=0.09614, RMSEA=0.093

Figure 3.3. Path diagram of 5-1-2 MIMIC model

Table 3.1: Estimated Coefficients<sup>13</sup> of the MIMIC Models

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Models	Direct Tax/GDP	Indirect Tax/GDP	Social Security Contributions/GDP	Bureaucracy Index	Unemployment Rate	Self-employment/Civilian Labour Force	M1/M2	Participation ratio	Hi-patrat (p-value) <sup>14</sup>	RMSEA (p-value) <sup>15</sup>	AGFI <sup>16</sup>	Df <sup>17</sup>
	$X_1$	$X_2$	$X_3$	$X_4$	$X_5$	$X_6$	$Y_2$	$Y_3$				
MIMIC 6-1-3	-0.84* (-2.47) <sup>18</sup>	1.88* (3.33)	5.28* (7.40)	0.4 (0.96)	0.33 (0.69)	0.25 (1.03)	0.16 (1.13)	0.01 (0.33)	29.68 (0.0031)	0.116 (0.023)	0.79	12
MIMIC 5-1-3a	-0.89* (-2.63)	1.89* (3.34)	5.26* (6.94)	----	0.26 (0.55)	0.25 (1.02)	0.16 (1.13)	0.01 (0.34)	29.58 (0.001)	0.13 (0.0087)	0.78	10
MIMIC 5-1-3b	-0.93* (-2.89)	1.91* (3.38)	5.38* (7.69)	0.35 (0.87)	----	0.23 (0.97)	0.14 (1.14)	0.01 (0.33)	29.67 (0.0009)	0.133 (0.0085)	0.78	10
MIMIC 5-1-3c	-0.80* (-2.32)	2.00* (3.57)	5.26* (7.34)	0.40 (0.95)	0.29 (0.6)	----	0.14 (0.99)	0.006 (0.26)	28.75 (0.0014)	0.13 (0.011)	0.78	10
MIMIC 4-1-3	-0.96* (-2.99)	1.91 (3.38)	5.34 (7.62)	----	----	0.23 (0.97)	0.16 (1.13)	0.01 (0.34)	29.57 (0.0002)	0.155 (0.0025)	0.75	8
MIMIC 4-1-3	-0.85* (-2.48)	2.01* (3.57)	5.24* (7.28)	----	0.22 (0.46)	----	0.14 (0.98)	0.01 (0.26)	28.65 (0.0003)	0.152 (0.0034)	0.76	8
MIMIC 3-1-3	-0.90* (-2.82)	2.02* (3.60)	5.31* (7.54)	----	----	----	0.14 (1.00)	0.01 (0.26)	28.62 (0.000)	0.183 (0.000)	0.73	6
MIMIC 6-1-2	-0.83* (-2.41)	1.90* (3.35)	5.26* (7.38)	0.40 (0.96)	0.33 (0.69)	0.24 (1.01)	0.15 (1.04)	----	17.71 (0.0034)	0.15 (0.015)	0.73	5
MIMIC 5-1-2a	-0.71* (-2.09)	1.91* (3.43)	5.33* (7.45)	0.38 (0.91)	0.28 (0.59)	----	----	0.02 (0.74)	8.03* (0.09)	0.095* (0.18)	0.86	4
<b>MIMIC 5-1-2c</b>	-0.77* (-2.28)	1.82* (3.23)	5.31* (7.44)	----	0.26 (0.55)	0.24 (0.98)	----	0.03 (0.78)	7.88* (0.09)	0.093* (0.19)	0.86	4
MIMIC 4-1-2a	-0.76* (-2.22)	1.92* (3.42)	5.31* (7.40)	----	0.22 (0.46)	----	----	0.03 (0.78)	7.88* (0.048)	0.12* (0.1)	0.84	3
MIMIC 4-1-2b	-0.83* (-2.61)	1.85* (3.27)	5.40* (7.72)	----	----	0.22 (0.93)	----	0.03 (0.78)	7.87* (0.048)	0.12* (0.1)	0.84	3
MIMIC 3-1-2	-0.81* (-2.53)	1.93* (3.45)	5.38* (7.67)	----	----	----	----	0.03 (0.78)	7.87 (0.019)	0.16 (0.044)	0.79	2

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<sup>13</sup> The estimations has been made with the software LISREL 8.8

<sup>14</sup> If the structural equation model is correct and the population parameters are known, then the matrix S(Sample covariance matrix) will equal to  $\sum (\theta)$  (model implied covariance matrix) therefore the perfect fitting correspond to p-value=1.0. This test has a statistical theory if there are large sample and multinormal distributions.

<sup>15</sup> P-value for Test of Close Fit (RMSEA<0.05) + means good fitting (p-value>0.05).

<sup>16</sup> Adjusted goodness-of-fit index, AGFI. This indicator takes values into the interval [0, 1].

<sup>17</sup> The degrees of freedom are determined by  $0.5(q+p)(q+p+1)-t$ , where p=number of indicators, p=numbers of causes, t=number of free parameters..

<sup>18</sup>T-statistic is given in parentheses. \* means  $|t - statistic| > 1.96$

According with the reference variable ( $Y_1, \frac{RealGDP_t}{RealGDP_{Q,1990}}$ ) the unobserved variable is scaled up to a value in 1990, which is our base year, the year in which there are several estimates of the Spanish shadow economy. Further, we built us an average of these estimates.

**Table 3.2: Estimates of the size of Japanese shadow economy (1990)**

<i>Author</i>	<i>Method</i>	<i>Size of Shadow Economy</i>
Johnson et.al(1998)	Currency Demand Approach	8.5%
Lacko(1999)	Physical Input(Electricity)	13.2%
Schneider and Enste(2000)	Currency Demand Approach	9.5%*
<b>Mean 1990</b>		<b>10.4%</b>

\*means for 1990-1993

The index of changes of the shadow economy in Japan as a percentage of GDP in the 1990 is linked to the index of changes of real GDP as follow:

$$\text{Measurement Equation: } \frac{GDP_t - GDP_{t-1}}{GDP_{1990}} = -\frac{\tilde{\eta}_t - \tilde{\eta}_{t-1}}{GDP_{1990}} \quad (3.8)$$

The estimates of the structural model are used to obtain an ordinal time series index for latent variable:

Structural Equation:

$$\frac{\Delta \tilde{\eta}_t}{GDP_{1990}} = -0.77\Delta X_{1t} + 1.82\Delta X_{2t} + 5.31\Delta X_{3t} + 0.26\Delta X_{5t} + 0.24\Delta X_{6t} \quad (3.9)$$

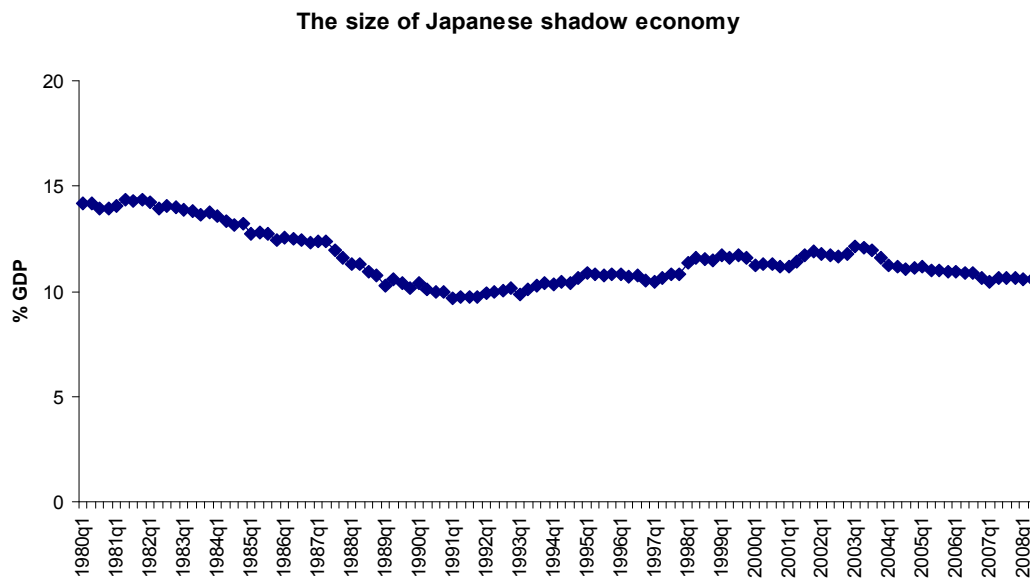
The index is scaled to take up to a value of 10.4% in 1990 and further transformed from changes respect to the GDP in the 1990 to the shadow economy as ratio of current GDP. These operations are show in the benchmark equation<sup>6</sup>:

$$\frac{\tilde{\eta}_t}{GDP_{1990}} \frac{\eta_{1990}^*}{\tilde{\eta}_{1990}} \frac{GDP_{1990}}{GDP_t} = \frac{\hat{\eta}_t}{GDP_t} \quad (3.10)$$

where:

<sup>6</sup> As the variables are all differenced to same degree, to calculate the levels of the latent variable multiplying the structural coefficients for raw (unfiltered) data, it is equivalent to compute the changes in the index by multiplying coefficients for the differenced causes and then to integrate them.

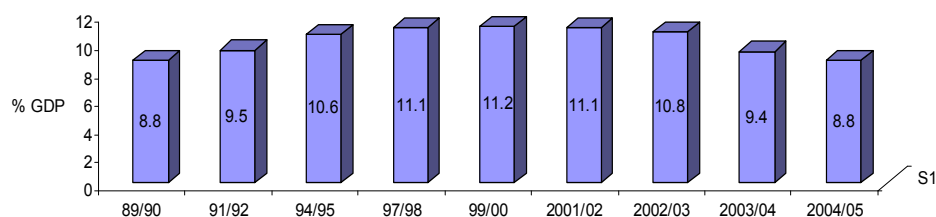
- I.  $\frac{\tilde{\eta}_t}{GDP_{1990}}$  is the index of shadow economy calculated by eq. (3.9).
- II.  $\frac{\eta_{1990}^*}{GDP_{1990}} = 10.6\%$  is the exogenous estimate of shadow economy.
- III.  $\frac{\tilde{\eta}_{1990}}{GDP_{1990}}$  is the value of index estimated by eq.(3.9).
- IV.  $\frac{GDP_{1990}}{GDP_t}$  is to convert the index of changes respect to base year in shadow economy respect to current GDP.
- V.  $\frac{\hat{\eta}_t}{GDP_t}$  is the estimated shadow economy as a percentage of official GDP.



**Figure 3.4. The size of shadow economy as % of GDP**

The shadow economy measured like percentage of official GDP records the value of 14% in the first trimester of 1980 and follows a descendent trend reaching the value of 9.7% in the second trimester of 1991. Then, it reaches a ascendant trend until the second trimester of 2003. From 2003, the shadow economy begins to decrease, registering in 2008 approximately 10% of the official GDP in Japan.

Finally, the results of this estimation are not far from other method, the currency demand approach applied by Schneider (1998, 2000, 2003, 2004, 2005, 2007) and Schneider and Enste(2000, 2001), who estimates the size of shadow economy as follows:



**Fig.3.5. The size of shadow economy using Currency demand Approach**

*Source: Schneider (1998, 2000, 2005, 2007), Schneider and Enste (2000, 2001)*

#### IV. CONCLUSIONS

Following the work of Frey and Weck-Hanneman (1984), the shadow economy in the last thirty years is estimated through trimestrial data. Applied are MIMIC to the Japanese economy, in order to (1) test the statistical significance of some of the most relevant determinants of informal activities, (2) the relationship between growth rate of GDP and underground economy.

This procedure is specifically designed to ensure the correct use of the MLE and therefore to have asymptotically unbiased, consistent and asymptotically efficient estimators (Bollen, 1989).

The main conclusions of applying the model approach of the Japanese economy are:

- 1) Tax burden (decomposed into direct tax, indirect tax and social security contributions) are a significant determinant of shadow economy in Japan.
- 2) The level of unemployment, self-employment and government employment does not appear like significant determinants for the shadow economy of Japan.
- 3) Also, the indicators, currency ratio and civilian labour force participation rate have not a significant relationship with the size of shadow economy.

The most important limitations of the MIMIC approach remains: the difficulty (1) to calculate of the confidence intervals associated with estimates of the latent variable; (2) to test the hypothesis of independence between structural and measurement errors; (3) arise for undertaking a time-series analysis with the

MIMIC model (to identify exhaustively the properties of the residuals, methods to perform co-integration analysis in the context of SEM); (4) to apply the SEM approach to small sample sizes and time series analysis and the strong dependence of outcomes by the (exogenous) choice of the coefficient of scale ( $\lambda_1$ ).

## REFERENCES

- [1] Adam, M., Ginsburgh, C. V. (1985), *The Effects of Irregular Markets on Macroeconomic Policy: Some Estimates for Belgium*. European Economic Review, 29/1, 15-33;
- [2] Alañón, A., Gómez-Antonio, M. (2003), *Estimación Del Tamaño De La Economía Sumergida En España: Un Modelo Estructural De Variables Latentes*. Mimeo
- [3] Albu, L. Ghizdeanu, Stanica C. (2008), *A Model to Estimate Spatial Distribution of Informal Economy: Theoretical and Empirical Investigation*. Paper prepared for the 48th Congress of the European Regional Science Association, Liverpool, UK;
- [4] Bollen, K.A., Long, J. S. (1993), *Testing Structural Equation Models*. Beverly Hills, CA: Sage;
- [5] Chatterjee, Sumana, Kausik Chaudhuri, and Friederich Schneider (2003), *The Size and Development of the Indian Shadow Economy and A Comparison with other 18 Asian Countries: An Empirical Investigation*; Discussion Paper 2003-02, Department of Economics, Johannes Kepler University of Linz.
- [6] Dell'Anno, Roberto, Miguel Gomez, and Angel Alañón Pardo (2004), *Shadow Economy in Three Different Mediterranean Countries: France, Spain and Greece. A MIMIC approach*, Empirical Economics 33: 51-84;
- [7] Dobre Ion, Alexandru Adriana AnaMaria (2008), *Informal Economy and USA Unemployment Rate. Is here a structural relationship? An empirical analysis, Macroeconomic of E.U. extension and economic growth Section*, International Conference: Economic growth and E.U. Extension Process, Academy of Economic Studies, Bucharest, ASE Publishing House, ISBN 978-606-505-065-5, 330-351;
- [8] Dobre Ion, Alexandru Adriana AnaMaria (2008), *Modelling Unemployment Rate using Box-Jenkins Procedure*, Journal of Applied Quantitative Methods, vol. 3/2, 156-166;
- [9] Feige, Edgar L. (1989), *The Underground Economies, Tax Evasion and Information Distortion*, Cambridge, Cambridge University Press;
- [10] Frey, Bruno S. and Hannelore Weck-Hannemann (1984), *The Hidden Economy as An "Unobservable" Variable*; European Economic Review 26: 33-53;
- [11] Giles, David E.A. (1995), *Measuring the Size of the Hidden Economy and the Tax Gap in New Zealand: An Econometric Analysis*; Working Paper on

Monitoring the Health of the Tax System 5a, Wellington, Inland Revenue Department;

[12] Giles, David E.A. (1998), *The Underground Economy: Minimizing the Size of Government, Econometrics*; Working Papers 9801, Department of Economics, University of Victoria;

[13] Giles, David E.A. (1999), *Measuring the Hidden Economy: Implications for Econometric Modeling*, Economic Journal **109**: 370-380;

[14] Giles, David E.A., and Lindsay M. Tedds (2002), *Taxes and the Canadian Underground Economy*; Canadian Tax paper 106, Toronto, Canadian Tax Foundation;

[15] Johnson, S., Kaufmann, D., Zoido-Lobaton, P. (1998), *Regulatory Discretion and the Unofficial Economy*. American Economic Review, 88:2, 387-92;

[16] Jöreskog, Karl G. and Arthur S. Goldberger (1975), *Estimation of a Model with Multiple Indicators and Multiple Causes of a Single Latent Variable*; Journal of the American Statistical Association **70**: 631-639;

[17] Jöreskog, Karl, Sörbom, D. (1993), *LISREL 8, User's Reference Guide*. Chicago: Scientific Software International;

[18] Kaufmann, Daniel and Aleksander Kaliberda (1996), *Integrating the Unofficial Economy into the Dynamics of Post-Socialist Economies: A Framework of Analysis and Evidence*, in B. Kaminski, ed., *Economic Transition in the Newly Independent States*, Armonk, NY, M.E. Sharpe Press;

[19] OECD (2002), *Handbook for Measurement of the Non Observed Economy*, Paris, OECD Publishing;

[20] Schneider, Friederich (2005), *Shadow Economies around the World: What Do we Really Know ?*, European Journal of Political Economy **21**: 598-642;

[21] Schneider, Friederich, and Dominik H. Enste (2000), *Shadow Economies: Size, Causes and Consequences*; Journal of Economic Literature **38**: 77-114;

[22] Schneider, Friederich, and Dominik H. Enste (2002), *The Shadow Economy*. An International Survey, Cambridge, Cambridge University Press.

[23] Tudorel, Andrei, Iacob Andreea, Stancu Stelian (2007), *The Application of the Econometric Models with Qualitative Variables in the Analysis of the Non Academic Behaviors at the Level of the Romanian Higher Education System*, Economic Computation and Economic Cybernetics Studies and Research, vol.41 (3-4), 131-140.

\*\*\* [www.oecd.org](http://www.oecd.org) OECD Economic Outlook Statistic and Projections

#### Databases

\*\*\* [www.oecd.org](http://www.oecd.org), OECD Labour Force Statistics

\*\*\* [www.oecd.org](http://www.oecd.org), OECD National Accounts

\*\*\* [www.oecd.org](http://www.oecd.org), OECD Main Economic Indicators

<b>Appendix A</b>								
Var.	CAUSES	Sources	Unit root analysis	Analysis of Non-stationarity(ADF test)				Transf. used.
					Level	First Difference	Second Difference	
$X_1$	Total Direct Tax/GDP	OECD-Economic Outlook 2008	I(1)	T&C	0.4016	0.0009	0.0000	$\Delta(X_1)$
$X_2$	Total Indirect Tax/GDP	OECD-Economic Outlook 2008	I(1)	T&C	0.5117	0.0000	0.0000	$\Delta(X_2)$
$X_3$	Social Security Contributions received by Government/GDP	OECD-Economic Outlook 2008	I(1)	T&C	0.7555	0.0000	0.0000	$\Delta(X_3)$
$X_4$	Unemployment rate	OECD-Economic Outlook 2008	I(1)	T&C	0.5806	0.0379	0.0000	$\Delta(X_7)$
$X_5$	Self-employment/Civilian Labour Force	OECD-Economic Outlook 2008	I(1)	T&C	0.9505	0.0000	0.0000	$\Delta(X_8)$
$X_6$	Index of bureaucracy	OECD-Economic Outlook 2008	I(1)	C	0.8111	0.0000	0.0000	$\Delta(X_9)$
<b>INCATORS</b>								
$Y_1$	Currency ratio(M1/M2)	Bank of Japan	I(1)	T&C	0.7266	0.0001	0.0000	$\Delta(Y_1)$
$Y_2$	Index of Real GDP	OECD-Economic Outlook 2008	I(1)	T&C	0.9279	0.0000	0.0000	$\Delta(Y_2)$
$Y_3$	Civilian labour force participation rate	OECD-Economic Outlook 2008	I(1)	T&C	0.8346	0.0000	0.0000	$\Delta(Y_3)$

For the tests ADF and PP-the Mackinnon(1996) one-sided p-values; \* means stationary for the level of significance of 5%. □